SPECIFICATION No.: 0901 – 321

for

NEW APARTMENTS

at

168 PROSPECT ROAD
PROSPECT 5082 SA

Prepared by:

Studio 9 Architects Pty Ltd T/A Studio Nine Architects

Specification:	901-321
Version:	FOR CONSTRUCTION
Contract No:	TBC
Date:	MAY 2019

STUDIO NINE
ARCHITECTS

9 King William Street
Kent Town SA 5067
Australia

ABN 67 096 031 604

P — +61 8 8132 3999
F — +61 8 8363 7499

hello@studionine.net.au
studionine.net.au

PRELIMINARIES 1-15
GENERAL REQUIREMENTS 16-33

ADHESIVES/SEALANTS/FASTENERS..... PAGES. 34-35

METALS / PREFINISHES ..... PAGES 36-37

TIMBER FINISHES AND TREATMENT ..... PAGES 38-39

STEEL PROTECTIVE FINISHES (PAINT) ..... PAGES 40-48

TERMITE CONTROL..... PAGES 49-52

DEMOLITION..... PAGES. 53-62

MASONRY ..... PAGES. 63-74

LIGHT STEEL FRAMING ..... PAGES. 75-79

LIGHT TIMBER FRAMING..... PAGES 80-83

INSULATION / BARRIERS..... PAGES 81-90

ROOFING..... PAGES. 91-101

DOORS ..... PAGES. 102-115

WINDOWS..... PAGES 116-123

GLAZING ..... PAGES. 124-128

DOOR HARDWARE..... PAGES 129-135

LININGS PAGES. ..... PAGES 136-145

PARTITIONS ..... PAGES. 146-147

SUSPENDED CEILINGS..... PAGES. 148-157

WATERPROOFING ..... PAGES 158-165

RESILIENT FINISHES ..... PAGES 166-174

TILING ..... PAGES 175-184

CARPET FLOOR FINISHES ..... PAGES 185-191

PAINTING..... PAGES. 192-201

METAL FIXTURES..... PAGES 202-213

MISC / FITTINGS / FIXTURES ..... PAGES 214-217

TIMBER FIXTURES..... PAGES 218-224

APPENDICES

APPENDIX A	- DOOR SCHEDULE	Pages	1-5
	- DOOR HARDWARE SCHEDULE	Pages	TBA
APPENDIX B	- MATERIALS AND FINISHES SCHEDULE	Pages	1-10
APPENDIX C	-ACOUSTIC REPORT	Pages	1-24
APPENDIX D	- PLANNING EXCEMPTION	Pages	1
	-CERTIFICATE OF CONSISTENCY	Pages	1
	- BCA CERTIFICATION	Pages	TBA
	- BUILDERS WRITTEN STATEMENT WRITTEN STATEMENT	Pages	1
	- APPLICATION FOR CERTIFICATE OF OCCUPANCY	Pages	1
APPENDIX E	- WATERPROOFING OF WET AREAS IN BUILDINGS	Pages	1-10
	REFER SEPARATE DOCUMENTS		
APPENDIX F	- NATHERS REPORT		
APPENDIX I	- FOOTING & GEOTECHNICAL REPORT		
APPENDIX J	-CIVIL WORKS		
APPENDIX K	STRUCTURAL WORKS		
APPENDIX L	- HYDRAULIC SERVICES		
APPENDIX M	- ELECTRICAL SERVICES		
APPENDIX N	- MECHANICAL SERVICES		
APPENDIX O	- FIRE SERVICES		

PRELIMINARIES

1 GENERAL

1.1 GENERAL

General conditions

To AS 2124 - 1992.General Conditions Of Contract (published by SAI Global)

Interpretation

General: The word "contract administrator" has the same meaning as "superintendent".

Cross reference: The clause **Interpretation**, in the *General requirements* worksection, also applies.

1.2 PROJECT INFORMATION

Outline description of the works

The scope of works involve the following works located at 168 Prospect Road Prospect SA.

--New Residential Apartment building

--New carparking

-Associated site works

Staging

Refer Demolition specification Clause 1.01 for notes on work plans and Staging of works

Description of the site

Location: 168 Prospect Road, Prospect SA 5082

Reports

Investigations carried out:

Nil

Document Schedule

The following drawings form part of the Contract:

ARCHITECTURAL	DRAWING
Ground first	901-321-WD01 T1
Second Third Roof plans	901-321-WD02 T1
Elevations	901-321-WD03 T1
Sections	901-321-WD04 T1
Plan details	901-321-WD05 T1
Plan details	901-321-WD06 T1
Plan details	901-321-WD07 T1
Sections	901-321-WD08 T1
Sections / Apartment plans	901-321-WD09 T1
Apartment plans	901-321-WD10 T1
Ceiling plan	901-321-WD11 T1
Ceiling plan	901-321-WD12 T1
Lobby / Misc details	901-321-WD13 T1
Landscape Plan	901-321-WD14 T1

STRUCTURAL	DRAWING
NOTES SHEET	1702160-S00/A
FOOTING PLAN - GROUND	1702160-S100/A
FOOTING PLAN - FIRST	1702160-S101/B
FOOTING PLAN - SECOND	1702160-S102/B
FOOTING PLAN –THIRD	1702160-S103/A
ROOF FRAMING PLAN	1702160-S104/A
ELEVATIONS	1702160-S200/B
ELEVATIONS	1702160-S201/B
SECTIONS	1702160-S202/B
CONC WALL PLAN	1702160-S300/A
CONC WALL PLAN	1702160-S301/A
WALL PANEL ELEVATIONS	1702160-S302/A
WALL PANEL ELEVATIONS	1702160-S303/B
CONC BEAM DETAILS	1702160-S304/A-307/A incl
FOOTING DETAILS	1702160-S400/A
FOOTING DETAILS	1702160-S401/A
PRECAST WALL DETAILS	1702160-S402/A-S404/A incl
STAIR DETAILS	1702160-S405/A
DETAILS	1702160-S406/A-S409/B
ROOF DETAILS	1702160-S410/A
ROOF DETAILS	17021605411/A
CIVIL PLAN	1702160-C1/B
ROOF PLANS	1702160-C2/B
CIVIL DETAILS	1702160-C3/B

SERVICES DRAWINGS	
ELECTRICAL	LCE12584-E01/T2-04/T1 incl
FIRE	LCE12584-F01/T2-03/T2 incl
HYDRAULIC DRAWINGS	LCE12584-H01/T1-06/T1 incl
MECHANICAL DRAWINGS	LCE12584-M01/T1-03/T1 incl

1.3 SELECTED AND NOMINATED SUBCONTRACTORS

Selected subcontract(s)

The following work under the Contract is defined as Selected Subcontract Work and nominated sub-contractors are requested to perform the specified Subcontract Work.

Nil	

The sub-contractors have been selected on the basis that they have the ability, resources and facilities necessary to complete the works and services as specified.

The Builder shall obtain Tender costing from the following preferred sub-contractors for the works specified. The Builder shall nominate the preferred Sub-contractor within the Tender submission.

Trade section	Preferred subcontractors

1.4 PROVISIONAL SUMS

Provisional sums identified in the Provisional sums schedule are for purposes stated in relevant work sections of the specification. Provisional sums exclude GST . Supply and install except where nominated as a supply only Where supply only Builder shall allow for installation in Tender. Nominate PC sums separately in Tender.

Provisional sums schedule (included in Tender)

Item	Reference	($) excluding GST
Door Hardware	Appendix A Door Hardware Schedule (supply only)	Builder to nominate

Contractor to include allowance for overhead / profit / admin costs etc

1.5 SEPARATE CONTRACTS – WORKS BY PROPRIETOR

The following works shall be carried out by Separate Contract nominated and undertaken by the Proprietor. The Builder shall allow access to site and provide all services as would be expected by a Builders sub-contractor.

Separate Contract Schedule (excluded from Tender)

Item	Reference	
Nil		

1.6 SEPARATE COSTINGS

The following works shall be costing separately by the Builder. All work associated with any individual separate cost may be DELETED from the contract during post Tender review. The Builder shall include all Preliminaries and OHP costs associated with each part so to not affect the cost of other parts remaining.

Nil		

The Builder is requested to provide a trade cost breakdown with the Tender submission for analysis and assessment of costs (Value management of project budget).

Trade		**$ Costing including GST**
Includes Parts 01-04 inclusive		
Preliminaries		
Site establishment (hoardings / protection etc)		
Asbestos Removal (as applicable)		
Demolition (applicable)		
Site Works		
Concrete (Floors)		
Concrete (carpark)		
Concrete (panelsr)		
Structural Steelwork		
External cladding		
Composite alumin linings		
Composite Timber linings		
Metal screens		
Handrails / Balustrades		
Metal work		
Roofing		
Partition walls / Linings including insulation		
Suspended Ceilings		
Doors including hardware and installation		
Door Hardware PC Sum (supply only)		
Windows / sliding door frames		
Glazing		
Floor coverings (timber)		
Floor coverings (carpet)		
Tiling		
Painting		
Metalwork		
Joinery		
Electrical		
Mechanical		
Hydraulic		
Fire		
PC Sums		
Services Schedules (forms only)		
Total (incl GST)		

1.7 STATUTORY REQUIREMENTS

Requirements of authorities

The principal, before entering into the contract, has given the notices, paid the fees, and obtained the permits, approvals and other authorisations stated in the **Prior applications and approvals schedule**.

Prior applications and approvals schedule

Prior notices given and applications made	Fees paid	Permits, approvals and authorisations received
Development Consent	Yes	Yes
Building Approval / Certification	-	Pending
Development Approval	-	-

Authority conditions schedule

Authority	Document	Condition
Building Approval / Certification (standard Forms)		Refer Appendix D

1.8 PROTECTION OF PEOPLE AND PROPERTY

General

Public viewing area: Nil

Occupied premises (for the full term of the contract unless noted otherwise)

For the parts of the site designated as occupied premises in the Occupied premises schedule

- permit occupants to continue in secure possession and occupancy of the adjacent premises;
- make available safe access for occupants;
- arrange work to minimise nuisance to occupants and ensure their safety; and
- protect occupants against weather, dust, dirt, water or other nuisance, by such means as temporary screens.
- Protect existing machinery, Proprietors property during demolition and construction.
- Provide Hoardings and protective barriers to areas to suit staging and minimise nuisance (dust / noise)

Submit details of proposed methods for approval (refer Work Plan requirements – Demolition Clause 1.01).

Occupied premises schedule

Occupants	Occupied premises	Period of occupancy
Patrons / Public parking	All adjacent buildings and carparking areas	Full term of contract

Protection

The Contractor shall be responsible for the provision of an approved hoarding and other physical barriers (as specified) with appropriate signage to the perimeter of the site and in other areas of the work to suit the project staging requirements and in accordance with OHS requirements for the security and safety of the premises at all times. The Contractor shall maintain the building site and all adjacent areas clear of all debris and building materials unless contained with in the designated builders area, and in a satisfactory state to the approval of the Proprietor and in accordance with OHS requirements.

The Contractor shall clearly identify and sign post the site as a 'building site' to the public and provide hoardings as required to prevent the entry of unauthorised persons into the building or Builders area.

The Contractor shall allow for the control and dispersal of dust / surface water etc during mechanical cutting (as applicable) and the cleaning of all areas as required upon the immediate completion of the same to the satisfaction of the Proprietor. Seal off all adjacent areas including doors , ventilation openings etc to prevent the spread of dust and dirt as specified.

Refer Demolition specification for specific requirements

No smoking policy *applies to all premises where sign posted.*

Safety

Accidents: Promptly notify the superintendent of the occurrence, of the following:

- Accidents involving death or personal injury.
- *Accidental fire or water damage.*
- Accidents involving loss of time.
- Incidents with accident potential such as equipment failure, slides and cave-ins.

Accident reports: Submit reports of accidents.

- Purpose of submission: Information only.

Notification of impairment to fire services

Notify in writing the Proprietor of any impairment to fire or security services

-72 hours notice required

Site induction and safety management

The contractor shall document, maintain and implement the contract induction process, which may be a standard company Safe Work Instruction with job specific additions. This shall be applicable to all employees and visitors to the site.

Provide additional training requirements (as identified by a Hazard Management Plan). The contractor's employees shall have, as a minimum, training equivalent to the SA Building Construction Industry Common Safety Induction Course (the "white card").

Access / Roads

Temporary roads: Nil

Use only existing site access crossovers and access gates. (Refer Builders approved Site Management Plan)

Loading of vehicles shall be limited to prevent damage to the existing pavement and base course surfaces. In this instance all shall be repaired to original condition. All road and path areas shall be cleaned / hosed down / made good as required at all times.

(Refer requirements for Dilapidation reports and joint inspections / photographic records.)

Protective clothing

Generally : Make available safety helmets / shoes / vests for the use of visitors.

- Standards: To AS/NZS 1801, Type 1.
- Standards Mark: Required.

Number of new helmets / shoes and vests : 2 pair

1.9 CARE OF THE WORK AND REINSTATEMENT OF DAMAGE/DAMAGE TO PERSONS AND PROPERTY OTHER THAN THE WORKS

General

Damage to services: Do not obstruct or damage roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Determine the location of such services. Rectify immediately any obstruction or damage to such services and provide temporary services whilst repairs are carried out.

Damage to property: Do not interfere with or damage property which is to remain on or adjacent to the site, including adjoining property encroaching onto the site, and trees. Rectify immediately any interference or damage to such property.

Dilapidation record

The Contractor shall arrange a photographic survey of the buildings and site in order to make a record of the existing conditions, including proposed contractors access roads, prior to site establishment or the commencement of any work. (must be carried out in conjunction and in the presence of the Proprietor and Representative).

Damage assessment: The photographic and/or video and written record of the condition of the existing building, adjoining buildings, and other relevant structures or facilities shall be used amongst other things as a means of assessing the responsibility for damage and/or making good arising out of the performance of the work under the Contract. A copy of the record shall be kept, and made available for inspection, at the office of the Contractor.

Existing services

Attend to existing services as follows:

- If the service is to be continued, repair, divert or relocate as required. If such a service crosses the line of a required trench, or will lose support when the trench is excavated, provide permanent support for the existing service.
- If the service is to be abandoned, cut and seal or disconnect, and make safe.

  Proposals: Submit proposals for action to be taken with respect to existing services before starting this work. Minimise the number and duration of interruptions.
- Purpose of submission: For review.

Adjoining property

Notice: At least 14 days before commencing work, submit to owners and occupants of adjoining property written notice of intention to commence work and an outline description of the type and extent of work.

Conditions for work on adjoining property: *Not Applicable*

Records: For properties described in the Adjoining properties to be recorded schedule

- inspect the properties with the superintendent and owners and occupants of the properties, prior to and on completion of the works;
- at the initial inspection, make detailed records of conditions existing within the properties, especially structural defects and other damage or defacement; and
- arrange for at least 2 copies of each record, including drawings, written descriptions, and photographs, to be endorsed by the owners and occupants, or their representatives, as evidence of conditions existing before commencement of work.

Endorsed copies: Submit one endorsed copy of each record to the Superintendant. Keep the other endorsed copy on site.

- Purpose of submission: Information only.

Adjoining properties to be recorded schedule

Title	Owner	Description
All adjacent properties		

Reinstatement

Clean and repair damage caused by installation or use of temporary work and restore existing facilities used during construction to original condition.

Excepted risks Nil

1.10 SITE

Access

Carpark shall be to areas as agreed on site (during site establishment process).

Adjacent commercial premise shall be accessible at all times.

Carparking areas shall be identified in the Builders Siote Management Plan and as approved by Council

The works shall be completed with minimal disruption to other areas on the site including adjacent residential zones.

Site restrictions

Refer Demolition specification Clause 1.01 for site activities / staging / access

Maintain rights of way unless agreed otherwise in writing.

Entry permits: Make available, to persons entering designated secure areas, valid entry permits. Ensure these persons comply with conditions of entry.

The Contractor is required to provide a list of all subcontractors together with contact phone numbers to the Proprietor. Contractors shall be confined to the designated Building site and Builders Area

1.11 ENVIRONMENTAL SITE MANAGEMENT

General

Plan and carry out the works to minimise construction waste and contamination of the site and surroundings, encourage recycling and resource conservation practices.

Pollution Prevention, Recycling and Resource Conservation

Conform to the requirements of the Environment Protection Act 1993 and the following publications.

Environment Protection Authority Stormwater Pollution Prevention:

- Code of Practice for the Building and Construction Industry.
- Handbook for Pollution Avoidance on Building Sites.

KESAB – Clean Site Code of Practice for the Building and Construction Industry.

Available from: Environment Protection Authority Phone (08) 8204 2004 Email www.epa.sa.gov.au

KESAB Phone: (08) 8234 7255 Email: www.kesab.asn.au

1.12 SETTING OUT THE WORKS

Surveys

The following is required:

Setting out: Confirm on site / Surveys: - Check all levels prior to commencement

1.13 MATERIALS, LABOUR AND CONSTRUCTIONAL PLANT

Toilet facilities

Provide access to and maintain suitable male and female toilet facilities in accordance with OHS regulations for all Contractors

Temporary services : All required services. The Contractor is to arrange in accordance with all relevant authorities. The Contractor is to make available to all sub contractors and on completion clear away all traces.

Temporary hoarding : The contractor is to provide to the perimeter of every work area to form a compound surrounded by 1800mm high steel wire mesh framed security fencing. The compound is to be secure and maintained during the construction period. The Contractor is to control access and circulation in and out of and around the dedicated works area. All safety signage shall be displayed at all entry points.

(Refer Demolition specification also)

Use of existing services

Existing services may be used as temporary services for the performance of the contract on the understanding that it will be the contractor's responsibility to ensure the availability and continuity of service for contractor purposes. Ensure no disruption to site Supply without agreement and notice.

Parking

Use only designated parking areas as agreed.

Generally : Within Contractors area or as agreed on site

Project signboard

No specific requirements

1.14 WORKING HOURS

Working hours / Restricted deliveries (as applicable)

Normal hours: Normal working hours between 7am to 6pm

Days: 5 days worked between Monday to Friday.

Working outside of these hours only with the approval of the Superintendant (no additional cost).

(Refer Demolition specification Clause 1.01 for details)

Removal of hazardous materials : shall be undertaken outside the hours of 8.00am – 5.00pm weekdays unless otherwise agreed in writing by the Superintendant. No others activities are permitted on the site during removal of hazardous materials. (excludes contractors where permitted).

Hazardous / noisy demolition shall be undertaken out of hours and / or on weekends / public holidays as approved by the Superintendent.

Contractor shall obtain approval from Proprietor for any works proposed out of hours

1.15 PROGRESS AND PROGRAMMING OF THE WORKS

Construction period

The contractor shall provide indicative program with TENDER to indicate possible construction period and staging times of work.

Program of work :

Construction program: The Contractor shall submit a preliminary program with the Tender submission indicating the completion of the works within the required delivery dates. Within 7 days after the date for possession of the site, submit a construction program showing the following:

- Sequence of work.
- Critical paths of activities related to the work.
- Allowance for holidays.
- Activity inter-relationships.
- External dependencies including provision of access, document approvals and work by others.
- Periods within which various stages or parts of the work are to be executed.
- The final programme shall be agreed by the Proprietor

Revisions: Revise the construction program as required by the progress of the work. Submit revisions with each progress claim. Identify changes since the previous version, and show the estimated percentage of completion for each item of work.

Program chart:

Display in the contractor's site office an up-to-date bar chart and network diagram based on construction program.

The Contractor shall be responsible for co-ordinating the works to ensure the delivery of the various works within the approved program time. Tenderers should consider lead up times for the delivery of all materials and finishes and plant equipment (as applicable)

The Construction Program shall become the document by which:-

- The Contractor's progress towards meeting the required contract dates are measured.
- Evaluation of work changes and delays will be made to ascertain valid contract extensions of time.
- The approved Construction Program will be the program by which progress is measured and extension of time applications considered.
- Regularly review and up-date the Construction Program monthly or as directed by the Architect.
- The Contractor shall be responsible for maintaining the progress of work on site and at no cost to the Contract, shall ensure all measures are taken including increasing contractor resources and undertaking weekend work in order to maintain the program.

The Contractor should review the progress of work on site daily to ensure the delivery program is maintained. Any claim for 'extension of time' should be notified by fax immediately (same day) indicating the cause and nature of delay and time lost. Any resulting claim shall be made within 28 days in accordance with the contract where applicable.

Site meetings

Hold and attend site meetings throughout the contract and ensure attendance of appropriate subcontractors, the superintendent, and appropriate consultants.

Frequency: Fortnightly (and as required)

Minutes: Keep minutes of site meetings including schedule of variations and instructions. Within 3 working days after each meeting, submit to each party written copies of the minutes.

Contacts: At the first site meeting, submit names and telephone numbers of responsible persons who may be contacted after hours during the course of the contract. Purpose of submission: Information only.

Progress photographs

Take digital photographs of construction progress and details fortnightly and email electronically to the superintendent. Purpose of submission: Information only.

1.16 CLEANING UP

Final cleaning

Before practical completion (handover of each stage), clean throughout all surfaces, including windows, glazed surfaces internal and external. Vacuum carpeted and soft surfaces. Clean debris from site, roofs, gutters, downpipes and drainage systems. Remove waste, surplus materials and rubbish.

Samples: Remove non-incorporated samples, prototypes and sample panels.

Staging

The Contractor shall allow for the industrial cleaning of the facility upon completion of each stage of the works and as directed by the Architect at no additional cost.

Removal of temporary works and constructional plant

Time for removal: 5 working days before Date of Practical Completion

(or as agreed in writing)

Pest eradication

Employ suitably qualified pest exterminators. Submit certificate to the superintendent stating that completed works are free of pest types identified in the Extent of Pest eradication treatments: Not applicable.
Existing Building adjacent
The contractor shall allow for industrial cleaning of all existing windows and frames to the existing tech studies building.

1.17 CERTIFICATES AND PAYMENTS

Payment claims break-down

Break down: With each progress claim submit a statement of amounts claimed in respect of each worksection or trade heading designated in the specification, together with variations included in the claim.

Method of measurement

In accordance with the principles of the Australian Standard Method Of Measurement Of Building Works (ASMM) Other Civil engineering works to AS1181.

1.18 VALUATION OF VARATIONS

The method which will be used by the Superintendent to arrive at the rate or price payable shall be :

- in accordance with the Australian Standard Conditions of Contract
- Rawlinsons Australian Construction Handbook

Each variation cost claim made by the Contractor must include a detailed breakdown in accordance with these requirements and include copies of rates and quantities / invoices for materials and photographic evidence where applicable.

Under Clause 40.2 (AS2124) the Contractor shall provide notice to the Superintendent within 7 days of receiving an instruction of the Contractors intent to submit a variation claim. No variation cost claim will be accepted after 7 days. Variation values shall be submitted within 14 days of completion.

0171 GENERAL REQUIREMENTS

1 GENERAL

1.1 RESPONSIBILITIES

Performance

Structural: If required, provide structures, installations and components as follows:

- Fixed accessways: To AS 1657.
- Structural design actions: To AS/NZS 1170.0 and the **Structural design actions schedule**.

Design

Design by contractor: If the contractor provides design, use only appropriately qualified persons and conform to all statutory requirements.

Conflict with the documents: If it is believed that a conflict exists between statutory requirements and the documents, notify the superintendent immediately and provide a recommendation to resolve the conflict.

Noise levels

General: Install systems in conformance with the **Noise level schedule** and within the limits of the contract design and documented equipment performance.

1.2 PRECEDENCE

General

Work Sections and referenced documents:

- The requirements of other Work Sections of the specification override conflicting requirements of this Work Sections.
- The requirements of the Work Sections override conflicting requirements of their referenced documents.
- The requirements of the referenced documents are minimum requirements.

1.3 CROSS REFERENCES

General

Requirement: Conform to the following:

- *Demolition*.
- *Service trenching*.

Common requirements

Requirement: Conform to the following:

- *Adhesives, sealants and fasteners*.
- *Fire-stopping*.
- *Metals and prefinishes*.
- *Termite management*.
- *Timber products, finishes and treatment*.
- *Building IT components*.

Cross referencing styles

Within the text:

- Work Sections titles are indicated by *Italicised* text.
- Subsection titles are indicated by **BOLD** text.
- Clause titles are indicated by **Bold** text.

1.4 REFERENCED DOCUMENTS

Contractual relationships

General: Responsibilities and duties of the principal, contractor and superintendent are not altered by requirements in the documents referenced in this specification.

Current editions

General: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

General Standards

Conform to standards referenced by the Building Code of Australia, State legislation and licensing authorities.

1.5 INTERPRETATION

Abbreviations

General: For the purposes of this-specification the following abbreviations apply:

- AS: Australian Standard.
- BCA: Building Code of Australia.
- EMC: Electromagnetic compatibility.
- MSDS: Material safety data sheets.
- NATA: National Association of Testing Authorities.
- NZS: New Zealand Standard.
- VOC: Volatile organic compound.

Definitions

General: For the purposes of this specification, the definitions given below apply.

- Attendance: 'Attendance', 'provide attendance' and similar expressions mean 'give assistance for examination and testing'.
- Default: Specified value, product or installation method which is to be provided unless otherwise documented.
- Design life: The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- Documented: 'Documented', 'as documented' and similar terms mean contained in the contract documents.
- Economic life: The period of time from the acquisition of an asset to when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: 'Give notice', 'submit', 'advise', 'inform' and similar expressions mean 'give notice (submit, advise, inform) in writing to the superintendent'.
- High level interface: Systems transfer information in a digital format using an open system interface.
- Hold point: The activity cannot proceed without the approval of the superintendent.
- Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680 Table 1.
- IP: 'IP', 'IP code', 'IP rating' and similar expression have the same meaning as 'IP Code' in AS 60529.
- Joints:
  - Construction joint: A joint with continuous reinforcement provided to suit construction sequence.
  - Control joint: An unreinforced joint between or within discrete elements of construction which allows for relative movement of the elements.
    - Contraction joint: An opening control joint with a bond breaking coating separating the joint surfaces to allow independent and controlled contraction of different parts or components, induced by shrinkage, temperature changes or other causes. It may include unbound dowels to assist vertical deflection control.
    - Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.
    - Isolation joint: A joint between elements of a structure designed to isolate structural movement while permitting horizontal and/or vertical movement between abutting elements.
  - Weakened plane joint: A contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.

  - Structural control joint: A control joint (contraction, expansion and isolation) in structural elements when used with applied material and finishes.
  - Substrate joint: A joint in the substrate which includes construction joints and joints between different materials.
  - Sealant joint: A joint filled with a flexible synthetic compound which adheres to surfaces within the joint to prevent the passage of dust, moisture and gases.
- Local government authority: A body established for the purposes of local government by or under a law applying in a state or territory.
- Low level interface: Systems transfer information via terminals and voltage free contacts.
- Metallic-coated: Steel coated with zinc or aluminium-zinc alloy as follows:
  - Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses.
  - Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.
  - Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.
- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Network Distributor: Body responsible for the distribution and control of electricity.
- Obtain: 'Obtain', 'seek' and similar expressions mean 'obtain (seek) in writing from the superintendent'.
- Practical completion or Defects free completion: The requirements for these stages of completion are defined in the relevant building contract for the project.
- Pipe: Includes pipe and tube.
- Principal: 'Principal' has the same meaning as 'owner', 'client' and 'proprietor' and is the party to whom the contractor is legally bound to construct the works.
- Professional engineer: A person who is listed on the National Professional Engineers Register (NPER) in the relevant discipline at the relevant time.
- Proprietary: 'Proprietary' means identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: 'Provide' and similar expressions mean 'supply and install' and include development of the design beyond that documented.
- Readily accessible: To AS/NZS 3000.
- Registered testing authority:
  - An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
  - An organisation outside Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
  - An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- Required: Means required by the documents, the local council or statutory authorities.
- If required: A conditional specification term for work which may be shown in the documents or is a legislative requirement.
- Samples: Includes samples, prototypes and sample panels.
- Statutory authority: A public sector entity created by legislation, that is, a specific law of the Commonwealth.
- Supply: 'Supply', 'furnish' and similar expressions mean 'supply only'.
- Tests:
  - Pre-completion tests: Tests carried out before completion tests.
    * Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
    * Production tests: Tests carried out on a purchased item, before delivery to the site.
    * Progressive tests: Tests carried out during installation to demonstrate performance in according with this specification.
    * Site tests: Tests carried out on site.
  - Completion tests: Tests carried out on completed installations or systems and fully resolved before the date for, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The superintendent may direct that completion tests be carried out after the date for practical completion.
- Tolerance: The permitted difference between the upper limit and the lower limit of dimension, value or quantity.

- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.
- Witness points: Provides an opportunity to attend an activity but does not involve an obligation. The activity can proceed without approval from the superintendent.

1.6 CONTRACT DOCUMENTS

Services diagrammatic layouts

General: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

Before commencing work:

- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.

Levels

General: Spot levels take precedence over contour lines and ground profile lines.

Drawings and manuals for existing services

Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

1.7 INSPECTION

Notice

Concealment: If notice of inspection is required in respect of parts of the works that are to be concealed, advise when the inspection can be made before concealment.

Tests: Give notice of the time and place of documented tests.

Minimum notice for inspections to be made and for witnessing of tests: Conform to the **Notices schedule**.

Light level requirements: to AS/NZS 1680.2.4.

Attendance

General: Provide attendance for documented inspections and tests.

1.8 SUBMISSIONS

General

Submit to: Superintendent

Default timing: Make submissions at least 5 working days before ordering products for, or starting installation of, the respective portion of the works.

Program: Allow in the construction program for at least the following times for response to submissions:

- Shop drawings: one week
- Samples and prototypes: one week
- Manufacturers' or suppliers' recommendations: 3 business days
- Product data: 3 working days
- Product/design substitution or modification: one week

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

Identification

General: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification.

Non-compliance: Identify proposals for non-compliance with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

Errors

General: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

Submissions - electronic copies

File format: Text in Microsoft Word, spreadsheet data in Microsoft Excel, drawings in AutoCAD dwg format. Text and graphic may also be in Adobe Acrobat pdf format.

Submissions - hard copy

Quantity: 3 Copies

- Loose documents larger than A3: One transparency on heavyweight plastic film the same size as the standard contract drawings.
- Loose documents up to and including A3: One copy.

Standard contract drawing size: A1

Authorities

Authorities' approvals: Submit documents showing approval by the authorities whose requirements apply to the work.

Correspondence: Submit copies of correspondence and notes of meetings with authorities whose requirements apply to the work.

Building penetrations

General: If it is proposed to penetrate or fix to the following, submit details of the methods proposed to maintain the required structural, fire and other properties:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.

Certification

General: Submit certification that the plant and equipment submitted meets all requirements of the contract documents.

Execution details

General: Before starting the installation of building services, submit the following:

- Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.
- Fixing of services: Typical details of locations, types and methods of fixing services to the building structure.
- Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

Inspection and testing

General: Submit an inspection and testing plan which is consistent with the construction program. Include particulars of test stages and procedures.

Test reports: Submit written reports on nominated tests.

Marking and labelling

General: Before marking and labelling submit:

- Samples of the proposed labels.
- A schedule showing, for each item or type of item:
  - A description of the item or type of item sufficient to identify it.
  - The proposed text of the marking or label
  - The proposed location of the marking or label.

Materials and components

Product certification: If products must conform to product certification schemes, submit evidence of conformance.

Product data: For proprietary equipment, submit the manufacturer's product data as follows:

- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.

Notice

Minimum notice: (5 working days for off site submissions, otherwise 10 working days.)

Submission points: If a submission is required for a part of the works, do not commence work on the part until the submission is endorsed that the work may proceed. Coordinate related submissions and do not cause delays by making late or inadequate submissions.

Substitutions

Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:

- Evidence that the performance is equal to or greater than that specified.
- Evidence of conformity to a cited standard.
- Samples.
- Essential technical information, in English.
- Reasons for the proposed substitutions.
- Statement of the extent of revisions to the contract documents.
- Statement of the extent of revisions to the construction program.
- Statement of cost implications including costs outside the contract.
- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:

- Is of net enhanced value to the principal.
- Is consistent with the contract documents and is as effective as the identified item, detail or method.

Samples

Submission: Submit nominated samples.

Incorporation of samples: If it is intended to incorporate samples into the works, submit proposals. Incorporate samples in the works which have been endorsed for inclusion. Do not incorporate other samples.

Retention of samples: Keep endorsed samples in good condition on site, until the date of practical completion.

Shop drawings

General: Include dimensioned drawings showing details of the fabrication and installation of structural elements, building components, services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and submit dimensioned set-out drawings.

Services coordination: Coordinate with other building and service elements. Show adjusted positions on the shop and record drawings.

Space requirements: Check space requirements of equipment and services indicated diagrammatically in the contract documents.

Submission medium: Hard Copies / Drawing size: A1 / Standard: A1 Hard Copy

Checking: Ensure that the drawings have been checked before submission.

Building work drawings for building services: Submit detailed dimensioned drawings showing all:

- Access doors and panels.
- Conduits to be cast in slabs.
- Holding down bolts and other anchorage and/or fixings required complete with loads to be imposed on the structure during installation and operation.
- Openings, penetrations and block-outs.
- Sleeves.
- Plinths, kerbs and bases.
- Required external openings.

2 PRODUCTS

2.1 GENERAL

Manufacturers' or suppliers' recommendations

General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Proprietary items/systems/assemblies: Assemble, install or fix to substrate in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturers' or suppliers' written recommendations and instructions.

Sealed containers

General: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

Prohibited materials

Do not provide the following:

- Materials listed in the Safe Work Australia Hazardous Substances Information System (HSIS).
- Materials that use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) in the manufacturing process.

2.2 TESTS

Attendance

General: Provide attendance on tests.

Testing authorities

General: Except for site tests, have tests carried out by a Registered testing authority and submit test reports.

- Reports: Submit copies of test reports, including certificates for type tests, showing the observations and results of tests and conformance or non-conformance with requirements.
- Site tests: Use instruments calibrated by authorities accredited by a Registered testing authority.

Electrical equipment – non hard wired

All equipment supplied shall be inspected, tested and tagged on entry to service to the requirements of AS/NZS3760

2.3 MATERIALS AND COMPONENTS

Consistency

General: For each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

Corrosion resistance

General: Conform to the following atmospheric corrosivity category as defined in AS/NZS 2312.

Atmospheric corrosivity category: Medium

Situation

The following classification of situation applies to the **Corrosion resistance and durability tables**.

- Internal: Building fabric protected from salt and moisture by vapour barriers, sarking, sheathing and building wraps.
- External: Includes external leaf and air spaces behind external leaf brickwork or blockwork walls.

Galvanizing

Severe conditions: Galvanize mild steel components (including fasteners) to AS 1214 or AS/NZS 4680 as appropriate, if:

- Exposed to weather.
- Embedded in masonry.
- Exposed to or in air spaces behind the external leaf of masonry walls.
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

PVC products

Verification: Provide third party verification to demonstrate that PVC products proposed for the project satisfy the criteria required by the GBCA for their Credit in the Materials category of Green star assessment.

Rainforest timber

Tropical rainforest timbers including species Meranti, Merbau, Philippine Mahogany and Chengel shall not be used for construction or second fix purposes.

Bushfire resistance

Bushfire resistant design and construction: N/A

3 EXECUTION

3.1 OFF SITE DISPOSAL

Removal of material

General: Dispose of building waste material off site to the requirements of the relevant authorities.

3.2 WALL CHASING

Holes and chases

General: If holes and chases are required in masonry walls, provide proposals to demonstrate that the structural integrity of the wall is maintained. Do not chase walls nominated as fire or acoustic rated. Parallel chases or recesses on opposite faces of a wall: Not closer than 600 mm to each other.

Chasing of blockwork: Only in core-filled hollow blocks or in solid blocks which are not designated as structural and to the **Concrete blockwork chasing table**.

Concrete blockwork chasing table

Block thickness (mm)	Depth of chase (maximum mm)
190	35
140	25
90	20

3.3 FIXING

General

Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

Fasteners

General: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

3.4 SERVICES CONNECTIONS

Statutory requirements

The Contractor is responsible for compliance with statutory requirements under the South Australian Electricity Act and compliance with ETSA Utilities Service and Installation Rules. Contractors are required to make application to the supply authority including submission of documents as detailed in the 'Supply Application, Connection & Disconnection' (of the ETSA Utilities Service and Installation Rules). Contractors are required to provide Retailer Energy Metering in accordance with these documents and in accordance with the National Metering Code.

Connections

General: Connect to network distributor services or service points. Excavate to locate and expose connection points. Reinstate the surfaces and facilities that have been disturbed.

Permanent connections

Responsibility: Be responsible for carrying out the following permanent connections, including for items supplied by the Principal, in accordance with the respective authorities, rules and regulations.

Electricity / Water / Gas

Telephone

Sewer

Stormwater

Fees: Pay all fees and costs in relation to the service provided.

Network distributors' requirements

General: If the network distributor elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities.

3.5 SERVICES INSTALLATION

General

Fixing: If non-structural building elements are not suitable for fixing services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Concealment: Unless otherwise documented, conceal all cables, ducts, trays and pipes except where installed in plant spaces, ceiling spaces and riser cupboards. If possible, do not locate on external walls.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

Suspended ground floors: Keep all parts of services under suspended ground floors at least 150 mm clear of the ground surface. Make sure services do not impede access.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

Dissimilar metals: Join dissimilar metals with fittings of electrolytically compatible material.

Temporary capping: During construction protect open ends of pipe with metal or plastic covers or caps.

Piping

General: Install piping in straight lines at uniform grades without sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Spacing: Provide at least 25 mm clear between pipes and between pipes and building elements, additional to insulation.

Changes of direction: Provide long radius elbows or bends and sets where practicable, and swept branch connections. Provide elbows or short radius bends where pipes are led up or along walls and then through to fixtures. Do not provide mitred fittings.

Vibration: Arrange and support piping so that it remains free from vibration whilst permitting necessary movements. Minimise the number of joints.

Embedded pipes: Do not embed pipes that operate under pressure in concrete or surfacing material.

Valve groupings: If possible, locate valves in groups.

Pressure testing precautions: Isolate items not rated for the test pressure. Restrain pipes and equipment to prevent movement during pressure testing.

Differential movement

General: If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide control joints in the pipes or conduits, as follows:

- Location: Adjacent to the pipe or conduit supports which are closest to the perimeter of the building.
- Arrangement: Arrange pipes and conduits to minimise the number of control joints.
- Magnitude: Accommodate the predicted movements.

3.6 BUILDING PENETRATIONS

Penetrations

Fire rated building elements: Seal penetrations with a system conforming to AS 4072.1.

Non-fire rated building elements: Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

Sleeves

General: If piping or conduit penetrates building elements, provide metal or PVC sleeves formed from pipe sections as follows:

- Movement: Arrange to permit normal pipe or conduit movement.
- Diameter (for non fire-rated building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm.
- Prime paint ferrous surfaces.
- Terminations:
  - If cover plates are fitted: Flush with the finished building surface.

  - In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.
  - In floors draining to floor wastes: 50 mm above finished floor.
  - Elsewhere: 5 mm beyond finished building surface.
- Termite management: To AS 3660.1.
- Thickness:
  - Metal: 1 mm.
  - PVC: 3 mm.

Sleeves for cables: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from PVC pipe sections.

3.7 CONCRETE PLINTHS

Construction

General: Provide concrete plinths as required.

3.8 SUPPORT AND STRUCTURES

General

Requirement: Provide incidental supports and structures to suit the services.

3.9 PIPE SUPPORTS

Support systems

General: Provide proprietary support systems of metallic-coated steel construction.

Vertical pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Do not provide saddle type supports for pipes > DN 25.

Dissimilar metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fixings of electrolytically compatible material.

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm.
- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.

Support spacing

Cold and heated water pipes: To AS/NZS 3500.1 Table 5.2. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Sanitary plumbing: To AS/NZS 3500.2 Table 9.1.

Fuel gas: To AS 5601 Table 5.5.

Other pipes: To AS/NZS 3500.1 Table 5.2.

Support Fixing

Fixing: Hangers fixed to lightweight cold formed purlins for support shall be fixed only to the purlin web, connections to the flanges are not acceptable. Refer to the Structural Steelwork specification for maximum purlin loads before specific structural design is required.

Hangers

Conform to the **Hanger size table**.

Hanger size table

Nominal pipe size (DN)	Minimum hanger diameter (mm) for single hangers
50	9.5
65 to 90	12.7
100 to 125	15.8
150 to 200	19.0

3.10 PLANT AND EQUIPMENT ACCESS

General

Services and equipment: Locate and arrange all services and equipment so that:

- They comply with the relevant requirements of the appropriate Occupational Health and Safety regulations.
- Failure of plant and equipment (including leaks) does not create a hazard for the building occupants.
- Failure of plant and equipment (including leaks) cause a minimum or no damage to the building, its finishes and contents including water sensitive equipment or finishes.
- Safe tray and an overflow pipe are provided to each tank, hot water heater and storage vessel.
- Piping: Provide access and clearance at fittings which require maintenance or servicing, including control valves and joints intended to permit pipe removal. Arrange piping so that it does not interfere with the removal or servicing of associated equipment or valves or block access or ventilation openings.
- Services and equipment are readily accessible for inspection and maintenance and arranged so that inspection and maintenance can be carried out in a safe and efficient manner. Include the following:
  - Conform to the relevant requirements of AS 1470, AS 1657, AS/NZS 1892.1, AS 2865 and AS/NZS 3666.1.
  - Minimise inconvenience and disruption to building occupants or damage to the building structure or finishes.
  - Locate plant (including high level tanks) requiring regular inspection and maintenance so it is either safely and readily accessible from floor level or provide permanent access platforms and ladders.
- In false ceilings, locate items of equipment that require inspection and maintenance above tiled parts. If not possible, provide access panels where located above set plaster or other inaccessible ceilings. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible.
- Modify manufacturer's standard equipment when necessary to provide the plant access in the contract documents.

3.11 VIBRATION SUPPRESSION

Standard

Rotating and reciprocating machinery noise and vibration: Vibration severity in Zone A to AS 2625.1 and AS 2625.4.

General

General: Minimise the transmission of vibration from rotating or reciprocating equipment to other building elements.

Speeds

General: If no maximum speed is prescribed do not exceed 1500 r/min for direct driven equipment.

Connections

General: Provide flexible connections to rotating machinery and assemblies containing rotating machinery. Isolate pipes by incorporating sufficient flexibility into the pipework or by use of proprietary flexible pipe connections installed so that no stress is placed on pipes due to end reaction.

Inertia bases

General: If necessary to achieve the required level of vibration isolation, provide inertia bases having appropriate mass and conforming as follows:

- Construction: Steel or steel-framed reinforced concrete. Position foundation bolts for equipment before pouring concrete.
- Supports: Support on vibration isolation mountings using height saving support brackets.

Vibration isolation mountings

General: Except for external equipment that is not connected to the structure of any building, support rotating or reciprocating equipment on mountings as follows:

- For static deflections < 15 mm: Single or double deflection neoprene in-shear mountings incorporating steel top and base plates and a tapped hole for bolting to equipment.
- For static deflections 15 mm: Spring mountings.

Selection: Provide mountings selected to achieve 95% isolation efficiency at the normal operating speeds of the equipment.

Installation: Set and adjust vibration isolation mounting supports to give clearance for free movement of the supports.

Spring mountings: Provide freestanding laterally stable springs as follows:

- Clearances: 12 mm between springs and other members such as bolts and housing.
- High frequency isolation: 5 mm neoprene acoustic isolation pads between baseplate and support.
- Levelling: Provide bolts and lock nuts.
- Minimum travel to solid: 150% of the designated minimum static deflection.
- Ratio of mean coil diameter to compressed length at the designated minimum static deflection: 0.8:1.

- Snubbing: Snub the springs to prevent bounce at start-up.
- Vertical resilient limit stops: To prevent spring extension when unloaded, to serve as blocking during erection and which remain out of contact during normal operation.

3.12 SEISMIC RESTRAINT OF BUILDING SERVICES

Provisions

General: Arrange all components, other than service items exempted in AS 1170.4, to resist seismic loads determined in accordance with AS 1170.4. Securely fix all plant and equipment to the building structure. Do not rely on gravity and/or friction to resist seismic forces.

Anti-vibration mounts: Use horizontally restrained type.

Components: Do not use components that will be damaged by earthquake conditions. Protect systems against the adverse effects of components such as mercury switches that, although not damaged by earthquake, may malfunction.

3.13 FINISHES TO BUILDING SERVICES

General

General: If exposed to view (including in plant rooms), paint new building services and equipment. Surfaces painted or finished off-site: Conform to the *Metals and prefinishes* Work Sections.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish documented.

Standard

General: Conform to the recommendations of AS/NZS 2311 Sections 3, 6 and 7 or AS/NZS 2312 Sections 5, 8 and 10, as applicable.

Powder coating

Standard:

- Aluminium for architectural applications: To AS 3715.
- Other metals: To AS 4506.

Painting systems

New unpainted interior surfaces: To AS/NZS 2311 Table 5.1.

New unpainted exterior surfaces: To AAS/NZS 2311 Table 5.2.

Paint application

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Ensure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and refix in position undamaged when painting is complete.

Underground metal piping

Corrosion protection: Provide corrosion protection for the following:

- Underground ferrous piping.
- Underground non-ferrous metal piping in corrosive environments.

Protection methods: Select from the following:

- Cathodic protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of AS 2832.1.
- Continuous wrapping using proprietary petroleum taping material.
- Impermeable flexible plastic coating.
- Sealed polyethylene sleeve.

Low VOC emitting paints

Provide the following low odour/low environmental impact paint types with the following VOC limits:

- Primers and undercoats: < 65 g/litre.
- Low gloss white or light coloured latex paints for broadwall areas: < 16 g/litre.
- Coloured low gloss latex paints: < 16 g/litre.
- Gloss latex paints: < 75 g/litre.

3.14 MARKING AND LABELLING

General

General: Mark services and equipment to provide a ready means of identification and as follows:

- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: Identify and label to AS 1345 throughout its length, including in concealed spaces.
- Cables: Label to indicate the origin and destination of the cable.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project.

Electrical accessories

General: Label isolating switches and outlets to identify circuit origin.

Equipment concealed in ceilings

Location: Provide a label on the ceiling indicating the location of each concealed item requiring access for routine inspection, maintenance and/or operation. In tiled ceilings locate the label on the ceiling grid closest to the item access point. In flush ceilings locate adjacent to closest access panel. Items to be labelled include but are not limited to:

- Fan coil units and terminal equipment (e.g. VAV boxes).
- Fire and smoke dampers.
- Isolating valves not directly connected to items otherwise labelled.
- Motorised dampers.
- Wall mounted equipment in occupied areas: Provide labels on wall mounted items in occupied areas including the following:
- Services control switches.
- Temperature and humidity sensors.

Points lists

Automatic control points: Provide plasticised, fade-free points lists for each automatic control panel. Store in a pocket on the door of the panel. Lists to include terminal numbers, point addresses, short and long descriptors.

Pressure vessels

General: Mount manufacturer's certificates in glazed frames on a wall next to the vessel.

Valves and pumps

General: Label to associate pumps with their starters and valves. Screw fix labels to body or attach label to valve handwheels with a key ring.

Underground services

Survey: Accurately record the routes of underground cables and pipes before backfilling. Include on the record drawings.

Records: Provide digital photographic records of underground cable and pipe routes before backfilling. Include in operation and maintenance manual.

Location marking: Accurately mark the location of underground cables and pipes with route markers consisting of a marker plate set flush in a concrete base, engraved to show the direction of the line and the name of the service.

Markers: Place markers at ground level at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

Marker bases: 200 mm diameter x 200 mm deep, minimum concrete.

Direction marking: Show the direction of the cable and pipe run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, aluminium or stainless steel with black filled engraved lettering, minimum size 75 x 75 x 1 mm thick.

Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.

Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

Marker tape: Where electric bricks or covers are not provided over underground wiring, provide a 150 mm wide yellow or orange marker tape bearing the words 'WARNING – electric cable buried below', laid in the trench 150 mm below ground level.

Labels and notices

Materials: Select from the following:

- Cast metal.
- For indoor applications only, engraved two-colour laminated plastic.
- Proprietary pre-printed self-adhesive flexible plastic labels with machine printed black lettering.
- Stainless steel or brass 1 mm thick with black filled engraved lettering.

Emergency functions: To AS 1319.

Colours: Generally to AS 1345 as appropriate, otherwise black lettering on white background except as follows:

- Danger, warning labels: White lettering on red background.
- Main switch and caution labels: Red lettering on white background.

Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.

Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape and as follows:

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions.
- Use aluminium or monel rivets for aluminium labels.

Label locations: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Labelling text and marking: To correspond to terminology and identifying number of the respective item as shown on the record drawings and documents and in operating and maintenance manuals.

Lettering heights:

- Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder.
- Equipment labels within cabinets: 3.5 mm.
- Equipment nameplates: 40 mm.
- Identifying labels on outside of cabinets: 5 mm.
- Isolating switches: 5 mm.
- Switchboards, main assembly designation: 25 mm.
- Switchboards, outgoing functional units: 8 mm.
- Switchboards, sub assembly designations: 15 mm.
- Valves: 20 mm.
- Self-adhesive flexible plastic labels :
  - Labels < 2000 mm above floor: 3 mm on 6 mm wide tape.
  - Labels 2000 mm above floor: 8 mm on 12 mm wide tape.
- Other locations: 3 mm.

Operable devices: Mark to provide a ready means of identification. Include the following:

- Controls.
- Indicators, gauges, meters.
- Isolating switches.

Vapour barriers: Do not penetrate vapour barriers.

3.15 SOFTWARE

General

General: Provide the software required for the operation and management of building services systems and equipment.

3.16 WARRANTIES

General

General: If a warranty is documented or if a manufacturer's standard warranty extends beyond the end of the defects liability period, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

3.17 RECORD DRAWINGS

General

General: Submit record drawings. Show the 'as installed' locations of building elements, plant and equipment. Show off-the-grid dimensions where applicable.

Shop drawings: Submit all documented shop drawings, including 'as installed' amendments.

Services: Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.

Services below ground or concealed: If services and fittings are below ground or concealed, show the depth and dimensioned references that will allow the future location of the service for maintenance or expansion.

Extensions and/or changes to existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient of the existing installation to make the drawing comprehensible without reference to drawings of the original installation.

Diagrams: Provide diagrammatic drawings of each system including the following:

- Controls.
- Piping including all valves and valve identification tags.
- Principal items of equipment.
- Single line wiring diagrams.
- Acoustic and thermal insulation.
- Access provisions.
- Fixings.
- Fixtures.
- Switchgear and controlgear assembly circuit schedules including electrical service characteristics, controls and communications.
- Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Detention: If on-site detention tanks or pondage are provided include the volume required on the drawing and the permitted flow rate to the connected system.

Domestic cold water or fire mains: Show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works.

Stormwater: If storm water pipes are shown include the pipe size and pipe grade together with the maximum acceptable flow and the actual design flow.

Accuracy

Progress recording: Keep one set of shop drawings on site at all times expressly for the purpose of marking changes made during the progress of the works.

Documents: Incorporate all modifications made during the progress of the work and testing period. Show any provisions for the future.

Endorsement: Sign and date all record drawings.

Drawing layout

General: Use the same borders and title block as the contract drawings.

Quantity and format

General: Conform to **SUBMISSIONS.**

Date for submission

General: Not later than 2 weeks after the date of practical completion.

3.18 OPERATION AND MAINTENANCE MANUALS

General

General: Submit operation and maintenance manuals for the whole of the work.

Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Referenced documents: If referenced documents or technical Work Sections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

3.19 TOOLS AND SPARE PARTS

Spare parts

General: Provide spare parts listed in the appropriate work sections.

Tools and spare parts schedule

General: At least 8 weeks before the date for practical completion, submit a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer's current price. Include the following in the prices:

- Checking receipt, marking and numbering in accordance with the spare parts schedule.
- Packaging and delivery to site.
- Painting, greasing and packing to prevent deterioration during storage.
- Referencing equipment schedules in the operation and maintenance manuals.
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

Replacement: Replace spare parts used during the maintenance period.

3.20 COMMISSIONING AND COMPLETION TESTS

Reports

General: Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

Notice

Inspection: Give sufficient notice for inspection to be made of the commissioning and completion testing of the installation.

Controls

General: Calibrate, set and adjust control instruments, control systems and safety controls.

Samples

General: Remove unincorporated samples on completion.

Circuit protection

General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

Completion tests

General: Test the works under the contract to demonstrate compliance with the documented performance requirements of the installation.

Functional checks: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Proprietary equipment: Submit type test reports confirming compliance of proprietary equipment.

Sound pressure level measurements: Conform to the following:

- Correction for background noise: To AS/NZS 2107 Table B1.
- External: To AS 1055.1.
- Internal: To AS/NZS 2107.
- Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.
- Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
- Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

Test instruments: Use instruments calibrated by a registered testing authority.

Certification
General: On satisfactory completion of the installation and before the date of practical completion, submit certificates stating that each installation is operating correctly.

3.21 TRAINING

General
Duration: Instruction to be available for the whole of the commissioning and running-in periods.

Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with proprietor.

Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

Demonstrators
General: Use only qualified manufacturer's representatives who are knowledgeable about the installations.

Maintenance
General: Explain and demonstrate to the principal's staff the purpose, function and maintenance of the installations.

Operation
General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

Seasonal operation
General: For equipment requiring seasonal operation, demonstrate during the appropriate season and within 6 months.

3.22 CLEANING

Final cleaning
General: Before practical completion, clean throughout, including all exterior and interior surfaces except those totally and permanently concealed from view.

Labels: Remove all labels not required for maintenance.

3.23 MAINTENANCE

General
General: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

Annual maintenance: Carry out recommended annual maintenance procedures before the end of the maintenance period.

Mandatory Maintenance: Schedule and carry out maintenance and testing of safety installations as required under the SA Development Act (Ministers Specification SA 76). Carry out maintenance at intervals not exceeding those specified in Ministers Specification SA76 and referenced Standards.Record all maintenance and repairs in logbooks.

Annual maintenance: Carry out recommended annual maintenance procedures at end of maintenance period.

Maintenance period: The greater of the defects liability period and the period nominated in the **Maintenance requirements schedule**.

Maintenance program
General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

Maintenance records
General: Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.

Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

Certificates: Include test and approval certificates.

Service visits
Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

Collate and retain services records on site during the Defects Liability Period.

Ensure records are up to date at the conclusion of the Defects Liability Period.

Periodic maintenance and performance report

At six monthly intervals provide a report summarising the maintenance performed and the performance of the services plant in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

- Dates and number of site labour hours for programmed maintenance. Exclude travelling time.
- Dates, number of site labour hours and nature of work for corrective maintenance. Exclude travelling time.
- Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time.
- Quantity and type of consumables used.
- Peak load and load profile for electrical power consumed by major plant.
- Plant gas consumption and load profile.
- List of any motors for which the motor current varied by more than 10% from the current measured during commissioning.
- Results of recommissioning if scheduled for the period.

Log Books

Provide appropriate Log Books for all installations requiring legislative mandatory maintenance.

Site control

General: Report to the principal's designated representative on arriving at and before leaving the site.

4 COMPLIANCE

4.1 WRITTEN STATEMENT

Prior to issuing practical completion provide written evidence that:

- the works have been carried out in accordance with the plans and specifications which were Certified for Compliance with the Building Rules under the Development Act and the requirements of relevant authorities;
- permanent connections required for services (refer clause 4.2, Services Connections above) have been made in accordance with the requirements of the relevant statutory authority (eg water, gas, electricity service provider);
- compliance with items of Essential Safety Provisions, as listed in the Schedule of Essential Safety (accompanying the Certificate of Compliance with the Building Rules);
- and, where relevant
- a report from the fire authority confirming that any hydrants, booster assemblies, fire alarms and the like have been installed and operate correctly.

(Refer Appendix : BCA Compliance / Essential Services for Standard Forms)

ADHESIVES, SEALANTS AND FASTENERS

1 GENERAL

1.1 CROSS REFERENCES

General

Conform to the Preliminaries / General Requirements.

Related sections : All sections as applicable.

2 EXECUTION

2.1 ADHESIVES AND SEALANTS

Standards

Mastic adhesive: To AS 2329.

Non-structural adhesive for timber: To AS 2754.3.

Polymer emulsion adhesive for timber: To AS 2754.2, not inferior to Type 3 if required to be water-resistant.

Performance

Provide adhesives and sealants capable of transmitting imposed loads, sufficient to ensure the rigidity of the assembly, or integrity of the joint and which will not cause discolouration of finished surfaces.

2.2 FASTENERS

General

Masonry anchors: To be proprietary expansion or chemical types.

Plain washers: To AS 1237.1.

- Provide washers to the heads and nuts of bolts, and heads and nuts of coach bolts.

Plugs: To be proprietary purpose-made plastic.

Powder-actuated fasteners: To AS/NZS 1873.4.

Steel nails: To AS 2334.

- Length: At least 2.5 x the thickness of the member being secured, and at least 4 x the thickness if the member is plywood or building board < 10 mm thick.

Unified hexagon bolts, screws and nuts: To AS/NZS 2465.

Bolts

Coach bolts: To AS/NZS 1390.

Hexagon bolts Grades A and B: To AS 1110.1.

Hexagon bolts Grade C: To AS 1111.1.

Corrosion resistance

Conform to the **Corrosion resistance table**.

Steel products:

- Distance to water: To the man high water mark.

Corrosion resistance table

Corrosivity category	Situation	Self drilling screws to AS 3566: Class	Threaded fasteners and anchors: Material or minimum local metallic coating thickness (m)	Powder actuated fasteners: Material or minimum local metallic coating thickness (m)

Low - More than 10 km from water subject to breaking surf - More than 1 km from salt water not subject to breaking surf	Internal	1	Electroplated zinc 4	Electroplated zinc 4
	External	3	Electroplated zinc or galvanize 30	Stainless 316
Medium - 1 to 10 km from water subject to breaking surf - More than 50 m from salt water not subject to breaking surf - Non-heavy industrial areas	Internal	2	Electroplated zinc 12	Electroplated zinc 12
	External	4	Hot-dip galvanize 50	Stainless 316
High - 200 to 1000 m from water subject to breaking surf - 0 to 50 m from salt water not subject to breaking surf - Heavy industrial areas	Internal	3	Electroplated zinc or galvanize 30	Stainless 316
	External	Stainless 316	Stainless 316	Stainless 316

Finishes

Electroplating:

- Metric thread: To AS 1897.
- Imperial thread: To AS 4397.

Galvanizing:

- Threaded fasteners: To AS 1214.
- Other fasteners: To AS/NZS 4680.

Mild steel fasteners: Galvanize if:

- Exposed to weather.
- Embedded in masonry.
- In external timbers such as weatherboards or decking.
- In contact with chemically treated timber.

Nuts

Hexagon chamfered thin nuts Grades A and B: To AS 1112.4.

Hexagon nuts Grade C: To AS 1112.3.

Hexagon nuts Style 1 Grades A and B: To AS 1112.1.

Hexagon nuts Style 2 Grades A and B: To AS 1112.2.

Performance

Provide fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

METALS AND PREFINISHES

1 GENERAL

1.1 CROSS REFERENCES

General

Conform to the *General requirements* worksection.

Related worksections

Conform to associated worksections as follows: *All sections as applicable.*

2 MATERIALS AND COMPONENTS

2.1 METALS

Coated steel

Ferrous hollow sections by a continuous or specialised process: To AS/NZS 4792.

Ferrous hollow sections by electrogalvanizing: To AS 4750 (Int).

Ferrous open sections by an in-line process: To AS/NZS 4791.

Ferrous open sections by electrogalvanizing: To AS 4751 (Int).

Metallic-coated sheet: To AS 1397.

- Thickness: Metal thicknesses specified are base metal thicknesses.

Steel wire: To AS/NZS 4534.

3 EXECUTION

3.1 GENERAL

Brazing

General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. For butt joints do not rely on the filler metal fillet only.

Filler metal: To AS 1167.1.

Damage

If prefinishes are damaged, including damage caused by unauthorised site cutting or drilling, remove and replace the damaged item.

Finishing

Visible joints: Finish visible joints made by welding, brazing or soldering using methods appropriate to the class of work (including grinding or buffing) before further treatment such as painting, galvanizing or electroplating. Ensure self-finished metals are without surface colour variations after jointing.

Preparation

General: Before applying decorative or protective prefinishes to metal components, complete welding, cutting, drilling and other fabrication, and prepare the surface using a suitable method.

Standard: To AS 1627.

Priming steel surfaces: If site painting is specified to otherwise uncoated mild steel or similar surfaces,

- prime after fabrication and before delivery to the works; and
- after installation, repair damaged priming and complete the coverage to unprimed surfaces.

Repair

If a repair is required to metallic coated sheet or electrogalvanized on inline galvanized steel products, clean the affected area and apply a two-pack organic primer to AS/NZS 3750.9 or APAS-2916.

Welding

Aluminium: To AS 1665.

Stainless steel: To AS/NZS 1554.6.

Steel: To AS/NZS 1554.1.

3.2 ELECTROPLATING

Electroplated coatings

Chromium on metals: To AS 1192.

Nickel on metals: To AS 1192.

Service condition number: At least 2.

Zinc on iron or steel: To AS 1789.

3.3 ANODISING

Anodising

Standard: To AS 1231.

Thickness grade:

- Indoor applications: At least AA10.
- Outdoor applications: At least AA25.

3.4 POWDER COATING

Preparation

General: Use chemical pretreatments. If recommended, provide conversion coatings.

Aluminium: Pretreat to AS 3715 Appendix G.

Galvanized steel: Clean by immersing in a suitable alkaline or acidic solution, apply a zinc phosphate chemical conversion coating, rinse and degrease.

Unprotected steel: Remove rust to the recommendations of AS 1627.4 to grade Sa 2½ of AS 1627.9. Clean by immersing in trichloroethylene or an alkaline solution, and apply a coat of iron phosphate.

Thermoset powder coating

Standards: To AS 3715 or AS/NZS 4506 as appropriate.

External use: APAS-0155/2.

Finish: Full gloss.

Internal use: APAS-0155/1.

3.5 PREPAINTING

Air-drying enamel

Application: Spray or brush.

Finish: Full gloss.

Internal use:

- Primer: Two-pack epoxy primer to APAS-2971.
- Topcoats: 2 coats to APAS-0015/1.

Equipment paint system

Description: Brush or spray application using paint as follows:

- Full gloss enamel finish coats, oil and petrol resistant: APAS-0024/1, two coats.
- Prime coat to metal surfaces generally: APAS-0032 or APAS-0162/1.
- Prime coat to zinc-coated steel: APAS-0017 or APAS-0134.
- Undercoat: APAS-0029.

High performance organic coatings

Description: Factory applied spray coatings on aluminium products, including polyvinylidene fluoride (PVF_2) coatings.

Standards: To AAMA 2604 and AS/NZS 2728.

Prepainted metal products

Standard: To AS/NZS 2728.

Product finish: Refer to Finishes Schedule Appendix C.

Product type: Not lower than the type appropriate to the field of application.

Stoving enamel

Application: Spray or dip.

Internal use:

- Primer: To APAS-0065.
- Topcoat: To APAS-0066/3.

Two-pack liquid coating

Application: Spray.

Finish: Full gloss.

Primer: Two pack epoxy primer to APAS-2971.

Topcoat:

- Internal use: Proprietary polyurethane or epoxy acrylic system.
- External use: Proprietary polyurethane system.

TIMBER FINISHES AND TREATMENT

1 GENERAL

1.1 CROSS REFERENCES

General
Refer to Preliminaries / General Requirements / Special Conditions Of Contract

1.2 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.

- Plywood: To AS/NZS 4491.
- 'Standard trade common names': To AS/NZS 1148.
- Groups of timbers: Terms employed for that purpose in relevant Australian standards.

1.3 SUBMISSIONS

Materials
Rainforest species: *Shall not be used.*

Pressure preservative treatment: For timber required to be pressure treated, submit a certificate or other satisfactory evidence showing that the timber has been treated.

2 PRODUCTS

2.1 TIMBER

Durability
General: Provide timbers having natural durability appropriate to the conditions of use, or preservative-treated timber of equivalent durability.

Natural durability class of heartwood: To AS 5604.

Minimum requirements:

- Class 1: Timbers in contact with ground.
- Class 2: Timbers above ground, not in continuous contact with moisture, well ventilated, protected from moisture but exposed to the weather.
- Class 3: Timbers above ground, not in continuous contact with moisture, well ventilated, protected with a finish, and well maintained.
- Class 4: Timbers fully protected from moisture, indoors, above ground, and well ventilated.

Lyctus susceptible timbers
General: Do not provide timbers containing Lyctus susceptible sapwood.

Preservative treatment
Glued laminated timber products: To AS/NZS 1604.5.

- Hazard classification: To Table A1.

Laminated veneer lumber (LVL): To AS/NZS 1604.4.

- Hazard classification. To Table A1.

Plywood: To AS/NZS 1604.3.

- Hazard classification: To Table A1.

Reconstituted wood-based products: To AS/NZS 1604.2.

- Hazard classification: To Table A1.

Sawn and round timber: To AS 1604.1.

- Hazard classification: To Table D1.

Water-repellent treatment

Repellent: *to APAS-0096.*

Moisture content

Tolerance: Make milled and dressed products from timbers seasoned as follows:

- To within 3% of the equilibrium moisture content appropriate to the timber and its intended conditions of use.
- To 10 – 15% moisture content.
- With no more than 3% difference between any 2 pieces in any one group.

Test: To AS/NZS 1080.1.

Moisture content for special site conditions: *NA*

Protection: Protect timber and timber products stored on site from moisture and weather. For milled, prefinished, prefabricated and similar elements which are protected in the final structure, provide temporary weather protection until the permanent covering is in place.

Finished sizes

General: Provide milled timbers with actual dimensions which are at least the stated dimensions, except for dimensions qualified by a term such as 'nominal' or 'out of' to which industry standards for finished sizes apply.

Unseasoned timber

General: If unseasoned timber is used, or if variations in moisture are likely, allow for shrinkage, swelling and differential movement.

Surface finish

Hardwood: To AS 2796.1 Table B1.

Softwood: To AS 4785.1 Table B1.

3 EXECUTION

3.1 WORKMANSHIP

Ploughing

General: Back plough boards liable to warp (e.g. if exposed externally on one face). Make the width, depth and distribution of ploughs appropriate to the dimensions of the board and degree of exposure.

Painting

Edges: Chamfer edges of work to receive paint or similar coatings.

Priming: For woodwork to be painted, prime *all surfaces including* hidden surfaces before assembly.

STEEL – PROTECTIVE PAINT COATINGS

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide protective paint coatings that control corrosion to structural steelwork and steel products in the time to first scheduled maintenance as documented.

1.2 CROSS REFERENCES

General

Requirement: Conform to Preliminaries / General Requirements:

Related Sections : Steelwork / Painting / All other Trade sections

1.3 STANDARDS

General

Surface preparation and coating: Conform to the recommendations of AS/NZS 2312.

Site testing of protective coatings

Test methods: To AS 3894.

1.4 INTERPRETATIONS

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

DFT: Dry Film Thickness.

ITP: Inspection and Test Plan.

µm: micron (10^{-6}m).

Definitions

General: For the purposes of this worksection the definitions given in AS/NZS 2310 and those below apply.

- Coating contractor: The protective coatings application contractor conducting the on or off site coating application works.
- Coating manufacturer: The supplier and/or manufacturer of the protective coating materials used.
- ITP: A series of formal Inspection and Test Plans, prepared by the coating contractor to reflect the specific inspection and testing that will be carried out on the surface preparation, coating application and the record keeping tasks to be undertaken.
- MSDS: The formal Material Safety Data Sheet, prepared in accordance with Worksafe Australia's requirements and distributed by the coating manufacturer to provide information on the safe handling, storage, personal protective equipment requirements, use and disposal of a coating product.

1.5 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Items after fabrication before commencing surface cleaning and preparation.
- Surfaces after preparation before application of first coating.
- Coating stages:
  - After application of primer or seal coats.
  - After application of each subsequent coat.

.

1.6 SUBMISSIONS

Licence

Requirement: Submit proof of currency of the applicator's Environmental Operating Licence.

Detailing of structural steelwork

General: If design and fabrication features of the items to be coated may lead to difficulties, advise before commencing surface preparation.

Quality

ITPs: Submit for each proposed coating system.

Quality supervisor: Submit the name and the experience record of the person nominated to oversee the implementation of the ITPs.

Removal of deleterious materials

General: Submit advice on suitability of marking paints, and removal of materials deleterious to coating processes such as grease, oil and paint.

Repair of coating damage

General: If the protective coating is damaged, submit a repair coating proposal, based on the coating manufacturer's technical data sheet, that will ensure that the full corrosion protection ability of the system is reinstated.

Reinstatement

Final coat reinstatement: If required due to variance, submit proposals for reinstatement of the visible final coating system to match the original coating system samples.

Records

General: Prepare and maintain records of all surface preparation and coating application works as follows:

- Standard: To AS 3894.10, AS 3894.11, AS 3894.12, AS 3894.13 and AS 3894.14.
- Reference the relevant parts of the ITPs, and record conformance.

Maintenance paint coating systems

Existing systems: Itemise areas of corrosion, damage, and other degradation.

Recoating systems: Supply coating systems for maintenance painting of previously coated items and structural elements, including surface preparation, to the **Protective paint coating schedule**.

Warranties

General: Submit details of the proposed warranty terms, form and period. If separate warranties are offered by the manufacturer and the applicator, ensure they are interlocking.

1.7 SAMPLES

Painting and coating colour

General: Submit a sample of the finished product for each different coating system.

Size of each sample: 400 x 400 mm.

Retention: Retain half of each sample for comparison during coating application.

1.8 TESTING

General

Conformance: All areas of any item must meet the required cleanliness standard.

Abrasive blast cleaning

Assessment: To AS 1627.4 and ISO 8501-1.

Power tool cleaning

Assessment: To AS 1627.2 and ISO 8501-2.

- Class 2.5.

Hand tool cleaning

Visual assessment: To ISO 8501-2.

- Class 2.5.

Surface profile

General: To AS 3894.5.

Profile grade: To AS 3894.5 Method A. Medium is nominal 50 - 62 µm.

Surface dust from abrasion

General: To AS 3894.6 Method C.

Chloride level testing

Test: To AS 3894.6 Method A.

Maximum allowable chloride levels: 50 mg/m^2.

Conformance: If this level is exceeded, rewash the affected surface area using fresh water until the chloride level is within acceptable limits. There are chloride neutralizing solutions commercially available. Jetwashing or steamcleaning is also acceptable before re testing and re-abrasive blasting.

Timing of testing: early in the blasting work so that removal procedures can be initiated before the blasting is completed.

Wet film thickness

Method of measurement: To AS 3894.3, Appendix C using an approved wet film gauge continuously during application.

Dry film thickness

Method of measurement: To AS 3894.3, clause 10.

Extent: All surfaces at the completion of each of the prime, intermediate and finish coats, in particular include areas of the structure which are difficult to paint, are masked by structure, or areas where double coating or light coating is likely due to the shape of the substrate.

Number of measurements: Perform a sufficient number of readings to ensure a representative account for the DFT compliance of the coated areas tested.

Deduction: If testing the DFT of coatings 150 µm and less, deduct the effect of the measured surface profile from all DFT readings.

Single readings: Single reading requirements are as follows:

- Check any single reading that is less than 80% of the specified DFT with three additional readings within 50 mm of the original reading. If these three readings average not less than 90% of the specified DFT, take the averaged readings to be the "point reading". If less than 90%, reject the DFT in that area.
- Check any single reading that is greater than 150% of the specified DFT with three additional readings within 50 mm of the original reading. If these three readings average not greater than 150% of the specified DFT, take the averaged readings to be the "point reading". If greater than 150%, reject the DFT in that area.

Rectification: Re-work areas rejected, using surface preparation and coatings in the same manner and order as the original work.

Defects including underthickness and overthickness : Mark with school grade chalk, adhesive inspection labels or masking tape. Do not use crayon, paint or spirit based ink pens.

2 PRODUCTS

2.1 GENERAL

General

Care: Handle, store, mix and apply all protective coatings strictly in accordance with the manufacturer's instructions.

Original containers: Provide coating products in unopened containers bearing the brand name and name of the manufacturer with a clearly legible batch number.

Ambient temperature range for storage: 15°C to 25°C.

Use-by-date: Use products with limited shelf life before their use-by-date unless written authorisation from the coating manufacturer's technical services section is provided.

Proprietary Recommended products

Requirement: Provide all products from the one manufacturer's supply unless specialised products are requires from other sources.

The protective finish (including Powdercoat finishes and thickness) shall be suitable for the application and exposure condition and shall be as recommended by the paint manufacture including substrate pre-treatment (cleaning / blasting / primers / undercoats etc) Provide manufactures literature in support of final selection. (Dulux industrial and powdercoat finishes or equal approved)

Material safety data sheets (MSDS)

Requirement: Keep on site copies of all relevant MSDSs.

3 EXECUTION

3.1 GENERAL

General

Product warnings: Conform to the requirements and recommendations of product MSDS's.

3.2 PROTECTION

Surroundings

Protection: Prevent the release of abrasive, overspray or paint waste debris to air, ground or to any watercourse. Repair or clean affected surrounding areas.

Damage: Prevent damage to other assets, services or equipment.

Contamination

Coating contamination: Prevent contamination of coatings contaminated from abrasive or other foreign matter.

Surfaces: Prevent contamination of coated surfaces which are not yet dry from blasting dust, abrasive or surface preparation debris.

On site storage

General: Deliver coatings to site in the original unopened containers coatings and store in a cool shady place.

Sunlight: Protect coating materials from direct sunlight before mixing or adding the converter (catalyst).

Post application care

General: Provide protection to the coating against physical, chemical, or atmospheric damage until all components are fully cured.

Care: Stack and handle all coated items using fabric slings or padded chains. Adopt soft packaging, carpet strips or other deformable materials between all coated items.

Water ponding: Stack coated items to prevent water ponding.

3.3 SURFACE PREPARATION

General

Defects: Remove all surface defects, including cracks, laminations, deep pitting, weld spatter slag, burrs, fins, sharp edges and other defects before the preparation of the surface to be coated.

Temporary welds: Grind flush temporary welds.

Site welding: Where possible avoid site welding.

Porous, skip or stitch welds: Not acceptable.

Edges: De-burr and round all edges to a 2 mm radius.

Surface contaminants: Remove surface contaminants such as oil, grease, dirt and loose particles, using an alkaline oil emulsifier/degreaser to AS 1627.1.

Surface preparation: Prepare surfaces to the required finish to AS 1627.1 , AS 1627.2, AS 1627.4, AS 1627.5, AS 1627.6 and AS 1627.9.

Surface cleaning: Remove spent abrasive from the surface by blowing with clean, dry air and/or by vacuum cleaning.

Bolts: Provide washers at heads and nuts at replacement bolts.

Surface preparation for atmospheric steel

General: Comply to the following requirements:

- Wash and degrease all surfaces to be coated in accordance with AS 1627.1 with a free-rinsing, alkaline detergent, in strict accordance with the manufacturer's written instructions and all safety warnings.
- Wash with fresh potable water and ensure that all soluble salts are removed in accordance with AS 3894.6 Methods A and D.
- Grind all sharp edges with a power tool to a minimum radius of 2 mm.
- Power tool clean welds to AS 1627.2 Class 2 to remove roughness. Remove filings, preferably by vacuum or compressed air.
- Abrasive blast clean all steel surfaces to be painted in accordance with AS 1627.4 to visual standard AS 1627.9 Class 2.5 (equivalent to ISO 8501-1, Sa 2.5: Very Thorough Blast-Cleaning). Use a non-metallic medium that will generate a surface profile of 35 to 65 microns (as tested to AS 3894.5 Method A.).
- Commence application within 4 hours of abrasive blast cleaning or before surface becomes contaminated, otherwise repeat abrasive blasting step.Stripe coat welds, bolts, boltholes and all edges with primer before application of full primer coat.
- Before application, ensure that the surface is free of contaminants including oil, grease, dirt, dust, salt and any other deleterious materials that will interfere with coating performance.

Treatment of on-site welding

On-site welding: If on site welding is performed, adopt the following procedures:

- Remove weld spatter.
- Power tool clean welds to AS 1627.2 Class 2 to remove roughness. Remove filings, preferably by vacuum or compressed air.
- Prime welds immediately with the nominated primer before contamination can reoccur. Ensure that the primer overlaps the sound adjacent coating by between 25 mm and 50 mm.
- Apply intermediate and topcoats over the primed welds to match the surrounding coating system, overlapping the sound adjacent coating by between 25 mm and 50 mm.

Preparing galvanized and aluminium surfaces

Remove grease, oil and other solvent-soluble contaminants by wiping with mineral turpentine or white spirit. Finally wipe with a clean solvent. Allow to dry and proceed with the next operation immediately. Abrade surfaces to a medium coarse type finish to provide an adhesion key.

Primed zinc primed surfaces

If present, remove zinc salts from zinc primers. Remove grease, oil and other solvent-soluble contaminants by wiping with mineral turpentine or white spirit. Finally wipe with a clean solvent. Allow to dry and proceed with the next operation immediately.

Shop priming

Dust off and apply a coat of primer, according to the technical specification.

Site coating

General: High pressure fresh water wash down all surfaces. Lightly sand down primer/intermediate coats, which have been shop applied, before site application of next coat.

3.4 MIXING

General

Mixing: Mix coatings thoroughly. Mix package sizes larger than 4 litres using powered agitators driven by air motors.

Multi-component coatings: Combine multi-component coatings as whole pack units. If partial mixing is proposed, submit details.

Thinners: If addition of thinners is proposed, conform to the Coating Manufacturers Technical Data Sheet for the specified product.

Colour consistency: If colour consistency is required, before the addition of the curing agent or converter and before coating application, pre-mix the components of coating products that have been tinted to ensure colour uniformity.

3.5 COATING APPLICATION

General

General: Conform to the Product Data Sheets.

Painting and coating colour: Verify all project finish colours with the retained samples.

Final surface preparation or coating application

Limits: If the following climatic/substrate conditions are present do not apply coating:

- The relative humidity is above 85%.
- The substrate temperature is less than 3C° above the dewpoint.
- The ambient air temperature is below 5°C or above 40°C.
- The substrate temperature is below 10°C or above 45°C.
- The surface to be coated is wet or damp.
- Where the full prime coat application cannot be carried out before the specified cleanliness of the surface deteriorates.
- For external or site applied coatings:
  - The weather is clearly deteriorating or unfavourable for application or curing.
  - High wind conditions.
- The surface preparation standard has not been achieved.
- The time between surface blast cleaning and the commencement of coating exceed 4 hours.
- Visual tarnishing or black spots develop on the surface of the metal.

-

Exception: Preliminary blast or other surface preparations may be performed in conditions that are outside the limits, providing the final surface preparation and all coating applications are undertaken under the limit conditions.

Prior coating: Before the spray application of each coating stripe coat by brush method all edges, welds, seams, rivets bolts and boltholes (including slots). Prime the underlying surfaces of replacement bolting, washers and nuts before installation.

Timing: Conform to the minimum and maximum recoat intervals and curing times.

Detail: Stripe coat all welds, bolt holes, corners and difficult to spray areas by brushing in with the prime coat and intermediate coat material before the full coating application.

Subsequent coats: Ensure that before any subsequent coating layer is applied, the surface condition of the preceding coat is complete and correct in all respects, including its DFT achievement, cleanliness, freedom from defects.

Correction: Correct any defect in a coating layer before the subsequent coating layer is applied.

Compatibility

Where required to ensure the compatibility of the corrosion protection coating with the specified final paint system, allow for the application of a primer/undercoat as recommended by the paint system manufacturer.

Protection

General: Perform all painting under cover and/or protected from rain, condensation, dew, excessive wind, overspray or wind-blown dust.

Period: Continue protection where any of these conditions exist before the coating has cured to a sufficient degree so as to be unaffected.

3.6 COATING REPAIR

Repair of coating damage

Preparation: 'Feather back' by hand or machine sanding all leading edges of intact coating adjacent to the repair, to remove any sharp edge.

Surface contamination: Remove by dusting or blowing down before applying the first coat of paint.

Sequence: Apply the repair coating in the same sequence and manner as the original coating.

Areas damaged without exposing the primer: Wash with a proprietary detergent solution and rinse with fresh water, followed by abrading and ensuring that edges of sound paint are feathered. Then coat the area with the appropriate intermediate and finishing coat materials.

Areas damaged to the primer or steel surface: Blast clean to the original standard. Prepare at least 50 mm into the sound coating and to a further feathering zone of approximately 50 mm. Recoat with the specified system to restore the film thickness and integrity over the whole prepared surface including the feathered zone.

Aesthetic reinstatement: If required, repaint to a physical or discernable boundary line.

Defects: If corrosion pitting or areas of significant metal loss and defects are exposed by the blasting process, advise for inspection and have areas passed "fit for service" before proceeding with the coating system.

Timing: Apply the Protective Coating system within 4 hours of blast cleaning or in any case before visual tarnishing of the steel occurs.

3.7 COMPLETION

General

Joints: On completion, seal all joints and mating surfaces with a compatible polyurethane sealant.

Warranty

General: Provide the approved warranty.

4 PROTECTIVE PAINT COATING SYSTEMS

Polyurethane – AS/NZS 2312 Category A and B table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	Nil	Nil
Internal decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil
External non-decorative conforming to AS/NZS 2312 PUR2	75 µm Epoxy Zinc phosphate conforming to AS/NZS 3750.13	50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil
External decorative conforming to AS/NZS 2312 PUR2	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil

Polyurethane – AS/NZS 2312 Category C, D and E table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	Nil	Nil
Internal decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	75 µm High Solids Polyurethane Conforming to AS/NZS 3750.6	Nil
External non-decorative conforming to AS/NZS 2312 EHB4	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External decorative conforming to AS/NZS 2312 PUR 5	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	75 µm High Solids Polyurethane Conforming to AS/NZS 3750.6

Micaceous Iron Oxide – AS/NZS 2312 Category A and B table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	Nil	Nil
Internal decorative	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	50 µm Alkyd MIO finish Conforming to AS/NZS 3750.12	Nil
External non-decorative conforming to AS/NZS 2312 ALK2	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	Nil	Nil
External decorative conforming to AS/NZS 2312 ALK6	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 type 2	40 µm Alkyd MIO finish Conforming to AS/NZS 3750.12	40 µm Alkyd MIO finish Conforming to AS/NZS 3750.12

Micaceous Iron Oxide – AS/NZS 2312 Category C, D and E table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	Nil	Nil
Internal decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	75 µm Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External non-decorative conforming to AS/NZS 2312 EHB4	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External decorative conforming to AS/NZS 2312 EHB6	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	125 µm Epoxy MIO Conforming to AS/NZS 3750.14	125 µm Epoxy MIO Conforming to AS/NZS 3750.14

Epoxy Acrylic – AS/NZS 2312 Category A and B table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	Nil	Nil
Internal decorative	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil
External non-decorative conforming to AS/NZS 2312 ACC2	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil
External decorative conforming to AS/NZS 2312 ACC2	75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil

Epoxy Acrylic – AS/NZS 2312 Category C, D and E table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	Nil	Nil
Internal decorative	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5	Nil
External non-decorative conforming to AS/NZS 2312 EHB4	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	Nil
External decorative conforming to AS/NZS 2312 ACC6	75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2	200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14	50 µm Epoxy Acrylic Conforming to AS/NZS 3750.5

Steel protection and decoration for green buildings - AS/NZS 2312 Category A and B table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil
Internal decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	40 µm waterborne acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L	Nil
External non-decorative conforming to AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil

External decorative exceeding AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L	Nil

Steel protection and decoration for 'green buildings' – AS/NZS 2312 Category C, D and E table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil
Internal decorative	50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L	Nil
External non-decorative conforming to AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	Nil	Nil
External decorative exceeding AS/NZS 2312 IZS2	75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC < 15 g/L	50 µm waterborne epoxy Conforming to AS/NZS 3750.13 VOC < 20 g/L	40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC < 75 g/L

Industrial silicone enamel – AS/NZS 2312 Category A and B table

Location	Primer	Second Coat	Third Coat
Interior non-decorative	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	Nil	Nil
Internal decorative	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	50 µm Silicone Enamel Conforming to AS/NZS 3750.22	Nil
External non-decorative conforming to AS/NZS 2312 ALK2	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	Nil	Nil
External decorative conforming to AS/NZS 2312 ALK4	75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2	50 µm Silicone Enamel Conforming to AS/NZS 3750.22	Nil

TERMITE MANAGEMENT

1 GENERAL

1.1 AIMS

Responsibilities
Provide termite management materials and systems.

Selections: As documented.

1.2 CROSS REFERENCES

General
General: Conform to the Preliminaries and General requirements.

Related sections : Concrete / Pavements

1.3 STANDARD

General
Termite barriers: To AS 3660.1.

1.4 INSPECTION

Notice
Inspection: Give sufficient notice so that inspection may be made of the completed termite barriers.

1.5 TESTS

Chemical soil barriers – reticulation systems
Type testing: To AS 3660.1 Appendix E.

1.6 SUBMISSIONS

Tests
Submit a Registered testing authority laboratory analysis certificate of chemical soil barrier type testing.

2 PRODUCTS

2.1 NON-CHEMICAL BARRIERS

Concrete slab barrier
Standard: To AS 3660.1 Section 4.

Termite cap and strip shields
Standard: To AS 3660.1 Section 5. (Ant Caps / Kordon dpc)

Woven stainless steel mesh barriers
Standard: To AS 3660.1 Section 6. (Termimesh)

Graded stone particles barriers
Standard: To AS 3660.1 Section 7.

Other -Interception baiting systems stations –Inspection (Exterra)

2.2 CHEMICAL SOIL BARRIERS

General
Standard: To AS 3660.1 Section 8.

-Spray application – Chemical
Approved treatments Altriset / Termidor / Biflex / Premise

Only one system and one warranty shall apply per building site. In the case of additions to buildings this includes the treatment of the joint between the addition and the existing building.

2.3 NON-SOIL MATRIX BARRIERS

Concrete slab barrier
Description: Composite membrane incorporating a termiticide (Kordon).

Brickwork
Description: Bedding mortar incorporating a termiticide.

Application: Brick bed and perpends as follows:

- Cavity walls built off a concrete slab on ground.
- Buildings with typical raft infill (footing) or formed void slab construction.
- Permanent barrier in sub-floor brickwork and brick piers.

Assessment criteria
Standard: To AS 3660.3.

3 EXECUTION

3.1 NON-CHEMICAL BARRIERS

Concrete slab barrier
Standard: To AS 3660.1 Section 4.

Termite cap and strip shields
Standard: To AS 3660.1 Section 5.

Woven stainless steel mesh barriers
Standard: To AS 3660.1 Section 6.

Graded stone particles barriers
Standard: To AS 3660.1 Section 7.

3.2 CHEMICAL SOIL BARRIERS

General
Standard: To AS 3660.1 Section 8.

3.3 COMPLETION

Termite barrier notice
Provide a durable notice permanently fixed in a prominent location to BCA B1.4 (i) (ii) or clause 3.1.3.2(b) and AS 3660.1

Waste materials
Progressively cleaning: Ensure that no waste materials which could attract termites remain on the site.

Warranty
Terms: *Minimum 10 years on materials and installation*

Completion inspection
At the end of the defects liability period, inspect the termite control systems and submit a report on their efficacy and status.

4.0 TERMITE MANAGEMENT

4.1 CONCRETE SLABS ON GROUND

Option 1

Provide a termite management system to comply with the requirements of AS3660.1 - 2000. The system must be accredited with a Certificate of Conformity to the Building Code of Australia and must abide by the conditions and limitations stated thereon. Engineer the slab through the use of adequate detailing and sufficient reinforcement to ensure that it acts as a barrier by limiting the crack widths. Construct the slab using good compaction and curing techniques to limit shrinkage crack widths. Ensure that where slab edge exposure is used as part of the termite barrier the exposed face of the slab has (min 75mm) a Class"2" off-form finish in accordance with AS3610 - 1995.

Option 2

Apply an approved chemical treatment to comply with the requirements of AS3660.1-2000 and the manufacturer's recommendations to underside of slab. Include maintenance and re-treatment as required to provide a 8 year warranty

Option 3

Doors and thresholds (where exposed slab edge is breached) provide a termite management system using stainless steel mesh barrier to comply with the requirements of AS3660.1-2000 and the conditions stated on the certificate of National Accreditation.

3.2 SUSPENDED REINFORCED CONCRETE GROUND FLOOR SLABS

Option 1

Provide a termite management system using stainless steel mesh or graded stone barrier to comply with the requirements of AS3660.1-2000 and the conditions stated on the certificate of National Accreditation. Engineer the slab through the use of adequate detailing and sufficient reinforcement to ensure that it acts as a barrier by limiting the crack widths.

Option 2

Install a reticulated perimeter and penetrations re-treatment system having a certificate of compliance with the Building Code of Australia. The materials and workmanship shall comply with the provisions of AS3660.1-1995 and to the conditions on the certificate of compliance. Engineer the slab through the use of adequate detailing and sufficient reinforcement to ensure that it acts as a barrier by limiting the crack widths. Include maintenance and re-treatment as required to provide a 10 year warranty.

Option 3

Apply and approved chemical treatment to comply with the requirements of AS3660.1-2000 and the manufacturer's recommendations. Include maintenance and re-treatment as required to provide a 10 year warranty.

3.3 SUSPENDED TIMBER FLOORS

Apply an approved chemical treatment to comply with the requirements of AS3660.1-2000 and the manufacturer's recommendations.

Provide ventilation to the underfloor space in accordance with the Building Code of Australia. Provide inspection space, clearance distance and drainage to the underfloor space in accordance with AS3660.1 – 2000. Ensure all parts of the underfloor are accessible. Ensure all demolition debri is removed from underfloor areas.
Ant caps : Maintain existing or provide continuous galvanised metal ant caps to provide physical separation between ground and timber components. Maintain 400 clearance between timber floors and sub floor ground level.

3.4 GENERAL

Ensure that details at the external walls comply with the requirements of the standard, AS3660.1 - 2000. For all projects, a durable notice shall be fixed to the building and certificate of installation provided in accordance with Appendix A of AS3660.1-2000.

3.5 WARRANTY

The construction contractor's warranty shall extend for a minimum period of 10 years for both the materials and the installation.

3.6 MAINTENANCE

Carry out periodic inspections for all systems as required for termite management and/or specified within the warranty to ensure the warranty is retained. Supply copies of all inspection reports.

DETAILED INSTRUCTIONS

1.01 TERMITE TREATMENT

(A) Extent
Buildings containing timber framing - No works

Generally
Provide protection systems as previously specified to suit construction requirements

Services / Penetrations
Provide stainless steel termite protection as previously specified

New Footings
Provide exposed perimeter concrete footing allowing inspection (75mm min above ground level all around).
Where not able to be exposed or breeched (door thresholds etc) provide physical termite barrier protection (Termimesh or equal approved).

Records
Provide log book for maintenance with 12months maintenance and inspections where applicable

DEMOLITION

1 GENERAL

1.1 CROSS REFERENCES

General
Refer Preliminaries / General Requirements / Special Conditions Of Contract

Associated worksections
Refer Masonry / Steelwork / Concrete / Suspended Ceilings / Appendix J / other sections

1.2 STANDARD

General
Demolition: To AS 2601.

1.3 INTERPRETATION

Definitions
For the purposes of this worksection, the following definition applies:

- Demolition: The complete or partial dismantling of a building or structure, by pre-planned and controlled methods or procedures.
- Dilapidation record: The photographic or video and written record made before commencement of demolition work of the condition of the portion of the existing building being retained, adjacent buildings, and other relevant structures or facilities.
- Dismantle: The reduction of an item to its components in a manner to allow re-assembly.
- Recover: The disconnection and removal of an item in a manner to allow re-installation.

1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:

- Adjacent structures before commencement of demolition.
- Services before disconnection or diversion.
- Trees as documented to be retained, before commencement of demolition.
- Contents of building before commencement of demolition.
- Structure after stripping and removal of roof coverings and external cladding.
- Underground structures after demolition above them.
- Excavations remaining after removal of underground work.
- Site after removal of demolished materials.
- Services after reconnection or diversion.

1.5 SUBMISSIONS

Authorities
Evidence of compliance: Before commencing demolition, submit evidence of the following:

- Requirements of authorities relating to the work under the contract have been ascertained.
- A permit to demolish has been obtained from the appropriate authority.
- A scaffold permit has been obtained from the appropriate authority (if scaffolding is proposed to be used).
- Precautions necessary for protection of persons and property have been taken and suitable protective and safety devices have been provided to the approval of the relevant authority.
- Treatment for rodent infestation has been carried out and a certificate has been obtained from the appropriate authority.
- Fees and other costs have been paid.

-

Investigation and work plan

Work plans: Submit **Construction Plans, Site Safety Plans** prior to commencement of any work on site . Include the following information:

- The method of protection and support for adjacent property.
- Locations and details of necessary service deviations and terminations.
- If removal of asbestos or of material containing asbestos is required, the information specified in NOHSC 2002 Code of Practice for the Safe Removal of Asbestos. Include information to be supplied to the removalist in clause 7.2.4 and information to be supplied by the removalist in clause 7.3.
- Confirmation of the sequence of work and the scope of other work required for the carrying out of demolition .
- Requirements of AS 2601 Section 2 Planning and execution.

Records

Dilapidation record: Contractor shall carry out dilapidation report and video record in the area of works in the presence of the Architect. Damage to surfaces not recorded as being existing shall be made good at Builders cost.

Submit a copy of the dilapidation record for inspection. Submit to each owner of each adjacent property a copy of the part of the record relating to that property, and obtain their written agreement to the contents of the record, prior to commencement of demolition.

Stockpiles

Location: Submit the locations for on-site stockpiles to be used for demolished materials for recycling in the works. Coordinate with the locations of storage for other waste streams and prevent mixing or pollution.

Recycling

Delivery location: Submit the name and address of the proposed recycling facility.

Certification: Provide evidence of delivery to the nominated recycling facility.

2 PRODUCTS

2.1 DEMOLISHED MATERIALS

Demolished materials classes

Ownership and implementation: Comply with the **Demolished materials classes table.**

Demolished materials classes table

Class	Requirement	Ownership
Recovered items for re-use in the works	Recover without damage items identified in the **Recovered items for re-use in the works schedule**	Principal/proprietor
Recovered items for delivery to the principal	Recover without damage items identified in the **Recovered items for delivery to the principal schedule**	Principal/proprietor
Demolished material for recycling in the works	Stockpile material identified in the **Demolished material for recycling in the works schedule**	Contractor
Demolished material for recycling off site	Demolish and deliver for recycling material identified in the **Demolished material for recycling off-site schedule**	Contractor
Deconstruction for relocation as part of the works	Dismantle without damage and store items identified in the **Deconstruction for relocation schedule**	Principal/proprietor
Demolished for removal	Remove from the site demolished materials identified in the **Demolish for removal schedule**. Do not burn or bury on site Transit: Prevent spillage of demolishing materials in transit	Contractor

3 EXECUTION

3.1 SUPPORT

Temporary support

General: If temporary support is required, certification for its design and installation is required from a professional engineer engaged by the contractor.

Existing buildings: Until permanent support is provided, provide temporary support for sections of existing buildings which are to be altered and which normally rely for support on work to be demolished.

Ground support: Support excavations for demolition of underground structures.

Adjacent structures: Provide supports to adjacent structures where necessary, sufficient to prevent damage resulting from the works.

- Lateral supports: Provide lateral support equal to that given by the structure to be demolished.
- Vertical supports: Provide vertical support equal to that given by the structure to be demolished.

Permanent supports

General: If permanent supports for adjacent structures are necessary and are not documented, give notice and obtain instructions.

3.2 PROTECTION

Weather protection

If walls or roofs are opened for alterations and additions or the surfaces of adjoining buildings are exposed, provide temporary covers to prevent water penetration. Provide covers to protect existing plant and equipment and materials intended for re-use.

Dust protection

Provide dust-proof screens, bulkheads and covers to protect existing finishes and the immediate environment from dust and debris.

Security

If a wall or roof is opened for alterations and additions, provide security against unauthorised entry to the building.

Maintenance

During the course of the building works it shall be the Contractors responsibility to maintain all protective screens, coverings, hoardings, fences etc as required to the satisfaction of the Architect.

Internal Barriers

Rigid timber framed / fortecon lined temporary partition. Tape and seal all temporary screen between the areas of new works and other parts of the existing building to contain dust and dirt within area of work. Close off and tape closed all air ducts / ventilation shafts / doors etc to prevent dust transfer / egress of dust. Maintain dust barrier

Floor Finishes

Allow to protect all existing floor finishes in area of work. Provide heavy duty self adhesive plastic covering over all floors in area of work / acess. Where impact protection is required provide trafficable boards laid over the plastic taped into position.

External Barriers / Hoardings

Generally : Provide proprietory hoarding comprising cyclone fence 2100 high supported on 60 galv tube framing set into weighted polypropylene bases. Do not penetrate pavement surfaces unless approved. Reinstate / make good pavement surfaces as required on completion. Screens shall be of good condition. Provide hessian or equal lining where required.

Public footpaths : Provide post and rail system set into weighted polypropylene bases and braced behind. Clad with selected colourbond sheet with capping piece.

Removal/Staging/Access

Contractor shall modify set-out and location of hoarding/protective screens to suit staging of works as applicable.

Contractor shall maintain access to and from building entrances as indicated on the drawings.

Temporary access

General: Provide a substantial temporary doorset fitted with a rim deadlock, and remove on completion of demolition.

Exposed surfaces

General: Where necessary protect and weatherproof the surfaces of adjacent structures exposed by demolition.

Fixed items

Individual protection: Protect items remaining in existing positions. Wrap / tape and seal (dustproof)

Recovered items

General: Recover all components associated with the listed items that are essential for their reuse. Protect from damage during removal.

3.3 DEMOLITION

Dilapidation record

Purpose: Use the dilapidation record to assess the damage and making good arising out of demolition work.

Availability: Keep the records of the investigations on site and available for inspection until practical completion of the contract.

Encroachment

General: If encroachments from adjacent structures are encountered and are not documented, give notice and obtain instructions.

Sequence

To suit staging requirements

Concrete slabs

General: Using a diamond saw, neatly cut back or trim to new alignment with a clean true face existing concrete slabs to be partially demolished or penetrated.

Recycling: If concrete crushing is proposed on site, submit details of plant and environmental controls.

Refrigeration systems

General: Undertake demolition work on refrigeration systems in conformance with:

- AS/NZS 1677.2.
- The recommendations of SAA HB 40.1 and SAA HB 40.2.

Material below grade

Extent: Demolish the following:

Remaining voids: Stabilise and provide barriers.

Explosives

General: Do not use explosives.

3.4 HAZARDOUS MATERIALS

General

General: Hazardous materials that have already been identified are set out in the **Identified hazardous materials schedule**.

Identified hazardous materials schedule

Item	Refer	Comments
Asbestos	Refer Asbestos Register – Appendix F	Inspect / Remove as noted

Hazardous materials

General: Give notice immediately hazardous materials or conditions are found, including the following:

- Asbestos or material containing asbestos.
- Flammable or explosive liquids or gases.
- Toxic, infective or contaminated materials.
- Radiation or radioactive materials.
- Noxious or explosive chemicals.
- Tanks or other containers which have been used for storage of explosive, toxic, infective or contaminated substances.

Asbestos removal requirements

In all cases asbestos removal shall occur only with the full knowledge and consent of the Superintendent and relevant authorities as specified. The DPTI Asbestos Management Unit is to be notified of the asbestos removal prior to commencement. The unit will advise on any special application of the Code of Practice and risk assessments.

Licensing Requirement

Asbestos material shall be removed by an approved company / persons holding a current 'Unlimited Asbestos Removal Licence' as issued by the Director, of the Premier and Cabinet, Workplace Services under the OHS and Welfare Regulations, 1995 *and shall be a DPTI pre-qualified asbestos removal trade contractor*.

Program Of Works

The Contractor shall provide a detailed program for the carrying out of the asbestos removal works. The programme shall indicate the undertaking of the asbestos removal works identifying removal and reinstatement.

The program shall utilise after hours, weekends, term breaks etc to ensure the OHS safety of all occupants. The program shall indicate that all asbestos removal work is to be carried out outside of school hours as previously specified with the preceding reinstatement works immediately following also after hours unless agreed otherwise. Work shall be carried out to the extent that facilities are available during normal School hours (unless agreed otherwise).

The Contractor shall carry out a detailed inspect of the site prior to commencement of works to identify all risks which may delay completion and handover of the facilities to the school.

Provide 48 hours (min) notice prior to disconnection of any electrical supply services or other.

Builder shall submit a staging program identifying service disconnection periods and duration prior to commencement of work on site for approval. (as applicable)

The program shall be continually updated and reviewed with the School and Architect during the course of the works as directed. The program shall be signposted on the School notice board to ensure all persons (staff, parents etc) are aware of the pending works.

Work Procedure / Commencement

Asbestos removal shall be performed in accordance with the SA Occupational Health Safety and Welfare Act and Regulations (1995, Division 4.2 – Asbestos work) and the Code of Practice for the Safe Removal of Asbestos' / AS 2601 / and the 'Federal Worksafe Australia Code of Practice and the approval of the 'Department of Labour, Minerals/Fibres Branch'.

A minimum of 7 days (unless otherwise agreed) shall be provided to the occupants of the premises or buildings prior to occupation of the site. This is to enable the occupants to take what action they consider necessary during the removal works to ensure their safety.

Prior to occupation of the site / or any asbestos removal work commencing the contractor shall submit a copy of the 'Approval To Remove Asbestos' notice from Workplace Services together with a copy of the submitted work-plan statement setting out the procedures to be followed for the various types of asbestos materials to be removed and a copy of the approved atmospheric monitoring program

A copy of the above documents (for each stage) shall be issued as follows :

- posted on site in a prominent place (administration notice board or folder at front desk)
- direct to the building occupant (Proprietor)
- forwarded to the Architects office and

the Asbestos Management Unit (DPTI) at the completion of each monitoring session.

The works have to be completed with adequate time for any residual air monitoring and testing of samples and any residual clean up subject to the results received.

Should any unrecorded asbestos be discovered during the course of the works or inadvertently exposed as a result of the works the Contractor is required to immediately contact the Superintendent for instructions.

The Asbestos removal work shall not commence or the site occupied until all required documentation has been received and approved by DPTI

Hoarding / Projection
Provide all necessary hoardings / projective seal screens, decontamination areas etc. as required for the removal from site of asbestos related items. Seal off all air ducts to prevent contamination / isolate systems as required.

Air dust monitoring
The atmospheric monitoring shall be undertaken by a company independent of the asbestos removalist company, accredited by NATA or approved by the Director Workplace Services.

Allow for all atmospheric monitoring in compliance with the Occupational Health Safety and Welfare Regulation 4.2.9 (Asbestos) and as required by the scope of works. A copy of the atmospheric monitoring program approved by the Director Workplace Services shall be submitted prior to commencement of works.

Atmospheric monitoring program shall include for monitors to be placed within the occupied spaces immediately below the asbestos removal work. Tests results shall continue to be taken until the areas recorded are deemed 'clean' / 'safe' by the supervising authority. Costs of all tests and additional cleaning shall be borne by the Contractor.

A 'clearance certificate' shall be issued in conjunction with the final test results. (Refer Appendix I section)

Certification
Generally provide documents **certifying** the safe disposal / storage / location of materials by an approved / qualified / authorized contractor progressively through the course of the works.
(includes Asbestos / Zelemite / PCB capacitors as applicable to this project.)

Within 24 hours of completion of the Asbestos removal works and **prior to occupation** of the site the Contractor shall issue the following documents :

- A copy of the final atmospheric monitoring results with summary statement on readings
- A written statement identifying areas of contamination which required remedial cleaning (where applicable) and corrective action required for protection / undertaking of cleaning.
- A 'clearance certificate' from a company independent of the asbestos removalist company accredited by NATA or approved by the Director Workplace Services based on all available information stating that the area of Asbestos removal has been cleaned and tested and the building deemed safe for occupation. (Refer also Appendix I - DPTI standard form)

A copy of the above documents (for each stage) shall be issued as follows :

- posted on site in a prominent place (administration notice board or folder at front desk)
- direct to the building occupant (Principal office)
- forwarded to the Superintendants office and -
- the Asbestos Management Unit (DPTI) at the completion of each monitoring session.

The works shall **not be re-occupied until all required documentation has been received** by the Superintendent / DPTI and an Asbestos Clearance Certificate has been received.

Within 7 days (unless otherwise agreed) of completion of the Asbestos removal works the Contractor shall issue the following to the Superintendants :

- Copies of 'Waste Transport Certificate' Part A-C incl as forwarded to the Environmental Protection Authority.
- Written statement of "Action taken" on asbestos and other related materials identified on site / or contained within Asbestos Log Books
- Issue of update Log books or provision of amended pages to the Proprietor / DPTI / Proprietor
- Identified any remaining Asbestos materials and have fixed caution labels adjacent indicating hazard (visible to view)

3.5 COMPLETION

Notice of completion
General: Give at least 7 working days' notice of completion of demolition so that adjacent structures may be inspected following completion of demolition.

Making good: Make good any damage arising out of demolition work. Obtain written acceptance from the owner of each adjoining property of completeness and standard of making good.

DETAILED INSTRUCTIONS

1.01 STAGING / WORK PLANS

Generally

Refer Hoarding / Protection clauses (Preliminaries) for carrying out of works. The Contractor in conjunction with the Electrical / Mechanical / Hydraulic contractor is required to provide a work plan for the carrying out of the Demolition and other works.

Modify / relocate protective barriers (and signage) to suit work plan – Refer Preliminaries section

Site Inspection

The work plan shall involve an inspection of the mechanical / electrical and hydraulic services to determine the effect of service disconnections on other parts of the site and making provision for maintaining service connections to other 'staging areas'.

The inspection shall include site survey identifying / recording / marking of existing electrical /mechanical / hydraulic systems to remain including the following :

- Sewer services / Water services
- Electrical services
- Specialist cabling and service connections (Data, communications etc)
- Irrigation conduits / pipework / sprinkler heads
- Stormwater including pits

The inspection shall also involve the recording and identifying of existing fitout works including the following :

- Specialist cabling and service connections
- Data cabling to Security and alarm systems
- Data / coaxial cabling to TVs including aerial MATV systems
- Cabling to sound and audio systems including interface with other systems
- Cabling to voice (telephone) outlets
- Active equipment associated with voice (telephone) PABX systems / MDF / IDF

Site Access

General access to site shall be via the designated contractors entry. Heavy vehicle or long vehicle deliveries shall be co-ordinate on site with Council approval.

Refer Preliminaries specification for carrying out of Dilapidation Report to all existing areas providing access.

Recycling

Comply with Councils Planning requirements : Provide waste management plan implementing practices covering : Resource recovery during Demolition / Waste minimisation and resource recovery during construction and administration.

Keep records against work plan.

Site Management

Provide a **Site Construction Management Plan** and **Site Safety Plan** prior to construction work beginning on site.

The Building Site Management Plan should include details of such items as: Work in the Public Realm / Occupation / Hoarding / Site Amenities / Traffic Requirements / Servicing Site / Adjoining Buildings / Reinstatement of Infrastructure / Recycling.

Protection Requirements (Trees) : Identify existing trees on site and signpost ensuring no materials are stored within the area of the tree canopy. Where trees are located within Builders Area protect trees with protective hoarding and signage. Where branches overhang the work site provide safety signage noting hazard over.

Restrictions

Fencing / hoarding barriers adjacent existing Residential areas / Retail premises. Maintain during the course of the works to the satisfaction of Council and as directed on site. Obtain Council approval and pay all fees for occupation of public spaces (footpaths etc)

Staging

Stage 01	Ground floor sub-structure (concrete / services in ground)
Stage 02	All works above ground Tower 01

Staging Notes / Concurrent Works

Nil	

1.02 LOOSE FURNITURE / FITOUT ITEMS

Refer Preliminaries for Works by Proprietor / Separate Contracts / Appendix C (Fit-out works)

Co-ordinate with the proprietor for the disconnection and removal and storage of the following items by the Proprietor.

Work shall be carried out to suit Staging above.

Nil

1.03 SALVAGE ITEMS

Extent

Refer other trade sections for extent.

Remove the following items from the area of work and provide container on site for storage in designated area on site raedy for reuse. Protect all items from dust, damage etc. plastic wrap (as applicable)

Remove / maintain / refurbish / reinstate as applicable to suit works program / staged works. Co-ordinate with Proprietor.

Nil

1.04 BARRIERS / HOARDING / PROTECTION

Extent

Provide hoardings to each staged area of work as required for the containment of dust, noise and security of works.

Type

Where external doors are to be modified and external trenching is to be carried out allow for the erection of protective hoardings in area of the work and for maintaining the security of the premises after hours.

(refer External / Internal Barriers and Hoarding clauses as previously specified)

Where works are to be carried out internally allow to seal off (air tight) the area of work for the containment of dust, noise and security of works. (refer Internal Barriers clauses as previously specified)

Seal off all air conditioning duct outlets (registers etc) to prevent egress of dust.

Contractors shall use designated doors only as agreed with the School for access to and from the Buildings during the course of the works.

Modify / relocate protective barriers (and signage) to suit staging works – Refer Preliminaries section for Staging

1.05 EXTG SERVICES / NEW SERVICES ACCESS

Extent

Refer Hydraulic drawings

Demolition

Carryout demolition works as shown on the drawings and as required for new works. Liaise with other trades for the isolation / disconnection of services in area of demolition

Remove all existing redundant Mechanical / Electrical / Plumbing fixtures / fittings service pipes, conduits, etc as identified by other trades and as specified. Refer Mechanical / Electrical / Plumbing contractors for disconnection of services and extent.

Existing Services

Carryout works in accordance with the Staging Plan and maintain services to other parts of the school during the course of the works.

Liaise with services contractors for termination / isolation of services prior to demolition

Identify on site and protect all extg service cables including Data Communications / Telephone equipment and cabling / Security equipment and cabling / Plumbing services (water, sewer, gas) and other required essential services.

(Protect essential equipment from damage / dust) (Tag / mark clearly on site)

Disconnections

Provide 48 hours (min) notice prior to disconnection of any electrical supply service. Builder shall submit a staging program identifying service disconnection periods and duration prior to commencement of work on site for approval.

Temporary

Provide temporary connections for electrical / water / sewer etc in area of work until final connections are provided or reinstated. Make good on completion.

Reinstatement

Reinstate Mechanical / Electrical services , fittings, conduits etc where noted on completion of new works. Form neat penetrations in linings for new / extg services complete with escutcheon plates where required.

Coring

Provide core holes to slab for new services. Refer Concrete section / Hydraulic services specification

Excavation

During the excavation works allow to carefully carry out the excavation of trenches with necessary hand digging near known underground services to prevent damage to services. All trenching work shall be carried out using a 'spotter' person.
Provide imported compacted fill to all service trenching and compact to suit final pavement finish.

Ceilings

Provide ceiling access to underfloor slab areas for installation of new hydraulic and electrical services. Sawcut existing ceilings neatly and square for access. Provide support to existing ceiling joists and ceiling framing.

Refer Ceiling plan for extent of ceilings to be removed and reinstatement of same upon completion.

1.06 DEMOLITION

Existing finishes

Protect existing timber floor and plaster wall finishes in the area of new works where remaining. Any damage to extg surfaces shall be made good at no additional cost to the contract. (Refer dilapidation report)

Generally

Refer drawings for extent of demolition works. Remove all materials and finishes as required for carrying out of new works. Remove all redundant and abandoned fitout items including plant / equipment / services including Cool Rooms / refrigeration etc unless noted to be removed by Proprietor or salvaged.

Buildings

Where buildings are noted to be demolished they shall be removed in their entirety including footings. All debri shall be removed from the site and reinstated top soils (natural ground) shall be free of demolition debri (bricks , concrete etc)

Services

Co-ordinate works with other trades for the relocation / isolation / termination / removal of existing services. Provide temporary services where required for carrying out of demolition works (as required)

MASONRY

1 GENERAL

1.1 RESPONSIBILITIES

General
General: Provide brick and block construction as documented.

1.2 CROSS REFERENCES

General
Requirement: Conform to Preliminaries / General Requirements
Related Sections : **Appendix K (brick / blockwork)**

1.3 STANDARD

General
Materials and construction: To AS 3700 / AS1640.

1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions in AS 3700 clause 1.5.2 and those given below apply:

- Brick: A masonry unit that does not exceed 338 mm long x 225 mm wide x 113 mm high, of a size that allows it to be picked up with one hand while the other is used to apply mortar with a trowel.
- Block: A masonry unit exceeding the size of a brick in any dimension, for use in the construction of walls or partitions.
- Brickwork and blockwork types:
  - Common or ordinary: Brickwork and blockwork which is not tested for specified strength values, is not especially treated for texture and colour and can include reject face units.
  - Face units: Bricks or blocks used in facework, including purpose-made units such as squints, sills and thresholds.
- Facework: Brickwork or blockwork in which the form, or form and colour, of the face units and joints is visible in the completed works.

1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:

- Set out.
- Unit type, colour and texture.
- Bottoms of cavities, after cleaning out.
- Bottoms of core holes, before grouting.
- Reinforcement type and diameter.
- Positioning of reinforcing before grouting.
- Control joints, ready for insertion of joint filler.
- Damp-proof courses, in position.
- Flashings, in position.
- Lintels, in position.
- Structural steelwork, including bolts and shelf angles, in position.

1.6 TESTS

Durability

Mortar: Mortar durability tests are required.

Conformance: Test to verify conformance as follows:

- Standard: To AS 3700 Appendix FA.
- Acceptance criteria:
  - Class M2: 0.5 mm.
  - Class M3: 0.3 mm.
  - Class M4: 0.1 mm.

Special masonry

Conformance: Test to verify conformance with the **Brick and block performance schedule** and as follows:

- Compressive strength: To AS 3700 Appendix C.
- Flexural strength: To AS 3700 Appendix D.

1.7 SUBMISSIONS

Brick or block unit samples

Face units: Submit face units of each type illustrating the range of variation available, including colour, texture, surface irregularities, defective arrises, and shape.

- Number of each type: 6.

Facework sample panels

Facer Brickwork: Provide, in a suitable position, a sample panel of each type of facework including pigmented face or pointing mortar.

- Minimum size (face of panel): 1200 mm high x 1190 mm or closest unit module long.

Sand samples

Type: Submit a 2 kg sample of each type of sand required to be of a particular colour, grade or source.

1.8 TOLERANCES

Masonry construction

Conformance: Conform to AS 3700 Table 11.1.

2 PRODUCTS

2.1 MATERIALS

Bricks and blocks

Standard: To AS/NZS 4455.1 and AS/NZS 4455.3.

Salt attack resistance grade: To AS 3700 Table 5.1.

- Bricks and blocks: Below damp-proof course, and in external leaves in the corrosivity categories D and F, provide Exposure grade to AS/NZS 4455.1 Table 2.3 or A AS/NZS 4455.3 Table 2.4, as appropriate.

Minimum age of clay bricks: 7 days.

Mortar materials

Durability classification.

- Above the damp-proof-course: Conform to the **Corrosion resistance and durability table**.
- Below the damp-proof-course: M4 mortar conforming to the **Mortar mix table**.

Admixtures: To AS 3700 clause 10.4.2.4.

Lime: To AS 1672.1.

- Portland cement: To AS 3972. Type: GP.
- Masonry cement: To AS 1316.
-

Proportions: Conform to the **Mortar mix table**.

Sand: Fine aggregate with a low clay content and free from efflorescing salts, selected for colour and grading.

Water: Clean and free from any deleterious matter.

White cement: With 1% iron salts content.

Pigment: To BS EN 12878, and as follows:

- Quantity: Less than 10% of the mass of cement in the mix.

For light colours: Use off-white cement in the mix.

Mortar mix table

Mortar class to AS 3700	**Cement, lime, sand ratios (by volume)**			**Water thickener**
	Clay	**Concrete**	**Calcium silicate**	
Masonry cement				
M3	1:0:4	1:0:4	n/a	No
M4	1:0:3	n/a	n/a	No
Portland cement				
M2	1:2:9	n/a	n/a	No
M3	1:1:6	1:1:6	n/a	Optional
1:0:5	1:0:5	1:0:5	Yes	
M4	1:0.5:4.5	1:0.5:4.5	n/a	Optional
1:0:4	1:0:4	1:0:4	Yes	

2.2 COMPONENTS

Steel lintels

Angles and flats: To AS/NZS 3679.1 .

Cold formed proprietary lintels: Designed to AS/NZS 4600 .

Durability Classification to AS/NZS 2699.3:

Corrosion resistance: Conform to the **Corrosion resistance and durability** To AS/NZS 2699.3.

Galvanizing: Do not cut after galvanizing.

Wall ties

Standard: To AS/NZS 2699.1 .

Type: Type A. including those for seismic conditions

Durability Classification to AS/NZS 2699.1

Corrosive resistance and durability: All wall ties shall be stainless steel.

Strength classification:

Ties shall be a minimum of medium duty.

Cavities > 60 mm and < 200 mm wide: Heavy duty.

Cavities > 200 mm wide: See AS 3700 clauses 4.10 and 10.5 for design principles

Connectors and accessories

Standard: To AS/NZS 2699.2.

Durability Classification to AS/NZS 2699.2:

Corrosive resistance and durability: Galv

Flexible masonry ties: If accommodation of movement is required at control joints and where masonry abuts structural elements such as column faces and slab soffits, provide details.

Corrosion resistance and durability

- Galvanizing: To AS/NZS 4680 .
- Built-in products: Below damp proof course, provide stainless steel 316 or engineered polymer.

Corrosion resistance and durability table – Atmospheric corrosivity category – A and B to AS/NZS 2312

Situation	Steel lintels (each surface)	Minimum mortar classification above damp proof course
Internal	Galvanize after fabrication 600 g/m^2	M2
External (including cavity air space)	Galvanize after fabrication 300 g/m^2	M2

Corrosion resistance and durability table – Atmospheric corrosivity category – C to AS/NZS 2312

Situation	Steel lintels (each surface)	Minimum mortar classification above damp proof course
Internal	Galvanize after fabrication 300 g/m^2	M2
External (including cavity air space)	Galvanize after fabrication 600 g/m^2	M3

Corrosion resistance and durability table – Atmospheric corrosivity category – D and F to AS/NZS 2312

Situation	Steel lintels (each surface)	Minimum mortar classification above damp proof course
Internal	Galvanize after fabrication 600 g/m^2	M2
External (including cavity air space)	Stainless 316 Galvanize after fabrication 600 g/m^{2}plus organic coating [1]	M4

Flashings and damp-proof courses

Standard: To AS/NZS 2904.

Proprietory black embossed polyethylene .5mm thick prior to embossing.

3 EXECUTION

3.1 GENERAL

Mortar mixing

General: Measure volumes accurately to achieve the documented proportions. Machine mix for at least six minutes.

Protection from contamination

General: Protect masonry materials and components from ground moisture and contamination.

Bond

Type: Stretcher bond.

Building in

Embedded items: Build in wall ties and accessories as the construction proceeds. If it is not practicable to obtain the required embedment wholly in the mortar joint in hollow unit brickwork or blockwork, fill appropriate cores with grout or mortar.

Steel door frames: Fill the backs of jambs and heads solid with mortar as the work proceeds.

Clearance for timber frame shrinkage

General: In timber frame brick veneer construction, leave clearances between window frames and brick sill and between roof frames and the brick veneer as follows:

- Additional clearance: To accommodate additional shrinkage of unseasoned floor timbers.
- Single storey frames and ground floor windows (not for slab on ground): 10 mm.
- Two storey frames and upper floor windows: 20 mm.

Construction at different rates or times

Monolithic structural action: If two or more adjoining sections of masonry, including intersecting walls, are constructed at different rates or times, rake back or tie the intersections between those sections so that monolithic structural action is obtained in the completed work.

Joining to existing

General: Provide a control joint where joining to existing structures. Do not tooth new masonry into existing work except where filling in existing openings (windows doors etc).

Mortar joints

Solid and cored units: Lay on a full bed of mortar. Fill perpends solid. Cut mortar flush.

Face-shell bedded hollow units: Fill perpends solid. Cut mortar flush.

Finish: Conform to the following:

- Externally: Tool to give a dense water-shedding finish.
- Internally: If wall is to be plastered, do not rake more than 10 mm to give a key.
- Thickness: 10 mm.

Cutting: Set out masonry with joints of uniform width and the minimum of cutting of masonry units.

Monolithic structural action

General: Provide brick or block header units, except in stretcher bond facework, to AS 3700 clause 4.11.2.

Spacing: 600 mm maximum.

Location: Conform to the following:

- At engaged piers.
- At engagement of diaphragms with the leaves in diaphragm walls.
- At intersections of flanges with shear walls.
- At intersections with supporting walls and buttresses.
- Between leaves in solid masonry construction.

Rate of construction

General: Regulate the rate of construction to eliminate joint deformation, slumping or instability.

Rods

Set out: Construct masonry to the following rods:

- 75 mm high units: 7 courses to 600 mm.
- 90 mm high units: 6 courses to 600 mm.
- 190 mm high units: 3 courses to 600 mm.

Protection

General: Keep the top surface of brickwork and blockwork covered to prevent the entry of rainwater and contaminants.

Temporary support

General: If the final stability of the brickwork or blockwork is dependent on (structural) elements to be constructed after the brickwork or blockwork, provide proposals for temporary support or bracing.

3.2 FACEWORK

Cleaning

General: Clean progressively as the work proceeds to remove mortar smears, stains and discolouration. Do not use an acid solution. Do not erode joints if using pressure spraying.

Colour mixing

Distribution: In facework, distribute the colour range of units evenly to prevent colour concentrations and banding.

Commencement

General: Commence at least 1 full course for blockwork, or 2 full courses for brickwork, below adjacent finished surface level.

Double face walls

Selection: Select face units for uniform width and double-face qualities.

Preferred face: Before starting, obtain a ruling as to which is the preferred wall face, and favour that face should a compromise be unavoidable.

Perpends

General: If it is proposed to use other than vertically aligned perpends in alternate courses, provide details.

Sills and thresholds

General: Solidly bed sills and thresholds and lay them so that the top surfaces drain away from the building.

Set out: Set out so that no unit is cut smaller than three quarters full width.

3.3 SUBFLOOR WORK

Access openings

General: In internal walls, leave door width openings beneath doorways to give access to underfloor areas.

Air vent locations

General: Provide air vents to give adequate cross ventilation to the space under ground floors.

Cavity walls: Provide matching vents in the internal leaves located as near as practicable to the vents in the external leaves.

Location: Below damp-proof course to internal and external walls.

Air vent types

Blockwork: Select from the following:

- Concrete framed: Bronze wire mesh in concrete frame 390 x 190 mm.
- Vent blocks: Purpose-made vent blocks.

Brickwork: Select from the following:

- Concrete framed: Bronze wire mesh in concrete frames, 470 x 160 mm.
- Cut brick: 2 cut bricks laid vertically and evenly spaced in a 230 mm wide x 2 course high opening, backed with bronze wire mesh built in.
- Terra cotta: Perforated, 230 x 160 mm.

Underpinning

Requirement: Install underpinning while maintaining the building undamaged.

Grouting: Pack dry mix M4 mortar between underpinning and existing structure at the completion of each panel of underpinning.

3.4 CAVITY WORK

Cavity clearance

General: Keep cavities clear at all times.

Cavity fill

General: Fill the cavity with mortar to 1 course above adjacent finished (ground) level. Fall the top surface towards the outer leaf.

Cavity width

General: Provide minimum cavity widths in conformance with the following:

- Masonry walls: 50 mm.
- Masonry veneer walls: 40 mm between the masonry leaf and the load bearing frame and 25 mm minimum between the masonry leaf and sheet bracing.

Openings

Care: Do not close the cavity at the jambs of external openings.

Wall ties connectors and accessories

Protection: Install to prevent water passing across the cavity.

3.5 DAMP-PROOF COURSES

General: Provide damp-proof courses as follows:

- Timber floors: In the first course below the level of the underside of ground floor timbers in internal walls and inner leaves of cavity walls.
- Cavity walls built off slabs on ground: In the bottom course of the outer leaf, continuous horizontally across the cavity and up the inner face bedded in mortar, turned 30 mm into the inner leaf 1 course above.
- Masonry veneer construction: In the bottom course of the outer leaf, continuous horizontally across the cavity. Fasten to the inner frame 75 mm above floor level.
- Walls adjoining infill floor slabs on membranes: In the course above the underside of the slab in internal walls and inner leaves of cavity walls. Project 40 mm and dress down over the membrane turned up against the wall.

Height: Not less than:

- 150 mm above the adjacent finished ground level.
- 75 mm above the finished paved or concrete area.
- 50 mm above the finished paved or concreted area and protected from the direct effect of the weather.

-

Installation

General: Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints. Step as necessary, but not exceeding 2 courses per step for brickwork and 1 course per step for blockwork. Sandwich damp-proof courses between mortar.

Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses and waterproof membranes.

Lap sealing: Lap joints 150mm and seal with a continuous bituminous adhesive and sealing compound.

3.6 FLASHINGS

General: Provide flashings as follows:

- Floors: Full width of outer leaf immediately above slab or shelf angle, continuous across cavity and up the inner face bedded in mortar, turned 30 mm into the inner leaf 2 courses above for brick and 1 course above for block. Where the slab supports the outer skin and is not rebated, bed the flashing in a suitable sealant.
- Under sills: 30 mm into the outer leaf bed joint 1 course below the sill, extending up across the cavity and under the sill in the inner leaf or the frame. Extend at least 150 mm beyond the reveals or each side of the opening.
- Over lintels to openings: Full width of outer leaf immediately above the lintel, continuous across cavity, turned 30 mm into the inner leaf 2 courses above for brick and 1 course above for block or turned up against the inner frame and fasten to it. Extend at least 150 mm beyond the lintels.
- At abutments with structural frames or supports: Vertical flash in the cavity using 150 mm wide material, wedged and grouted into a groove in the frame opposite the cavity.
- At jambs: Full height flash extending 75 mm beyond the closure into the cavity, interleaved with the sill and head flashing at each end. Fix to jambs.
- At roof abutments with cavity walls: Cavity flash immediately above the roof and over-flash the roof apron flashing.

Installation

General: Sandwich flashings between mortar except where on lintels or shelf angles. Bed flashings, sills and copings in one operation to maximise adhesion.

Laps: If required, lap full width at angles and intersections and at least 150 mm at joints. Step as necessary, but not exceeding 2 courses per step for brickwork and 1 course per step for blockwork.

Lap sealing: Seal with a bituminous adhesive and sealing compound.

Pointing: Point up joints around flashings, filling voids.

Weepholes

Provide weepholes to AS3700. Provide weepholes to external leaves of cavity walls in the course immediately above flashings, and cavity fill, and at the bottoms of unfilled cavities.

Install Weepa weephole former in locations as necessary with mortar protection cap in place. Position the Weepa so the face of the Weepa protrudes beyond the face of the masonry and is line with the finished surface yet to be applied. Ensure the Weepa can move freely so the plasterer can adjust to required depth if necessary. Following the completion of brickwork remove mortar protector cap and install the standard vermin proof gate.

Maximum spacing: 1200 mm.

3.7 WALL TIES

Location

General: Space wall ties in conformance with AS 3700 clause 4.10 or BCA Figure 3.3.3.1 or AS 4773.2, as appropriate, and at the following locations:

- Not more than 600 mm in each direction.
- Not more than 300mm adjacent to vertical lateral supports.
- Not more than 300mm adjacent to control joints.
- Not more than 300mm around openings.

Installation

Embedment: At least 50 mm into mortar making sure that mortar cover is 15 mm minimum to the outside face of the mortar.

Fixing of masonry veneer ties at abutments:

- To timber frames: Screw fix to outer face of timber frames with AS 3566 fixings.
- To concrete: Masonry anchors.
- To steel frames: Screw fix to outer face of steel studs with AS 3566 fixings.

3.8 CONTROL OF MOVEMENT

Joints

General: To AS 3700.

General: To AS 3700 or AS 4773.2, as appropriate.

Filler material: Provide compatible sealant and bond breaking backing materials which are non-staining to masonry. Do not use bituminous materials with absorbent masonry units.

- Bond breaking materials: Non-adhesive to sealant, or faced with a non-adhering material.
- Foamed materials: Closed-cell or impregnated, not water-absorbing.

Joint filling:

- Installation: Clean the joints thoroughly and insert an easily compressible backing material before sealing.
- Sealant depth: Fill the joints with a gun-applied flexible sealant for a depth of at least two-thirds the joint width.

Fire rated control joints

General: If a control joint occurs in an element of construction required to have a fire resistance rating, construct the control joint using fire stopping materials so that the fire resistance rating of the element is not reduced.

Fire stopping: To AS 4072.1.

3.9 BRICK BED JOINT REINFORCEMENT

Location

General: Locate as follows:

- In 2 bed joints below and above head and sill flashings to openings.
- In 2 bed joints below and above openings.
- In third bed joint above bottom of wall.
- In second bed joint below top of wall.

Maximum vertical intervals: 500 mm.

Installation

General: Lap 450 mm at splices. Fold and bend at corners so that the longitudinal wires are continuous. Stop 50 mm short of control joints.

- In brickwork: Extend 450 mm beyond each side of openings.

Reinforcement

Material: Galvanized welded wire mesh.

Width: Equal to the width of the leaf, less 15 mm cover from each exposed surface of the mortar joint.

3.10 REINFORCED AND GROUTED BLOCKWORK

Cleaning core holes

General: Provide purpose-made cleanout blocks or machine cut a cleaning hole at the base of each grouted core.

Location: Locate on the side of the wall which is to be rendered or otherwise concealed.

Cleaning: Rod cores to dislodge mortar fins protruding from the blocks and mortar droppings from reinforcement. Remove through the clean-out blocks.

Grouting

Commencement: Do not commence until grout spaces have been cleaned out and the mortar joints have attained sufficient strength to resist blow-outs.

Height of lift: Limit the height of individual lifts in any pour to make sure that the grout can be thoroughly compacted to fill all voids and ensure bond between grout and masonry.

Compaction: Compact by vibration or by rodding.

Topping up: On the completion of the last lift, top up the grout after 10 min to 30 min, and vibrate or rod to mix with the previous pour.

3.11 LINTELS

Generally

Mild steel flat or angle lintels galvanized / BHP Duragal

Steel lintels table

Maximum span (mm)	Lintel dimensions (mm)	Bearing each end (mm)
Up to 1050	75 x 10	
1200	75 x 75 x 8	150
1500	90 x 90 x 8	150
1800	100 x 75 x 8	230
2400	125 x 75 x 8	230
3000	150 x 90 x 10	230

Special Lintels

Description: Hesbia concealed galvanised tension bar lintel

Location:– As scheduled

Installation

General: Do not cut on site. Keep lintels 10 mm clear of heads of frames.

Steel lintels: Pack mortar between any vertical component and supported masonry units. For angles install the long leg vertical.

Propping: Do not prop lintels unless approved by the Structural Engineer.

3.12 ARCHES

Arch voussoirs

General: Cut units using a masonry saw.

Shapes and dimensions

General: Form arches using solid or cored (not hollow) masonry units.

3.13 BAGGING

Preparation

General: Cut joints flush before bagging.

Dry bagging

Application: Apply laying mortar to the surface using a hessian bag or similar. Flush up irregularities, but leave a minimum amount of mortar on the surface.

Preparation: Cut joints flush before bagging.

Textured bagging

Application: Apply laying mortar to the surface using a sponge float. Flush up irregularities, but leave approximately 2 mm of mortar on the surface. When initial set is reached, texture using a hand bristle brush.

DETAILED INSTRUCTIONS

1.01 DEMOLITION / NEW MASONRY OPENINGS

Extent

Refer drawings / Site

Protection

Refer Preliminaries section / Demolition clauses for protection and dust control.

Existing Door and Window Frames

Liase with Carpenter contractor for the removal of extg door and window frames to positions shown.

Demolition

Saw cut extg plaseter wall finishes and form new openings to existing brick walls where shown. Remove existing lintel beams where openings are to be enlarged. Remove all deri from cavity / underfloor areas.

Prop existing walls and build in new lintel beam to new openings. Provide support off walls below for propping. Where walls are not available prop floor structures down to basement footings.

Steelwork Supports

Liaise with Steelwork contractor for fabrication of new steel lintel support beams where walls are to be demolished.

Refer Engineers drawings for large span lintels and purpose fabricated composite lintels.

Brick Reveals / Support

Rebuild sides and top of opening to provide brick bearing for new lintel. Provide new brick reveal for timber reveal linings and plaster wall finishes to perimeter of opening. Generally conceal new lintel beams within walls.

Refer Timber Fixtures for specification of new reveal linings

Damp proof courses

Vertical and horizontal damp proof courses where required. Ensure all cavity spaces are kept clear of debri.

Plaster wall finishes

Liaise with Plaster Contractor for making good plaster finishes to reveal openings and adjacent wall.

Liaise with Carpentry contractors for new timber reveal linings to sides of opening.

Thresholds

Reinstate existing damp proof and ant cap courses.

Externally provide new brickwork and make good ready for new threshold. Provide 40thick nominal bull nosed slate threshold slab to full width of opening finished at centre of new door leaf. Co-ordinate and confirm setout and details on site.

Internally allow to make good wall remaining below floor level. Co-ordinate works with Carpentry Contractor for making good and extending timber floors and new framing into opening.

1.02 NEW MASONRY

Extent

Refer drawings for extent of new blockwork / brickwork / stonework / repairs etc. All blockwork shall be standard grey unless noted otherwise.

Type

Block wall (Fire Hydrant)	Fire rated 2hr	-Boral 15-01 reinforced block / grout filled
Block wall (Gas meter emclosure)	Fire rated 2hr	-Boral 15-01 reinforced block / grout filled

Existing walls

Salvage brickwork from Demolition where possible for making good face work. Where additional brickwork is required source materials to match existing as required for completion of work.

Stonework

Carryout Demolition work where shown on the drawings. Salvage existing stonework for reuse and making good. Where additional stonework is required source materials to match existing as required for completion of work.

Joints / Motar etc

Non face walls - Flush joints – Portland Grey

Face walls – Halfround - Portland Grey

Stonework – to match existing

Setbacks / Recessed bands / Coursing

Replicate existing masonry detailing to new walls (where applicable). Inspect site for details / brick types etc.

Wall Infills

External face walls remove half bricks to side of openings and key new brickwork into existing.

Internal walls tie in to existing walls and set back ready for new hard plaster finishes.

Provide damp proof courses to match adjacent.

Block Core Filled Walls

Provide block walls (core fiiled) to position as shown on the drawing. Grout using approved concrete mixed (to engineers approval) to ensure all block voids are full. Where below ground provide flush joints externally ready for application of waterproof membrane. Refer Waterproofing specification.

Hesbia Lintels

Provide hesbia lintel beams to tops of face brick wall openings where shown. Install in accordance with manufacturers details.

1.03 MAKING GOOD

(A) Extent

Refer drawings / site

Making Good Walls

Existing External Walls : Make good masonry to sides of existing openings where damaged and as shown on the drawings. Allow to remove sections of wall locally for keying in of new brickwork. Rebuild wall to match existing coursing and finishes. Refer previous notes on salvaging materials for making good.

Existing Penetrations

Allow to replace masonry locally where services removed (includes downpipes / penetrations through walls). Key into existing coursing. For small holes (where not practical to remove bricks) provide mortar infill finished flush with masonry face and coloured using crushed masonry dust.

Cleaning Walls

On completion : Allow to generally pressure spray clean all external brickwork without damage. Refer elevations for extent of masonry walls and other finishes.

1.04 PENETRATIONS / SERVICES

Extent

New Services – Refer Drawings

Co-ordinate

With other trades for coring and provision of purpose made penetrations for new services.

New Penetrations

Provide penetrations to existing masonry walls for new Bev Serv / Beer trunks and other hydraulic / electrical services to positions as required. Obtain approval for setout of all wall penetrations prior to commencement of work.

Make good

Make good / close off / brickwork up around all new / existing penetrations on completion of services work / demolition works. Finish to match extg brickwork, coursing etc. (external / internal openings) Vermin proof all penetrations using expanding foam and provide purpose made or proprietory escutcheon plates or equal to service penetrations (By service contractor).

Liase

Liase with Plumbing / Electrical / Mechanical contractor as applicable for setting out of penetrations to suit new services.

1.05 FLASHINGS / PERPENS

Extent

All new external walls

Provide

Open proprietory open perpens and Visqueen damp proof coursing to external walls for ventilation and to prevent egress of moisture to internal parts. Provide flashings to head and sides of all openings complete with open perpens (every second) as applicable.

Steel Structure

Provide vertical dpc flashing between all cavity steelwork and external masonry .

LIGHT STEEL FRAMING

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide light steel floor, wall and roof framing that is:

- In conformance with the performance criteria documented.
- Integrated into the building.
- Suitable for the fixing to it of flooring, linings cladding and roofing.
- Independently designed and documented.
- Independently certified by a professional engineer for the design and the erected framing.

1.2 CROSS REFERENCES

General

Requirement: Conform to Preliminaries / General Requirements

Related Sections : Linings Section

1.3 STANDARDS

General

Design, materials and protection: To AS/NZS 4600.

Residential and low-rise steel framing: To NASH-1 (National Association of Steel Housing) Standard.

1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of steel framing erected on site before lining or cladding.

1.5 SUBMISSIONS

Design

General: Where the structural drawings define performance criteria, submit design, documentation and independent certification from a professional engineer including for the erected work prior to the commencement of fabrication, for project record purposes.

The structural design and independent certification of all steel roof trusses, purlins, associated members and galvanised steel roof bracing, in areas noted on the drawings shall be the responsibility of the Contractor.

Reactions: Provide location and magnitude of reactions to be accommodated by the support structure.

Floor and wall frame member sizes: Submit a schedule of proposed member sizes, certified as meeting stated project and AS/NZS 4600 requirements for span, spacings and loadings.

Shop drawings

General: Submit shop detail drawings certified by a professional engineer stating that the design has been carried out in accordance with documented project and AS/NZS 4600 requirements for the configurations and loadings.

Roof trusses: Prepare drawings to show:

- On a plan, the truss layout.
- On elevations, the arrangement of members allowing for the accommodation of in-roof services and the size and section type of each member.
- The method of assembly, connection, holding down and bracing.

Wall frames: If wall framing is to be pre-fabricated, prepare drawings to show:

- On plan, the wall layout.
- On elevations, the arrangement of members, and the size and section type of each member.
- The method of assembly, connection, holding down and bracing.

1.6 TOLERANCES

General

Manufacturing and assembly tolerances: To NASH-1 Standard, Appendix D.

Installation tolerances for attachments to supporting structures, walls, trusses, rafters, ceiling joists and floor members: To NASH-1 Standard, Appendix D.

2 PRODUCTS

2.1 COMPONENTS

Cold-formed steel framing

Cold-form sections from metallic-coated steel to AS 1397.

Corrosion protection: To BCA 3.4.2.2.

Framing members

Cold-formed steel framing: For a proprietary system, comply with NASH-1.

Fascias and barge boards

Proprietory colourbond steel folded to profile

3 EXECUTION

3.1 CONSTRUCTION GENERALLY

Fabrication

Length: Cut members accurately to length so that they fit firmly against abutting members.

Service holes: Form holes by drilling or punching.

Bushes: Provide plastic bushes or grommets to site cut holes.

- Swarf: Remove swarf and other debris from cold-formed steel framing immediately.

Site work: Do not fabricate on site where welded connections are required.

Fastening

Type: Select from the following:

- Bolting.
- Self-drilling, self-tapping screws.
- Blind rivets.
- Proprietary clinching system.
- Structural adhesives.
- Welding.

Welding

Burning: Avoid procedures that result in greater than localised 'burning' of the sheets or framing members.

Prefabricated frames

General: Protect frames from damage or distortion during storage, transport and erection.

Metal separation

General: Install lagging to separate non-ferrous service pipes and accessories from the framing.

Unseasoned or CCA treated timber

General: Do not fix in contact with framing without fully painting the timber and/or the steel.

Earthing

Permanent earthing: Required.

Temporary earthing: Provide temporary earthing during erection until the permanent earthing is installed.

Protection

General: Restore coatings which have been damaged by welding or other causes. Thoroughly clean affected areas to base metal and coat with zinc rich organic primer .

Grommets: Provide grommets to isolate piping and wiring from cold-formed steel framing.

Swarf: Remove swarf and other debris from cold-formed steel framing immediately.

Certification

General: For components for which independent design certification has been required, provide independent certification for the erected components confirming compliance with the design intent.

3.2 FLOOR FRAMING

General

General: Construct framing in conformance with an approved proprietory flooring system or in accordance with engineers details.

Tolerance: Construct floors to a tolerance of 5 mm maximum deviation in 3 m measured under a straight edge placed anywhere on the surface in any direction.

Protection: If floor framing is for ground floor construction, ensure that it is protected from moisture.

Construction loads: If construction loading exceeds design loading, provide additional support so as to avoid overstressing of members.

3.3 WALL FRAMING

Wall studs

General: Provide studs in single lengths without splices. Place a stud under, or within 40 mm from, each structural load point from roof or ceiling (except for openings). Provide multiple studs at points of concentrated load.

Maximum stud spacing: 600 mm.

Heads to openings

General: Provide lintels appropriate to load and span.

Additional support

General: Provide additional support in the form of noggings, trimmers and studs for support and fixing of lining, cladding, hardware, accessories, fixtures and fittings.

Vermin barriers

- General: Provide vermin barriers in accordance with the *DPTI Termite Treatment Guidenote.*

Damp-proof course

General: Provide damp-proof courses under the bottom plate of stud walls built off slabs or masonry dwarf walls, as follows:

- External walls (not masonry veneer): Turn up at least 75 mm on the inside and tack. Project 10 mm beyond the external slab edge or dwarf wall and turn down at 45°.
- Walls of bathrooms, shower rooms and laundries: Turn up at least 150 mm on the 'wet' side and tack to studs.

Installation: Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints.

Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses, sarking and waterproof membranes.

Flashings

Location: Provide flashings to external openings sufficient to prevent the entry of moisture. Form trays at the ends of sill flashings.

Masonry veneer construction: Extend across cavities and build into brickwork.

3.4 ROOF FRAMING

Beam framing

General: Construct framing for 'flat' or pitched roofs where the ceiling follows the roof line, consisting of rafters or purlins supporting both ceiling and roof covering.

Antiponding

Requirement: Fix appropriate members to the tops of framing at the rear of fascias, to prevent sagging of and ponding on the sarking.

Additional support
Provide a framing member of minimum 45mm width behind every joint in fibre cement or plasterboard sheeting or lining or provide a framing member each sides of the joint.

Battens
Requirement: Supply and fix battens suitable for span, spacing and roofing.

3.5 TRUSSES

Fabrication
Assembly: Factory assemble trusses.

Supports for in roof services
General: If walkways, mechanical plant or other services are to be supported within the roof space, provide support.

Water container and heater: Where a water container or heater is located in the roof space, provide a support platform to AS/NZS 3500.4 clause 5.5.

Marking
General: Permanently mark each truss to show:

- Project identification.
- Manufacturer.
- Tag or number.
- Location.
- Support points.

Installation
General: Fix to support structures, plumb to within H/200, where H is the height at the apex.

Support: Support trusses on bottom chord at two points only, unless designed for additional support.

Vertical movement: Over internal walls provide at least 10 mm vertical clearance and use bracing methods which allow for vertical movements.

Holding down and bracing: Provide details demonstrating capability to resist lateral and uplift forces.

Certification: Obtain certification from a professional engineer for the erected trusses.

3.6 ROOF TRIM

Fascia, valley gutter and barge boards
Requirement: Supply and fix fascia, valley gutter and barge boards in accordance with the drawings using propietory items purposely folded to profile (colourbond) .

3.7 COMPLETION

Cleaning
General: On completion of framing remove debris from any gaps between members.

DETAILED INSTRUCTIONS

1.01 FRAMED STUD WALLS

Extent

Refer Drawings

Framing Generally

Provide proprietory external galvanised steel frame walling systems to positions as shown on the drawings. Install all external wall framing to suit application / location for applied design wind loads. Brace stud framing to structural frame to suit maximum design spans. Setout of stud framing shall suit applied linings (horizontal and vertical wall sheeting) and other secondary framing (top hats etc).

Provide double studs to sides of openings or other as required by the stud manufacturer. Install and fix all steel stud framing in accordance with manufacturers details and instructions.

Allow to provide furring channel framing to all external walls where structural columns are to be concealed. Provide additional framing and misc trims and fixings for building in around structural steel framing / bracing etc as required.

Steel Stud Wall Framing

Provide 92/64 x 0.75 BMT internal Rondo steel stud framing at 600 centres (span 3.6-3.9m) with double boxed studs at sides of all openings. Brace walls to adjacent structure for stability. Provide boxed studs between aluminium frames where required for stabilising window walls. All frames / stud / nogging junctions shall be screw fixed to achieve maximum amount of rigidity. Install deflection heads. Frame studwork around internal steel wall bracing.

External Steel Framed Walls

Provide 92 x 1.15 BMT external steel stud framing (Rondo Maxiframe) at to all external walls fixed between structural steel framing or concrete structure. Extend studs to levels as show. Brace studs to the structural building frame for rigidity and stability. Provide framing to walls where shown and as required for support of top hat framing. Steel studs shall not exceed manufacturers design spans for application. All frames / stud / nogging junctions shall be screw fixed in accordance with manufacturers details and instruction to achieve maximum amount of rigidity. Frame studwork around steel wall bracing where applicable.

Top Hat / Furring Channel Framing

Provide 25/35/16 Rondo furring channel framing at 450 / 600 centres and to suit sheet joint setout where shown. Install framing in accordance with sheet manufacturers details and specification.

Refer sheet manufacturers specification and details for specific framing requirements. Use manufacturers top hats and framing components for fibre cement wall linings. Provide 1.15 BMT guage framing members to withstand sheet deflection and avoid popping of flushed fixings (where applicable).

Refer

Linings specification for Linings and stud framing notes .

LIGHT TIMBER FRAMING

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide light timber floor, wall and roof framing.

1.2 CROSS REFERENCES

General

Requirement: Conform to Preliminaries / General Requirements

Related Sections : Timber products, finishes and treatment / Linings / Wall Framing etc

1.3 STANDARDS

General

Framing: To AS 1684.2, AS 1684.3 or AS 1684.4, as appropriate.

Design: To AS 1720.1.

1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Prefabricated units before installation.
- Fabricated items before priming or water-repellent treatment.
- Bolts after final tightening.
- Timber work after erection but before it is covered.

1.5 SUBMISSIONS

Subcontractors

Prefabricated items: Submit the name and contact details of the proposed manufacturer.

Certification

Local legislation or regulations may require non-prefabricated timber framing to be certified by a professional engineer. Amend to suit by adding certification requirements.

The structural design and independent certification of all timber roof trusses, purlins, associated members and galvanised steel roof bracing, in areas noted on the drawings shall be the responsibility of the Contractor.

General: Submit independent certification by a professional engineer of the design, documentation and erected work to AS 1684 and AS 1720.1 – prior to commencement of fabrication, for the project record purposes. Include the following:

- Reactions: Provide location and magnitude of reactions to be accommodated by the support structure.
- Floor and wall and roof frame member sizes: A schedule of proposed member sizes, certified as meeting stated project, AS 1684 and AS 1720.1 requirements for span, spacings, loadings and deflections.
- Species and stress grade.
- Moisture content at time of manufacture.
- Preservative treatment, if any.
-

Shop drawings

Provide timber framing drawings by a professional engineer stating that the design has been carried out to AS 1684 and AS 1720.1 requirements.

Show all structural wall / roof / floor framing (as applicable) and other members for construction including all bracing and tie down details. Drawings shall be suitable for certification and approval purposes.

Provide details for timber treatment (preservative protection / pre primeing etc).

Materials
Identification:

- Certification: Submit a supplier's certificate (which may be included on an invoice or delivery docket) verifying that the timber complies with the specification, including moisture content.
- Inspection: Submit the inspection authority's certificate verifying that the timber complies with the specification.

Moisture content: Submit records of moisture content.

Preservative treatment
Certificate: Submit a test certificate from an independent testing authority confirming that the required preservative retention has been achieved.

CCA treated timber: If proposed, provide details of treatment.

CCA treated timber: Do not use.

1.6 TOLERANCES

General
Walls: Conform to the **Walls tolerances table**.

Walls tolerances table

Property	Permitted deviation (mm)
Generally: Verticality in 2000 mm	4
Generally: Flatness[1] in 2000 mm	3
Features[2]: Verticality in 2000 mm	2
Features: Horizontality in 2000 mm	2
1. Flatness: Measured under a straightedge laid in any direction on a plane surface.	
2. Features: Conspicuous horizontal or vertical lines including external corners, parapets, reveals, heads, sills.	

2 PRODUCTS

2.1 TIMBER

Identification
Method: Identify timber using branding, certification or both.

Branding: Brand structural timber, under the authority of a recognised product certification program applicable to the product. Locate the brand mark on faces or edges which will be concealed in the works. Include the following data for timbers not covered by branding provisions Australian standards or regulations for which branding is required.

- Stress grade / Method of grading / 'Seasoned' or 's'
- The certification mark of the product certification program.
- The applicable standard.

Certification: Forest certification, chain of custody and product labelling to the *Timber products, finishes and treatment* worksection.

Fascias and barge boards
Hardwood: To AS 2796.1 / Seasoned cypress pine: To AS 1810 / Softwood: To AS 4785.1 / Preserve treatment: all exposed external timber

2.2 LAMINATED VENEER LUMBER AND GLUED LAMINATED TIMBER

Laminated veneer lumber Standard: To AS/NZS 4357.0. / **Glued laminated timber Standard:** To AS/NZS 1328.1.

2.3 SHEET PRODUCTS

Structural plywood
Standard: To AS/NZS 2269.0. / Bond: Type A to AS/NZS 2754.1 (Int).

Veneer
Veneer quality to visible surfaces: CD (minimum) to AS/NZS 2269.0.

Identification
Branding: To AS/NZS 2269.0. Brand mark: Locate the brand mark on faces or edges which will be clearly visible for certification inspections and concealed in the works.

2.4 COMPONENTS

Nail plated joined beams
Standard: To AS 4446.

Type: Proprietary composite member made up by butt and horizontally joining timber with pressed in nail plates.

Mild steel post bases
Minimum dimensions:

- Conform to AS 1684.2 Table 9.20(p) and AS 1684.3 Table 9.20(p), as appropriate.

Location: To timber posts supported off concrete slabs or footings.

Finish: Galvanize after fabrication.

Fasteners
General: Conform to the *Adhesives, sealants and fasteners* worksection.

Installation: Do not split or otherwise damage the timber.

Coating: Before placing bolts in contact with CCA treated timber, coat the shank of the bolt in a grease or bituminous coating.

Damp-proof course
Material: To AS/NZS 2904.

Flashings
Material: To AS/NZS 2904.

2.5 FINGER JOINTED STRUCTURAL TIMBER

General
Standard: To AS 5068.

2.6 RECONSTITUTED STRUCTURAL TIMBER PRODUCTS

Wet-processed fibreboard (including hardboard)
Standard: To AS/NZS 1859.4.

3 EXECUTION

3.1 TRANSPORT AND DELIVERY

General
Handling and protection: Do not distort or damage timber or timber products.

Moisture content: Maintain the equilibrium moisture content of seasoned timber.

Protection from weather
General: Provide temporary protection for members until permanent covering is in place.

3.2 FLOOR FRAMING

Bearers and joists
Levelling: Level bearers and joists by checking or by packing for the full width of the member with dense corrosion resistant material which is secured in place:

- Maximum thickness of packing: 3 mm. / Spring: Lay bearers and joists to allow for straightening under loading.

Joints: Locate joints only over supports: (Minimum bearing of bearers: 50 mm. Minimum bearing of joists: 30 mm.)

Fixing: Secure bearers and joists to supports to provide restraint against lateral movement.

Joist restraint:

- Unseasoned timber: If joist timber is unseasoned, the span 3000 mm, and there is no ceiling lining, provide solid blocking between each joist in rows at 1800 mm centres.
- Deep joists: If the joist depth:width ratio is 4, restrain joists at the ends of the joists over supports and at 1800 mm centres using either of following as appropriate:
  . Continuous trimming joists. / Solid blocking or herringbone strutting.
- Trimmers or blocking dimensions: Depth: Joist depth less 25 mm. Width: 25 mm. / Herringbone strutting dim: 38 x 38 mm.

Tolerance
Floors: 5 mm maximum deviation in 3 m measured under a straight edge placed anywhere on the surface in any direction.

3.3 WALL FRAMING

Wall Framing

Provide timber framed walls to positions as shown on the drawings in accordance with Timber Framing Code AS1684.

Unless noted otherwise allow to provide 90x35MPG10 stud framing at 600 / 450 centres where noted with 90x45 jamb studs and double studs to sides of openings. Provide lintel beams to all wall openings and structural waterproof ply / steel bracing to walls and roof.

Noggings

General: Provide additional support in the form of noggings, trimmers and studs for fixing lining, cladding, hardware, accessories, handrail brackets, fixtures and fittings etc as required.

Maximum spacing of noggings: 1350 mm centres.

Vermin barriers

General: Provide vermin barriers in accordance with the DPTI Termite Management Guidenote.

Damp-proof course

General: Provide damp-proof courses under the bottom plate of stud walls built off slabs or masonry dwarf walls, as follows to AS/NZS 4200.1:

- External walls (not masonry veneer): Turn up at least 75 mm on the inside and tack. Project 10 mm beyond the external slab edge or dwarf wall and turn down at 45°.
- Walls of bathrooms, shower rooms and laundries: Turn up at least 150 mm on the 'wet' side and tack to studs.

Installation: Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints.

Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses, sarkings and waterproof membranes.

Flashings

Location: Provide flashings to external openings to prevent the entry of moisture. Form trays at the ends of sill flashings.

Masonry veneer construction: Extend across cavities and build into brickwork.

3.4 ROOF AND CEILING FRAMING

Wall plates

Fixing: Fix timber wall plates to masonry, with straps, bolts or both.

Nailing plates

General: Where timber joists, rafters or purlins bear on or into steel members, provide nailing plates to transfer the design loads, bolted to the steel member at 500 mm maximum centres and 100 mm maximum from the end of the nailing plate.

Nailing plates

General: Where timber joists, rafters or purlins bear on or into steel members, provide 50 mm thick nailing plates bolted to the steel member at 500 mm maximum centres with M12 hot dip galv bolts, nuts and washers

Beam framing

Ridge straps: Butt ends of rafters together at ridge, and strap each pair together with 900 mm long steel strap passing over the ridge, triple nailed to each rafter.

Roof space: If a water container or heater is located in the roof space, provide a support platform to AS/NZS 3500.4 clause 5.5.

Additional support: Provide a frame member of at least 45mm width or alternatively a frame member both sides behind every joint in fibre cement sheeting or lining.

Anti-ponding boards

Standard: To AS/NZS 4200.2.

Fascia / Barge Boards / Timber beams (exposed)

Provide pre-primed timber to all exposed positions except where scheduled for clear or stained finishes. Prime all timber cut ends as applicable.

3.5 COMPLETION

Tightening

General: Tighten bolts, screws and other fixings so that joints and anchorages are secure at the date of practical completion.

INSULATION AND SARKING MEMBRANES

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide insulation and sarking membrane systems:

- Complete for their function.
- Conforming to the detail and location drawings.
- Firmly fixed in position.
- Maintain their performance for the life of the building.

1.2 CROSS REFERENCES

General

Requirement: Conform to Preliminaries / General Requirements

Related sections : Linings / Roofing

1.3 STANDARDS

Installation of mineral wool insulation

Comply with the ICANZ Industry Code of Practice for the Safe Use of Glass Wool and Rock Wool Insulation.

Marking: Deliver mineral wool products to site in packaging labelled FBS1 BIOSOLUBLE INSULATION.

1.4 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Terminology: To AS/NZS 4859.1.
- Fire hazard properties: To BCA A2.4.
- Sarking membrane: Flexible membrane material normally used for waterproofing, vapour proofing or thermal reflectance.
- FBS-1 Glass wool: Spun fibres of molten glass, utilizing up to 60% recycled waste glass, thermally bonded to form batts, blankets and sheets for thermal and acoustic insulation.
- FBS-1 Rock wool: Spun fibres of molten rock thermally bonded to form batts and blankets for thermal and acoustic insulation.
- Polyester insulation: Polyester fibres thermally bonded to form batts and blankets.
- Vapour barrier: A material or system that adequately impedes the transmission of water vapour under specified conditions.
- Breathable (vapour permeable) membrane: A flexible membrane material normally used for secondary waterproofing that allows for the transmission of water vapour.

1.5 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the sarking, vapour barrier and insulation before they are covered up or concealed.

1.6 SUBMISSIONS

Fire hazard properties

General: Submit evidence of conformance with the following:

- Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3, including, if the material has a reflective facing, scoring and blackening to AS/NZS 1530.3 clause A6:
  - Spread of flame index: 0 / Smoke developed index: 3.
- Facing materials: Flammability index < 5 when tested in conformance with AS/NZS 1530.2.

Thermal properties

General: Submit evidence of conformance with AS/NZS 4859.1.

2 PRODUCTS

2.1 INSULATION MATERIALS

Fire hazard properties

General: Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:

- Spread of flame index: 0.
- Smoke developed index: 3.
- Materials with reflective facing: Test to AS/NZS 1530.3 clause A6.

Facing materials: Flammability index < 5 when tested in conformance with AS/NZS 1530.2.

Bulk and reflective insulation

Mineral wool blankets and cut pieces: To AS/NZS 4859.1 Section 8.

Polyester: To AS/NZS 4859.1 Section 7.

Reflective insulation: To AS/NZS 4859.1 Section 9.

Wet processed fibreboard (including softboard): To AS/NZS 1859.4.

Wool: To AS/NZS 4859.1 Section 6.

Certification: Required.

Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Sarking membranes

Standard: To AS/NZS 4200.1.

Thermal performance: To AS/NZS 4859.1 Section 9.

Breathable (vapour permeable) membrane: Vapour resistance of not more than 0.5 MNs/g when tested to AS/NZS 4200.1.

Combined bulk insulation and sarking membrane

Bulk insulation factory bonded to sraking memebrane to AS1903, reinforced to be of sufficient strength to span 900mm (AS1904) in both directions without the requirement for mesh support.

Fasteners and supports

General: Metallic-coated steel.

Mesh support to roof insulation

Metallic-coated steel wire netting: To AS 2423 Section 4.

- Size: 45 mm mesh x 1 mm diameter.

Welded safety mesh: To AS/NZS 4389.

3 EXECUTION

3.1 GENERAL

Framed wall thermal break strips

Product type: Proprietary item.

Application: To steel or timber framing with lightweight external cladding.

R-value: 0.2.

Screw fixing: Button head screws at 1 m centres.

Adhesive fixing: Wallboard adhesive 'walnuts' at 1 m centres.

Bulk insulation

Installation: To AS 3999 and BCA J1.2.

General: Ensure batts or blankets are firmly butted with no gaps except as follows:

- Access openings and vents: Do not obstruct. / Light fittings: To AS/NZS 3000 clause 4.5.
- Electrical cables: Prevent contact with polystyrene insulation by wrapping the cable with foil tape.

Sarking membrane

Standard: To AS/NZS 4200.2.

3.2 FLOOR INSULATION

Under suspended framed floors - bulk insulation

Product type: Fibre batts.

Batts: Fit tightly between framing members. If support is not otherwise provided, staple nylon twine to the framing and stretch tight.

Below concrete slab on ground

Product type: Rigid cellular extruded sheets.

Laying pattern: Stretcher bond, with edges tightly butted.

Location: Under the damp proof membrane.

Over concrete slab on ground

Product type: Rigid cellular extruded sheets.

Application: Under slab heating.

Substrate preparation: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- Excessive projections are removed.
- Voids and hollows > 10 mm with abrupt edges are filled with a cement:sand mix not stronger than the substrate nor weaker than the bedding.

Extent: The entire heated slab.

Laying pattern: Stretcher bond, with edges tightly butted.

Under suspended concrete slab

Product type: Rigid cellular extruded sheets.

Joints: Apply reinforced foil tape to all joints.

Over framed suspended floors

Product type: Rigid cellular extruded sheets.

Under framed suspended floors

Product type: Rigid cellular extruded sheets.

Reflective sarking membrane

Fixing: Install as follows:

- To timber: Proprietary fixings or metallic-coated clouts or staples at 300 mm maximum centres.
- To steel: Tek screw with either 20 mm diameter washers or fixed through hardboard strips.

Overlap (minimum): 150 mm and adhesive tape fix.

Support mesh: 300 x 150 mm mesh size of 2 mm wire gauge to AS/NZS 4389.

Combined bulk insulation and sarking membrane

Glue laps to sarking membrane to manufacturers recommendations.

3.3 WALL INSULATION

Bulk insulation to framed walls

Product type: Fibre batts.

Batts: Friction fit between framing members. If support is not otherwise provided, staple nylon twine to the framing and stretch tight.

Full masonry cavity walls

Product: Rigid cellular insulation board.

Application: To the inner brick skin.

Fixing: Proprietary plastic clips on pre-installed wall ties.

Installation: Horizontally with the tongue to the top edge and firmly against the inner brick skin. Keep boards clean and dry and free from mortar and grout. Do not bridge the cavity.

Flashings: Install flashings before installing insulation panels. Prevent entry of water behind the insulation boards.

Masonry veneer cavity walls

Product: Rigid cellular insulation board.

Application: To steel or timber framing.

Installation: Horizontally with the tongue to the top edge pushed through prefixed wall ties and held firmly against the wall frame. Keep boards clean and dry and free from mortar and grout. Do not bridge the cavity.

Fixing: No. 12-14 x 45 mm Hex Buildex Hi Teks screws at 450 mm centres.

Flashings: Install flashings before installing insulation panels. Prevent entry of water behind the insulation boards.

Retrofit masonry walls – internal face

Product type: Rigid cellular extruded sheets.

Preparation: Ensure substrates have:

- Any deposit or finish which may impair adhesion cleaned off.
- Excessive projections hacked off and voids and hollows filled with plaster.
- Tolerance: 6 mm in 2400 mm.

Substrate correction: Skim plaster.

Installation: Apply boards horizontally with staggered vertical joints, all close butted and without crushing.

Fixing: Proprietary adhesive compatible to both the membrane and the rigid cellular extruded sheets . Apply sufficient pressure to ensure even adhesive distribution.

Final finish: Apply plasterers scrim to all joints and prepare the surface as required by the manufacturer of the final finish.

Vapour permeable wall wrap

Application: Provide wall wrap behind cladding which does not provide a permanent weatherproof seal or may be subject to condensation forming on the internal face, including the following:

- Boards fixed vertically or diagonally.
- Boards or planks fixed in exposed locations where wind driven rain can penetrate the joints.
- Unpainted or unsealed cladding.
- Behind external cladding in bushfire prone areas to AS 3959.
- Masonry veneer.

Installation: Fix wall wrap to all framing members after being pulled taught over the framing. Apply to run horizontally to the outer face of external stud walls from the bottom plate up, over the flashing. Seal across the wall cavity at the top.

Horizontal laps: At least 150 mm wide with the direction of the lap ensuring that water is shed to the outer face of the membrane.

End or vertical overlaps laps: At least 150 mm wide made over framing.

Installation: Run the wall wrap over the openings and leave covered until fenestrations are to be installed. Cut the membrane on a 45° diagonal from each corner of the opening and fold the flaps inside and fix to the inside frame of the opening. If the membrane is used to provide a continuous air tight layer, seal all joints with pressure sensitive adhesive tape.

ixing to timber frames: Metallic-coated clouts, 20 mm long 6-8 mm staples or punched multi-point metallic-coated steel brads.

Fixing to steel or aluminium: Tek screw with either 20 mm diameter washers or through hardboard strips.

Fixing to plywood: Alternatives:

- Metallic-coated clouts, 20 mm long 6-8 mm staples or punched multi-point metallic-coated steel brads. Fixing centres: At least 300 mm.
- Water based contact adhesive with a 50% adhesive cover.

3.4 ROOF INSULATION

Mesh support to roof insulation

Locations: Provide support to the following:

- Sarking, vapour barrier or reflective thermal insulation membranes laid over roof framing members which are spaced at more than 900 mm centres.
- Blanket type thermal insulation laid over roof framing members as sound insulation to metal roofing.

Installing wire netting: Lay over the roof framing providing sufficient slack or sag between members to suit the application.

Fixing wire netting: Staple to timber frame, wire to steel frame.

Installing welded safety mesh: To AS/NZS 4389.

Roof sarking

Sarking membrane:

- Installation to AS 2050.
- Location: Provide sarking under tile and shingle roofs.

Vapour barrier

Installation: Lay over the roof support frame with sufficient sag to allow the bulk insulation to achieve its full thickness. Overlap roll edges 150 mm and seal all joints with pressure sensitive adhesive tape.

Bulk insulation – metal roofs

Batts: Fit tightly between framing members.

Blanket for sound insulation: Install over the roof support frame, reflective thermal insulation (if any), and mesh support, so that the blanket is in continuous contact with the underside of the metal roofing sheets.

Combined bulk insulation and sarking membrane

Glue laps to sarking membrane to manufacturers recommendations.

Waterproof membrane roofs – IRMA/PMR types

Product type: Rigid cellular extruded sheets.

Preparation: Ensure membrane is clean and free of loose material.

Separation layer: Lay over membrane with edges lapped 300 mm and turned up at upstands and penetrations.

Installation: Lay insulation boards in brick pattern with shiplap edges pushed together firmly , cut neatly around penetrations and extended up upstands.

Cathedral ceiling insulation – metal roofing and roofing tiles

Product type: Rigid cellular extruded sheets.

Application: Over ceiling lining that has been applied over rafters.

Installation: Lay insulation boards with their long edges at right angles to the rafters and with the tongue pointing up the slope. Start laying at eaves and progress towards the ridge. Secure temporarily by occasional nailing to the rafters, the permanent fixing is provided by the nails used to secure the counter battens to the rafters. Cut boards and tightly fit to abutments and penetrations. Seal gaps with polyurethane foam.

3.5 COMPLETION

Warranties

Insulation: Submit the manufacturer's published product warranties.

DETAILED INSTRUCTIONS

1.01 INSULATION AND BARRIERS

Generally

Extent of work generally as shown on the drawings and including the following :

- Insulation to all internal plasterboard walls – (Refer Linings Section)
- Insulation to all external light weight framed walls
- Insulation to all wet areas – Wet area walls and ceilings
- Insulation to all roof areas (thermal insulation)
- Insulation to all wall areas (thermal insulation)
- Insulation to ceiling areas (acoustic insulation)
- other areas as specified or shown on the drawings

Wall / Ceiling Types

Refer Linings / Timber Fixtures / Metalwork section for wall types.

Insulation Types

Insulation shall be Fletcher Industries / Tontine (Glasswool / Polyester)

Provide

Insulation / sisilation (as applicable) to all new external walls and partitions. Install in accordance with manufacturers details and instructions to achieve required acoustic / fire ratings etc (Refer Linings section).

Insulation Support

Provide insulation to all external vertical surfaces / bulkheads / walls above ceilings etc. Provide full support for the insulation linings using galvanised wire mesh as previously specified where required.

External wall / Roof Insulation (min requirements)

Generally extend all insulation to full height of external walls to underside of roof sheeting in order to maintain thermal / acoustic envelope. Lap all junctions. Install insulation to achieve required thermal rating R2.8 walls / R2.3 for concrete walls and R3.5 for roof (in total) in combination with other ceiling linings.

Nathers Report requires R3.5 insulation to ceilings and underfloor.

(A) Extent – Apartments

Internal Plasterboard and Wet Area walls

Polyester Tontine TSB03 insulation blanket or 90 thick Glasswool insulation batts fitted tightly between steel stud wall framing.

All External Concrete walls / Framed Walls – Sisilation

Install Fletcher Titantuff MD breather sisilation fixed to the following :

-External face of steel stud wall framing

-Internal face of concrete wall panel (top hat / steel stud framing over.

External Concrete walls – Acoustic / Thermal Insulation (WT1A)

76mm steel stud : Install Fletcher Partition 70mm 32 R2.7 glasswool insulation fitted tightly between steel stud framing.
Acoustic wall rating Rw50 / Fire rating 1.5hrs / SEC 2-4

WT1A – SEC 2 / SEC 4

External hebel wall – Acoustic / Thermal Insulation (WT2 / 2A / 2B / 2C)

Hebel on 35 top hats / 90mm steel stud / R2.0 90mm Glasswool insulation 11kg/m3
Acoustic wall rating Rw50 / Fire rating 1.5hrs / WT2 – SEC 1 / WT2A,B,C – SEC nil

Concrete wall panels – ends / top (underside roof)
Fire stop panels at junctions of other walls and fire rated linings using compressed mineral fibre insulation 70kg/m3 to form fire barrier.

Light weight steel framed external walls (WT3 / 3A / 3C / 3D / 3E)

Install Fletcher R2.5HD 90mm Glasswool batts 11kg/m3 fitted tightly between steel stud framing.

WT3 – SEC 1 / Fire Rating 1.5hr / Acoustic rating RW+CTr 45

WT3A – SEC 2-3 / Fire Rating 1.5hr / Acoustic rating RW+CTr 50

WT3C-D – SEC nil / Fire Rating 1.5hr / Acoustic rating RW50 (SEC 1 / RW+CTr 45 – First floor Apt 5 and 7 only)

Common light weight Apartment diving walls (WT04 / WT3B)

Install Fletcher 90mm Glasswool batts 14kg/m3 to each stud leaf (eg 2x90mm) fitted tightly between steel stud framing.

Metal Roof – Colourbond Roof Sheeting

Install Fletcher Type 430 Permastop / R1.3 50 thick blanket. Installed system to achieve require Thermal rating R3.5 total in combination with roof and ceiling materials. (Provide additional insulation over and under concealed slab areas to achieve overall performance requirements).

Metal Clad Walls – Colourbond Wall sheeting (Long Line)

Install Fletcher R1.3 50 thick blanket behind sheeting. Installed system to achieve require Thermal rating R3.5 total in combination with wall materials.

Suspended Ceilings – Third Floor

Install Fletcher R3.5 175mm Fletcher glasswool batts or equal to ceiling above apartment areas.

Suspended Ceilings – Generally

Install Fletcher R2.0 70mm Fletcher glasswool batts 14kg/m3 or equal to ceiling areas between apartments.

Concrete Slab exposed below – Apartment located above carpark

Install Kingspan Kooltherm K10 FM 30mm R1.4 Soffit Board to underside of external concrete slabs where apartments located above. Include beams sides.

Concrete Slab exposed above –air conditioned space below

Provide insulation to ceiling under as previously specified to achieve insulation value R3.5. Close off ceiling space at sides.

Concrete Slab exposed above – non air conditioned space below (carpark / Balcony)

Nil

ROOFING – PROFILED SHEET METAL

1 GENERAL

1.1 AIMS

Responsibilities
Provide a roofing system and associated work which:

- Satisfies the product performance requirements.

1.2 CROSS REFERENCES

General
Refer to Preliminaries / General Requirements / Special Conditions Of Contract

Associated worksections
Refer Insulation Barriers / Metalwork / other framing sections / Mechanical – Hydraulic – Services

1.3 PERFORMANCE CRITERIA

Ambient climatic conditions
Design rainfall intensity (196mm/hr) to AS/NZS 3500.3:

Location exposure severity
Exposure severity category: Benign

Bushfire prone areas
Level of construction to AS 3959:

1.4 INSPECTION

Notice
Refer to Contractors approved inspection and test plan for witness and hold points

1.5 SUBMISSIONS

Shop drawings : Nil

2 PRODUCTS

2.1 COMPONENTS

Fasteners
Finish: Prefinish exposed fasteners with an oven baked polymer coating to match the roofing material.

Fastenings to timber battens: Provide fastenings just long enough to penetrate the thickness of the batten without piercing the underside.

Profiled fillers
Provide: Purpose-made closed cell polyethylene foam profiled to match the roofing profile.

Locate profiled fillers under flashings to:

- Ridges.
- Eaves.
- Lapped joints in roof sheeting.

Safety mesh
Standard: To AS/NZS 4389.

2.2 SHEET METAL ROOFING

Standards
Design and installation: To AS 1562.1.

Prepainted and organic film/metal laminate products: To AS/NZS 2728.

2.3 ROOF PLUMBING

General

Standard: To AS/NZS 3500.3.

General: Provide the flashings, cappings, gutters, rainwater heads, outlets and downpipes necessary to complete the roof system.

Materials

Metal rainwater goods: To AS/NZS 2179.1.

PVC rainwater goods and accessories: To AS/NZS 3500.3.

Proprietary flashings and cappings

Standard: To AS/NZS 2904.

Rib notching: Match roof sheeting.

Proprietary ridge and barge cappings

Material and colour: Match roof sheeting.

2.4 GLAZED ROOFING

Description

General: Provide sloped overhead glazing fixed to glazing bars or directly to the roof framing. Provide the necessary trim, flashings and sealants.

Glass selection and installation: To AS 1288.

StandardsMark: Required.

2.5 PLASTIC SHEET ROOFING

Materials

Unplasticised polyvinyl chloride (UPVC) sheet: To AS 4256.2.

Glass fibre reinforced polyester (GRP) sheet: To AS 4256.3.

Polycarbonate: To AS 4256.5.

2.6 SKYLIGHTS

Standard

General: To AS 4285.

Skylights (rooflights) in bushfire prone areas: To AS 3959 clause 3.9.1.4.

Description

General: A proprietary skylight system including framing, fixing, trim, accessories and flashings.

2.7 ROOF HATCHES

Description

General: A proprietary roof hatch system including framing, fixing, trim, accessories and flashings.

2.8 ROOF WINDOWS

Type

General: A proprietary window system designed for non-vertical installation in roofs pitched between 15° and 85°, consisting of the following:

- Timber frame and sash, shop clear primed.
- External anodised aluminium protective profiles.
- Sealed double glazing.
- Horizontally pivoted sash, 180° reversible, on patent friction hinges.
- Opening and locking by patent control bar.
- Ventilation flap.

2.9 ROOF VENTILATORS

Description

General: A proprietary roof ventilator system including framing, fixing, trim, accessories and flashings.

Finish: Match adjacent roofing.

2.10 ROOF PLANT ACCESS

Walkways

General: A proprietary 600 wide galvanised metal grate roof walkway system supported off fixing clips screw fixed to sheet crest including neoprene isolators. (unless noted otherwise)

3 EXECUTION

3.1 INSTALLATION

Protection

General: Keep the roofing and rainwater system free of debris and loose material during construction, and leave them clean and unobstructed on completion. Repair damage to the roofing and rainwater system.

Touch up: If it is necessary to touch up minor damage to prepainted metal roofing, do not overspray onto undamaged surfaces.

Thermal movement

Provide for thermal movement in the roof installation and the structure, including movement in joints and fastenings.

Pan type sheets

Removal: Capable of being de-indexed and removed without damage.

Curved corrugated sheet

General: Form by rolling from material recommended for curving or bullnosing. Minimise crimping or creasing across the face of the sheet. Trim off crimped or creased edges and ends.

Metal separation

Prevent direct contact between incompatible metals, and between green hardwood or chemically treated timber and aluminium or coated steel, by either:

- Applying an anti-corrosion, low moisture transmission coating to contact surfaces.
- Inserting a separation layer.

Tolerances

Conform to the **Tolerances table**.

Tolerances table

Property	Tolerance criteria: Permitted deviation (mm)
Spacing of supporting members	± 5 mm on the nominated support member spacing
Vertical or horizontal misalignment at the abutting ends of sheets	2 mm
Tops of supporting members in a plane parallel to the nominated roof slope	7 mm smooth deviation per metre length of supporting member

3.2 SHEET METAL ROOFING

Roof sheet installation

Accessories: Provide material with the same finish as roofing sheets.

Expansion joints: For long sheets and expansion joints (stepped roof sheets) provide Lysaght Lok-Klip end and expansion joint system for waterproof seal. (As per manufacturers recommendations and detail)

3.3 BUILDING ELEMENTS

Ridges and eaves

Treat ends of sheets as follows:

- Project sheets 50 mm into gutters.
- Close off ribs at bottom of sheets using mechanical means or with purpose-made fillers or end caps.
- Turn pans of sheets up at tops and down into gutters by mechanical means.
- Provide pre-cut notched eaves flashing and birdproofing where necessary.
- Close off ridges with purpose-made ridge fillers of closed cell polyethylene.

Ridge and barge

Capping: Finish off along ridge and verge lines with purpose-made ridge capping or barge rolls.

Sprung curved ridge

General: Lay the roofing sheets in single lengths from eaves to eaves by naturally curving the sheets over the ridge.

Ridge: Seal side laps at the ridge and extend the sealant to the point where the roof pitch equals the recommended pitch of the roofing profile.

End laps

General: Where end laps are unavoidable, and the sheet profile is not suitable for interlocking or contact end laps, construct a stepped type lap.

3.4 ROOF PLUMBING

Jointing sheet metal rainwater goods

Butt joints: Make joints over a backing strip of the same material.

Soldered joints: Do not solder aluminium or aluminium/zinc-coated steel.

Sealing: Seal fasteners and mechanically fastened joints. Fill the holes of blind rivets with silicone sealant.

Flashings

Installation: Flash roof junctions, upstands, abutments and projections through the roof. Preform to required shapes where possible. Notch, scribe, flute or dress down as necessary to follow the profile of adjacent surfaces. Mitre angles and lap joints 150 mm in running lengths. Provide matching expansion joints at 6 m maximum intervals.

Upstands: Flash projections above or through the roof with two part flashings, consisting of a base flashing and a cover flashing, with at least 100 mm vertical overlap. Provide for independent movement between the roof and the projection.

Wall abutments: Provide overflashings where roofs abut walls, stepped to the roof slope in masonry and planked cladding, otherwise raking.

- In masonry: Build into the full width of the outer leaf. Turn up within cavity, sloping inward across the cavity and fixed to or built in to the inner leaf at least 75 mm above.
- In concrete: Turn 25 mm into joints or grooves, wedge at 200 mm centres with compatible material and point up or return into cast in pvc raglet.
- Existing masonry: Scribe out motar joint and wedge overflashing into joint using a v crimp egde finished with full depth silicone sealant joint (surface fixing no acceptable).

Fixing to masonry or concrete: Step in courses to the roof slope. Interleave with damp proof course, if any.

Fixing to pipes: Solder, or seal with neutral cured silicone rubber and either of the following:

- Secure with a clamping ring.
- Provide a proprietary flexible clamping shoe with attached metal surround flashing *to penetrations less than 30mm diameter (for penetrations greater than 30mm diameter a two part upstand flashing must be used)*.

Gutters

General: Prefabricate box gutters. Form stop ends, downpipe nozzles, bends and returns. Dress downpipe nozzles into outlets. Provide overflows to prevent back-flooding.

Gutter and sump support: Provide framing and lining to support valley gutters, box gutters and sumps. Line the whole area under the gutters and sumps.

Support: *30mm x 1mm galvanised ms straps and saddles, coating class Z275, at not more than 1000mm centres, bent and screw fixed to purlins or built into brickwork.*

Valley gutters: Profile to suit the valley boarding. Turn back both edges 180° x 6 mm radius. Nail or screw to the valley boarding at the top end to prevent the gutter creeping downwards.

Expansion joints: Provide proprietary expansion joints in mid point of all box gutters to provide alternative unrestricted overflow to alternative dp outlet.

Downpipes

General: Prefabricate downpipes to the required section and shape where possible. Connect heads to gutter outlets and, if applicable, connect feet to rainwater drains allowing ability for movement.

Material: Downpipes to be 0.8mm thick from ground level up to 2m above ground level

Access cover: Provide a removable watertight access cover at the foot of each downpipe stack.

Downpipe support: Provide supports and fixings for downpipes.

Internal downpipes

Caulked joint (or bolted gland joint) to AS 1631, Screwed fittings to AS 1589 (copper), Solvent cement jointing (PVC),

Access: Provide access openings as follows:

- At each junction and bend.
- At the foot of each stack.
- At every second floor level.

Type of access opening: Cast iron inspection openings to AS 1631' (or AS/NZS 1260 for PVC, AS 1589 for copper).

Sound insulation: Mineral fibre pipe insulation 50 mm thick, spirally bound on with 1.5 mm wire at 150 mm pitch.

Building in: Where pipes are built into masonry or concrete, spiral wrap the pipe (and insulation, if any) with building paper.

3.5 ROOF ACCESS SAFETY SYSTEM

Shop drawings

Submit shop drawings noting the following:

- Evidence of compliance with the relevant WorkCover authority.
- Certification from a professional engineer to confirm the proposed structural assembly will be stable and safe.
- Roof plan and layout of all elements of the system.

Assembly

Type: cable based fall arrest system.

Fixing: Multiple side fixings to roofing ribs, or direct fixing to roof structure with flashings at penetrations.

3.6 COMPLETION

Warranties

Roofing materials: Submit the manufacturer's published product warranties.

Maintenance manual

On completion submit a manual of recommendations from the roof manufacturer or supplier for the maintenance of the roofing system including, frequency of inspection and recommended methods of access, inspection, cleaning, repair and replacement.

DETAILED INSTRUCTIONS

1.01 SCOPE OF WORKS

Generally

Extent of work generally as shown on the drawings and including the following :

- Colorbond roof sheeting (Kingclip) to roof area complete with sisilation / insulation as specified
- Forming of all penetrations to metal sheeting as detailed and required by other trades
- Provision of all Colorbond cappings and flashings (standard / purpose made)
- Provision for services penetrations from plant equipment (including AC / HWS / Flues etc)
- Gutters / downpipes / Rainwater Heads / Gutter sumps and connection to stormwater
- Roof Hatch / Platform (refer Metalwork section)
- Other works as required for completion of the roof and wall cladding system

All materials / accessories / fixings etc shall be compatible and shall comply with corrosion resistance and compatible metals requirements for rainwater goods (Refer Technical Bulletins as issued by metal sheet manufacturer)

Refer Mechanical / Electrical and Hydraulic drawings for extent of penetrations to linings.

1.02 ROOF / WALL SHEETING SYSTEMS

(A) Roof Areas

Metal Deck (concealed fixed)	0.48 BMT Fielders Kingclip 700 colourbd roof sheeting system
Operable Roof system	Vergola or equal approved
Wall cladding	Lysaght LongLine colourbond wall sheeting system
Internal parapet	Custom orb colourbond cladding

Install

Sheeting system to manufacturers details and specification complete with all flashings, cappings and accessories for the completion of the works and as required. All work shall be carried out by a specialist roof / walling contractor

(as approved by sheet manufacturer)

Accessories

Provide all finishing angles / trims / tapes / closed cell profiled strips etc and other accessories as required to conceal all exposed sheet edges and ensure dust and water tightness of the roofing system. Include all profiles gap fillers.

All external cappings and flashings shall be scribed to roof and wall sheeting profile (as applicable).

Purpose Made Flashings

Provide proprietary and purpose made flashings / cappings to perimeter of all sheet edges and as detailed on the drawings

(as applicable).

Co-ordinate

Installation of sheeting with other trades for building in of all Mechanical / Electrical / Hydraulic (as applicable)

Finish

All sheeting / cappings and flashings shall be Colorbond unless noted otherwise

1.03 INSULATION / SISALATION

Extent

All sheet metal roof areas

Type

Kinkclip roof sheeting - Fletcher R1.3 50mm Permastop MD.

Refer Insulation Barriers section for specification of all insulation and sisilation barriers.

1.04 PENETRATIONS / FLASHINGS / CAPPINGS

Extent

Refer Mechanical / Electrical / Hydraulic / drawings for general extent of services and size of penetrations. Provide all penetrations as required by other trades and as shown on the drawings

Support

Provide misc packing behind for full support of sheeting around all service and structural penetrations Refer structural steel Contractor for provision of purlin framing / trims to perimeter of penetrations for support of sheeting.as required.

Liaise

With other trades for final sizes and position of all required penetrations and co-ordination of works.

Services

Provide two part formed upstand roof flashing and sealed over flashing for all service penetrations. EPDM or Dektite flashings are not approved. Where penetrations are greater than 50% of the roof pan / flute width provide continuous over flashing extending back to the apex of the roof.

Flashings exposed to view shall match roof sheeting (as applicable)

Clean down all roof areas on completion.

Cappings / Flashings

Provide all necessary angle flashings / drainage channels etc as required where abutting openings to ensure water drains to the outside of the structure and installation remains watertight.

Flashing / cappings and other profiled sheeting shall be supplied where practical in continuous lengths to minimise joints. Where joints are required be lapped to provide minimal visual impact and constructed in order to maintain the water tightness of the roof. Provide additional expansion / control joints in the construction as required.

Fixing of all capping and flashing shall be concealed using proprietary clips. Where surface fixings are required they shall be of the same colour and durability as the base sheeting and be installed in the best workmanship manner to avoid deflection / distortion of the surface.

Provide two part purpose made folded parapet capping to perimeter of roof. Fall capping internally at grade (ponding cappings will not be accepted). Upstand flashings shall be lapped min 150 high with over flashing to suit.

External cappings (where visible) shall be purpose folded to suit wall profile. Edges shall be mechanically press folded for added strength and rigidity. Return folded cappings vertical down wall face nominal 50mm.

Conceal all fixings and use proprietary concealed fixing clips to exposed cappings / flashings where applicable.

Internal flashings (where applicable) Provide colourbond custom orb sheeting to internal face of parapet wall supported on 16 furring channel framing fixed to face of masonry parapet. Where framed provide stud framing or top hat framing to suit spans between supports. Provide under flashings to roof and cappings as previously specified.

Stainless Steel

Refer drawings for purpose made stainless steel capping and flashings.

Masonry Walling

Provide two part purpose made folded parapet capping to perimeter masonry walls where detailed. Provide support to cappings to prevent ponding and fall at grade to roof side. Provide 150 high upstand flashing adjacent roof edges with zinc over flashing built into brickwork joint. Co-ordinate building in to new masonry with Mason.

Dimensions

Flashings and cappings shown on the drawings shall be purpose made to match the specified cladding and framing details. Use standard profiles where possible. Confirm final dimensions / size and building in / fixing details on site prior to fabrication.

1.05 DOWNPIPES / RAINWATER HEADS

Extent

Refer Drawings

Generally

Pvc downpipes shall be sewer grade and painted. Metal downpipes shall be 1.0mm thick from pavement level to 1.8m above with paint finish. Provide all accessories and fixings for installation.

Stainless Steel

Fabricate stainless steel downpipes as detailed and where scheduled. Liaise with other trades for installation of PVC risers / receivers for connection.

Flying Downpipes

Provide flying downpipes as shown on the drawings. Connect to existing / new dp riser. Co-ordinate installation with other trades.

Ensure all internal flying downpipes are fully supported allowing for building movement / expansion etc and at required grade. Provide sealed inspection openings at all junctions / changes in directions for maintenance.

Support downpipes on galvanised threaded rods with adjustable bracket / collar connected to steel structure.

Bracket fixings and supports shall be in accordance with pipe manufacturers recommendations and AS2030 generally 1500mm centres.

Provide galvanised purlin trimming section between or to underside of purlin framing for support of dp internally

Speaders

Provide proprietary designed downpipe spreaders securely fixed to wall / positioned 600mm from roof end / running across minimum 4 pans (or 2 sheet widths) with open ends

Gutter Sumps

Provide purpose made gutter sumps to all gutter / downpipe outlets (nominal 100 deep)

Provide Modtec proprietary gutter sumps or equal approved

Wall Support Brackets

Provide galvanised powdercoated two part proprietary galvanised stand off bracket screw fixed to wall . Bracket should allow removal of downpipe if damaged. Provide brackets at ends and at intermediate points for full support of pipework in accordance with pipe manufacturers recommendations.

SW Connection

Connect downpipes to UPVC receiver connected to underground stormwater drain finished min 75mm above pavement level. Ensure downpipe / stormwater connections are provided with flexible couplings for Class H site.

Generally provide screw cap to base of all upvc downpipes / or where metal provide purpose made inspection opening for cleaning / access etc. (Refer specification Index for standard detail

Co-ordinate setout of drains / downpipe connection with other trades

Rainwater Heads

(A) Provide purpose made galvanised steel seam welded rainwater heads to match existing profile. Powdercoat finish.

(B) Colorbond rainwater heads shall be to standard Fielders profile to suit downpipe size (as selected)

Profile : Fielders Ned Kelly or equal (refer drawings)

Guards

Install debri guards to all downpipe outlets without restricting downpipe capacity

Protection / Finish

All external new Upvc downpipes shall be painted / Metal downpipes shall be Colorbond (unless noted otherwise)

1.06 WALL SHEETING SYSTEMS

Extent

Refer Drawings - Lysaght Longline Colourbond sheeting

Installation

Install wall cladding system in accordance with manufactures details and instructions. Refer Insulation Barriers for specification of sisilation linings behind and insulation to walls. Fix using concealed proprietory brackets. Close off all sheet ends to prevent water egress and provide concealed closed cell compressible fillers / rods etc at junctions.

Shop Drawings

Provide shop drawings of wall sheeting setout for setout of all windows and ends of walls including positioning of wall penetrations for construction. Liaise with other trades for co-ordination of all works. Aluminium windows and door frames shall be sized to suit opening module (allow for perimeter flashings / cappings).

Cappings / flashings

Provide profiled purpose folded flashing / capping to perimeter of all window penetrations / aluminium frames as shown on the drawings (nominal 35mm wide.) Provide matching flashing / capping to top and ends of sheet for uniform 'framed' appearance.

Wall Wings

Refer Linings specification for cladding to end wing walls (PCL)

1.07 BOX GUTTERS

Extent

Refer Drawings Colourbond

Type

0.6 thick Colorbond box gutter mechanically formed to shape shown complete with 0.6mm Colorbond / zincalume (as applicable) Provide over flashings into box gutter from roof surround. Form gutter complete with tapering edges / sides for falls as applicable. Provide sumps to all downpipe outlets. (min 350 wide)

Supports

Provide Colorbond Spanform gutter boards or equal approved supported on 30x25x3.0mm galvanised angle brackets with 10 dia galvanised threaded adjustable rods supported off gutter purlins at 900 centres. (trafficable gutters >350 wide))

Alternatively support gutters on Auqatite gutter board with proprietary zincalume gutter bracket at 600 centres (Feilders Size 1, 2 or 3 to suit gutter width) non trafficable gutters <350 wide.

Position gutter supports adjacent to each gutter joint and intermediately at 900 centres.

Fall gutter at minimum 1:200 grade or greater. (ponding gutters will not be accepted)

Expansion Joints

Box gutters shall be formed in lengths to allow alternative discharge of stormwater to an adjacent downpipe in the event of one downpipe blocking / use proprietary flexible expansion joiners between gutters for alternative discharge.

Overflows

All internal box gutters shall be provided with emergency overflow pops at ends. Box gutters to extend to end of roof for free overflow where possible.

Where alternative discharge is not available provide 90dia Pvc overflow pops to high end of gutter with overflow downpipe discharging outside line of building (wall or soffit). Provide penetration to linings complete with Pvc flange /seal watertight

1.8 ROOF PLATFORM SYSTEM

Extent

Refer Drawings

Provide

Purpose made penetrations to roof sheeting for roof hatch / plant walkway / plant platform. Provide upstand flashings to suit. Extend flashings to ridge (where practical) to maintain water drainage in roof pans. Soaker flashings to suit.

Ceiling Access

Refer Suspended Ceiling specification for recessed ladder access.

Walkway

Provide proprietary galvanised steel walkway roof system from roof access hatch to plant and equipment and plant located on the roof. Install walkway system and allow circulation space around plant for maintenance purposes. Install walkway system adjacent roof access hatch and provide landing platform 1200x1200

Type

Gripspan grating system or equal approved setout generally 600 wide.

Installation

Install walk-way system in accordance with manufacturers details and recommendation for application. Fix brackets to roof sheeting. Provide neoprene strips for isolation. Seal all penetrations / fixings etc watertight

Railings

Provide handrails in accordance with AS1657 and to roof platforms where installed greater than 300mm above roof level. Monowills or equal approved proprietary system.

(refer Metalwork section)

Structural Penetrations

Provide penetrations to roof sheeting for stub columns form steel structure under roof complete with overflashings. Refer Engineers structural drawings for details.

Liase

With Mechanical / Hydraulic and Electrical trades for setout of service penetrations.

Roof Access

Provide proprietory retractable ceiling access ladder (all aluminium) to ceiling to position as shown on the drawings. Provide additional structural framing between walls for building in and support of ladder frame.

Provide fixed rung ladder and landing platform in ceiling for access to roof in accordance with AS1657. (where required)

Roof Hatch

Proprietary Colorbond roof hatch 700x700 min (Sayfa or equal approved) with hinged telescopic waterproof lid to main roof for access. Install in accordance with the manufacturers details and instructions. Provide hydraulic arms to lid with master keyed padlock.

Fixed Ladders

Rung ladders shall be shop fabricated and all materials and fixings hot deep galvanised. All welds shall be finished smooth and flush. Check final levels and details on site prior to fabrication. Shall be constructed in accordance with AS1657-1992.

Provide 50x10 MS stiles 375 to 525mm max apart with min 20 to 25mm dia MS rungs set 250 to 300mm centres vertically. With of ladder at top shall be between 525 and 675mm and the top rung shall be level with the roof hatch with a 60 to 100mm gap to the perimeter.

Dyna bolt rung ladder to structural framing using stand off cleats at base and top using 2xM10 fixings per fixing. Set ladder angle at 70 degrees Cage enclosure is not required. Provide clearances as per code.

Co-ordinate

Works with other trades for set out of steelwork fixing supports for ladder / Timber ceiling platform / Roof and Ceiling hatch.

Shop Drawings

Submit shop drawing of all components incorporating equipment support and walkway layout for approval prior to commencement. Submit all details to engineer for approval prior to ordering of walkway. Co-ordinate works with Steelwork contractor.

Finish

Hot dipped galvanised

1.08 ROOF SAFETY ACCESS ANCHORS

Extent

Main roof – maintenance acess to gutters / plant equipment etc (Refer Drawings)

Safety Access System

Provide a cerified proprietary safety access anchor system to all roof areas for attaching safety harness.

Provide anchor points installed in accordance with sheet manufactures recommendation / harness suppliers instructions and to structural engineers approval.

DOORS AND ACCESS PANELS

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide doors, frames, doorsets, security screen doors and fire doorsets as documented.

1.2 CROSS REFERENCES

General

Requirement: Conform to Preliminaries and General Requirements

Related Sections : . Door hardware / Alumin Windows and Doors / Appendix A

1.3 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Balanced construction: A construction of flush doors in which the facings on one side of the core are essentially equal in thickness, grain direction, properties and arrangement to those on the other side of the core. It is such that uniformly distributed changes in moisture content will not cause warpage.
- Door frame: Includes jamb linings.
- Doorset: An assembly comprising a door or doors and supporting frame, guides and tracks including the hardware and accessories necessary for operation.
  - Fire-doorset: A doorset which retains its integrity, provides insulation and limits, if required, the transmittance of radiation in a fire.
  - Smoke-doorset: A doorset which restricts the passage of smoke.
- Flush door: A door leaf having two plane faces which entirely cover and conceal its structure. It includes doors with intermediate rail, cellular, blockboard and particleboard cores.
  - Solid core door: A flush door with a solid core continuous between stiles and rails or edge strips and fully bonded to the faces.
- Joinery door: A door leaf having either stiles and rails, or stiles, rails and muntins, framed together. A joinery door may also incorporate glazing bars.
  - Louvred door: A joinery door in which the panel spaces are filled in with louvre blades.
  - Panelled door: A joinery door with spaces filled in with panels including glass.

1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Door frames in place before building in to masonry.
- Door frames installed before fixing trim.

1.5 SUBMISSIONS

General

General: Submit 2 samples as follows:

- Colour range samples from prefinished production material (e.g. anodised or organic coated extrusions and sheet). When the colour selection has been made, submit 5 sets of samples showing the colour range.
- Door manufacturer's standard hardware items.
- Finishes to prepared surfaces.
- Joints made using proposed techniques.
- Sections proposed to be used for frames, louvres and slats.
- **Shop drawings**
- Provide shop drawings for Operable doors including building in details and door panel elevations showing finishes.

Type tests
General: Submit type-test certification complying with the following standards to verify conformance with the **Doorsets performance schedule**:

- Fire and smoke doors: To AS 1905.1 and BCA Spec C3.4.
- Weighted sound reduction index (R_w): To AS/NZS 1276.1, ISO 717-1 or AS/NZS ISO 717.1.

Maintenance documentation
Recommendations: Submit manufacturer's published recommendations for service use.

2 PRODUCTS

2.1 FRAMES

Aluminium frames
General: Assembled from aluminium sections, including necessary accessories such as buffers, pile strips, strike plates, fixing ties or brackets and cavity flashing, with suitable provision for fixing nominated hardware.

Timber frames
Hardwood: To AS 2796.1.

- Grade: Select.

Softwood: To AS 4785.1.

- Grade: Select.

Joints:

- Morticed head and through tenons.
- Trenched head:
  - Bare faced tenons on jambs.
  - Full let-in jambs.

Steel frames
General: Continuously welded from metallic-coated steel sheet sections, including necessary accessories such as buffers, strike plates, spreaders, mortar guards, switch boxes, fixing ties or brackets, and cavity flashing with suitable provision for fixing hardware and electronic security assemblies, and prefinished with a protective coating.

Finish: Grind the welds smooth, cold galvanize the welded joints and shop prime.

Hardware and accessories: Provide for fixing hardware including hinges and closers, using 4 mm backplates and lugs. Screw fix the hinges into tapped holes in the back plates.

Base metal thickness:

- General: 1.1 mm.
- Fire rated doorsets: 1.4 mm.
- Security doorsets: 1.6 mm.

Metallic-coated steel sheet: To AS 1397.

- Coating class interior: Z275.
- Coating class exterior: Z450.

2.2 DOORS

Standards
Materials: To the following:

- Decorative laminated sheets: To AS/NZS 2924.1.
- Wet processed fibreboard (including hardboard): To AS/NZS 1859.4.
- Dry processed fibreboard (including medium density fibreboard): To AS/NZS 1859.2.
- Particleboard: To AS/NZS 1859.1.
- Plywood and blockboard for interior use: To AS/NZS 2270.
- Plywood and blockboard for exterior use: To AS/NZS 2271.
- Seasoned cypress pine: To AS 1810.
- Timber – hardwood: To AS 2796.1.
- Timber – softwood: To AS 4785.1.

Certification

General: Brand panels under the authority of a recognised certification program applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

General

Doors: Proprietary products manufactured for interior or exterior applications and for the finish required.

Flush doors

General: Of balanced construction.

Solid core: Solid flush doors as follows:

- Nominal thickness 42mm.
- External solid core doors: To have 4mm thick premium exterior quality hoop pine plywood (A-C facings and A bond) glued and pressed to a high moisture resistant (HMR) particle board core inside a 35mm wide select grade pinus frame surround.
- Internal solid core doors: To have 6mm thick medium density fibre board (MDF) facings glued and pressed to a particle board core inside a 35mm wide select grade pinus frame surround.
- Edges strips: 12mm thick Tasmanian oak edge strips, mitred at corners, to perimteter of door.

Foam core internal doors as follows:

- Nominal thickness 42mm.
- To have 6mm MDF facings glued over a 150x30mm particle board outer frame with a core of 30mm thick solid polystyrene foam.
- Edges strips: 12mm thick Tasmanian oak edge strips, mitred at corners, to perimteter of door.
- Cut outs: Provide a 25mm wide timber subframe around cut outs (eg.louvres and glazing). No cut outs to be closer than the width of the stiles at the edges of the doors.

Acoustic door:

- To have 6mm MDF facings glued over a 180x30mm particle board outer frame with 100x30mm particle board central support stile. Core to be filled with acoustic insulation to achieve required rating.
- Edges strips: 12mm thick Tasmanian oak edge strips, mitred at corners, to perimteter of door.

Smoke doors: Solid core 42 mm thick.

Construction

Adhesives:

- Internal: To AS/NZS 2270.
- External: To AS/NZS 2271.

Door thickness:

- General: 42 mm.

Edge strips: Fix to stiles. Minimum thickness 12 mm Tasmanian oak mitred at corners. Increase overall thickness to > 19 mm to accommodate the full depth of the rebate in rebated doors. Form rebates to suit standard rebated hardware. Bevel square edged doors as necessary to prevent binding between the leaves.

Louvre grilles: Construct by inserting the louvre blades into a louvre frame, and fix the frame into the door.

Double doors

Rebated meeting stiles: Provide rebated meeting stiles or fix equivalent metal 'T' stop to one leaf unless the doors are double acting.

Tolerance

Squareness: The difference between the lengths of diagonals of a door: 3 mm.

Twist: The difference between perpendicular measurements taken from diagonal corners: 3 mm.

Nominal size (mm):

- Height: + 0, - 2.
- Width: + 0, - 2.

2.3 DOORSETS

Automatic sliding door assemblies

Standard: To AS 5007.

Arrangement: Conform to the **Automatic door schedule**.

Control systems: Refer to *Door hardware*.

Duct access panels

General: Proprietary products comprising metal-faced doors side hung to steel door frames, inclusive of the necessary hardware and accessories including hinges and lock and lugs or other suitable means for installation.

Fire-resistant doorsets
Standard: To AS 1905.1 and BCA Spec C3.4.

Floor access panels
Frame: Weld from 50 x 50 x 6 mm angle, with two 40 mm cogged fixing lugs each side and shop prime.

Covers: 6.5 mm chequer plate, with 40 x 40 x 6 mm angle frame welded on all round and 32 x 6 mm diagonal stiffening flats. Cut, radius and grind off 100 x 25 mm lifting slots in each end of covers.

Revolving doorsets
Standard: To AS 5007.

Arrangement: Conform to the **Automatic door schedule**.

Control systems: Refer to *Door hardware*.

Security screen doorsets
Standard: To AS 5039.

Arrangement: Conform to the **Security screen doors construction schedule.**

Bushfire screens and doors
Standard: To AS 3959.

Protection: Protect openings from the ingress of embers.

Aluminium doorsets
Type: Proprietary doorset system comprising an aluminium framed glazed door or doors, hung to or otherwise supported by a fixed aluminium door frame, inclusive of the necessary hardware and accessories.

Side hung Doors
Description: Extruded aluminium framed, fully glazed, side hung door fixed to and including extruded aluminium frames.

Fabrication: Assemble doors using approved extruded aluminium sections with stiles secured through rails with continuous 9 mm dia. cadmium plated ms rods top and bottom, including spreader plates, locating block spacers, washers and nuts each end.

Hanging: Hang on three (3) 100 mm, full leafed type, nylon bushed, extruded aluminium butt hinges per door. Fix hinges and lock strikes with stainless steel screws, tapped into concealed cadmium plated ms plates of size equal to bearing surface of hinge leaf on interior of jamb and stile extrusion.

Recess all hardware flush with door and frame edges.

Overhead door closer: Provide similar reinforcement to frame and door as last described for fixing overhead door closers.

Increase depth of top rail to accommodate closer.

Selection and installation: AS 2047.

2.4 ANCILLARY MATERIALS

Trims
Timber: Solid timber at least 19 mm thick, mitred at corners.

Extruded gaskets and seals
General: Provide seals to the **Door seal schedule**.

Materials: Non cellular (solid) elastopressive seals as follows:

- Flexible polyvinyl chloride (PVC): To BS 2571, 100% solids with high consistency, ultra-violet stabilised.
- Rubber products (neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber): To BS 4255-1.

Flashings
General: Corrosion resistant, compatible with the other materials in the installation, and coated with a non-staining compound where necessary.

Standard: To AS/NZS 2904.

Jointing materials
General: Compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

Nylon brush seals
General: Dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door with double sided PVC foam tape.

Pile weather strips
General: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.

Standard: To AAMA 701/702.

Weather bars
General: Provide a weather bar under hinged external doors, locate under the centres of closed doors.

3 EXECUTION

3.1 FRAMES

General
Frames: Install so that the frames are as follows:

- Plumb, level, straight and true.
- Fixed or anchored to the building structure.
- Will not carry any building loads, including loads caused by structural deflection or shortening.
- Recess all hardware flush with door and frame edges.

Aluminium frames
Building in to masonry: Screw galvanized steel brackets twice to jambs and build in.

Fixing to masonry openings: Build in seasoned timber plugs to masonry joints or use proprietary expansion anchors and screw twice through jambs at each fixing.

Fixing to stud frame openings: Screw once to studs at each fixing.

Frame fixing
Brackets: Metallic-coated steel:

- Width: 25 mm.
- Thickness: 1.5 mm.

Depth of fixing for building into masonry:

- Brackets: 200 mm.
- Expansion anchors: 50 mm.
- Plugs: 50 mm.
- Rods: 60 mm.

Heads of fasteners: Conceal where possible, otherwise sink the head below the surface and fill the sinking flush with a material compatible with the surface finish.

Jamb fixing centres: 600 mm.

Joints
General: Make accurately fitted joints so that no fasteners, pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Steel frames
Building in to masonry: Attach galvanized steel rods to jambs, build in and grout up.

Fixing to masonry openings: Build in hairpin anchors and install locking bars, or use proprietary expansion anchors and screw twice through jambs at each fixing.

Fixing to stud frame openings: Attach galvanized steel brackets to jambs and screw twice to studs at each fixing.

Timber frames
Building in to masonry: Screw galvanized steel brackets twice to jambs and build in.

Fixing to masonry openings: Build in seasoned timber plugs to masonry joints or use proprietary expansion anchors and screw twice through jambs at each fixing.

Fixing to stud frame openings: Back screw twice to jambs at each fixing.

Weatherproofing
Flashings and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing to prevent water from penetrating the building between the door frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

Finishing
Trim: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the door frames. Install to make neat and clean junctions between the frame and the adjoining building surfaces.

3.2 DOORS

Priming
General: Prime timber door leaves on top and bottom edges before installation.

3.3 DOORSETS

Security screen doorsets
Standard: To AS 5040.

3.4 COMPLETION

Operation
General: Make sure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and that they are lubricated where appropriate.

Protection
Temporary coating: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

DETAILED INSTRUCTIONS

1.01 DOORS AND FRAMES - Generally

Extent
Refer Door Schedule

Timber Frames
Generally Victorian Ash 125x45f timber door frames with dove tailed joints and planted door stops generally 40x12f. Allow to provide Victorian Ash 12x30f profiled timber beads to perimeter of all frames / openings. Confirm all sizes and details on site. Pre prime all timber prior to installation. Co-ordinate with skirtings.

Metal Frames
Proprietory zinc annealed metal door frames complete with fanlight (as applicable) to positions as shown. Check throat size and others details on site prior to ordering of frames. Refer hardware schedule and provide all accessories and cutouts / backing plates etc for striker plates / recessed hinges etc.
Build frames into masonry walls where shown with all jambs grout / mortar filled.
-Expressed frames in lightweight walls shall be finished flush with the wall with Rondo P50 shadowline bead to wall linings.
-Built in frames in masonry walls and other lightweight walls shall be 12mm proud of wall with linings returning into frame.
-Concealed Frame : Provide Ezy-Jamb split flushed door frame to door openings where scheduled

Aluminium Frames
Unless noted otherwise external door frames (non acoustic) shall be Capral 400 series with head section and sub sill. Doors shall be 275 series with bottom rails and narrow door stiles and 120 mid as shown. Co-ordinate installation of mortice locks / door stiles and offset push pull handles. Hinged doors fit 4 off McCallum alumin hinges.

On partition walls systems provide proprietory partition type frames with wall studs to suit. Return plasterboard into frame with double studs adjacent openings.

On other doors provide Capral 400 series frame and return plasterboard into frame on public side / and provide Rondo reveal flushing angle to wall on inside.

Refer Door schedule for other requirements

Where aluminium frames abut ceilings (discontinuous wall) provide 12mm thick shadowline MDF packer (painted black) to ceiling set back 12mm form edge of frame (both sides).

Timber Doors
Solid / hollow core door as previously specified. Provide viewing panels as specified.

Hardware
Refer Door Hardware Schedule / Door Hardware section for door sizes and door hardware and furniture special handles internally / externally, locks etc. Confirm all hardware compatibility with frames prior to fabrication.

Building in
Co-ordinate building in of new door and frame with other trades. Install all doors / windows to manufacturers details and spec. Adjust all closers, seals etc on completion. Provide concealed recessed bolt / screw fixing to double stud framing at sides of framed openings.

Door Reveals
Refer Mason for making good sides of new brick openings. Refer Linings / Plastering specification for returning of wall linings to side of openings. Refer Timber Fixtures specification for provision of timber reveals to door openings where scheduled.

Angles / Trims
Provide all cappings / flashings / angle trims etc for building in. Allow to provide aluminium powdercoat angle trims to internal and external perimeter of all frames. Polyurethane seal perimeter frame to adjacent surfaces

Thresholds
All external doors shall be fitted with Raven threshold plates and seals. Undercut doors to suit. Provide heavy duty dust and brush seals to all door stiles and head. Confirm all setout dimensions prior to fabrication.
Liaise with Mason / Carpenter / Tiler for making good of thresholds and new threshold finishes (externally fall at grade).

Protection
Provide protection to frames during construction as required. All aluminium windows/doors shall be plastic wrapped in areas work with bubble wrapping to sills. Touching up of prefinished surfaces will not be acceptable in areas of damage.
Glazing
6mm laminated glass (min) dry glazed / Pre paint all timber glazing beads / glazing pockets prior to installation of glass.
Refer Glazing specification for glass types and decal requirements.
Finish
All timber work shall be sealed / pre-primed prior to delivery to site. Doors shall be preprimed including top and bottom edges
Shop drawings
Provide shop drawings of all installations for construction purposes indicating structural support members / linings / flashings / misc packers and brackets etc. (Floor / Head / Jamb / Stile details)

Refer
Painting section for clear finishes to timber veneer faced doors

1.02 METAL CLAD DOORS

Extent

Refer Door Schedule

Type

Proprietory manufactured metal clad door (Lietzke or equal approved). Doors shall be manufactured with polyurethane resin core within concealed 38shs galv steel perimeter metal frame faced both sides with 0.6mm thick colourbond steel sheeting with mechanical press folded and seam locked edges.

Seal all junctions water tight with silicone sealant. Provide solid blocking for fixing hardware / furniture items. Door shall be prehung in metal door frame complete with all door hardware / fittings as scheduled. Allow clearances for threshold plates and seals and building in to masonrt opening.

Confirm

Door furniture and hardware requirements prior to ordering. Confirm all sizes prior to ordering making allowance for threshold clearances and seals. Provide aluminium T bar section at junction of door leafs.

1.03 VIEWING PANEL DOORS

Extent
Refer Door Schedule

Provide
Generally 900x150mm nom glazed viewing panel to doors (1150 AFL) Set glazed panel min 90mm from door edge 125 from top. Make allowance in setout for rebated mortice locks. Refer door schedule for other sizes.
Glazing
6mm laminated glass. Use glazing putty for bedding of glass (not silicone) applied evenly to rebate .
Refer Glazing section for glass type
Timber Glazing Beads
Glazing beads shall be uniform in appearance all around and set 2mm forward of door face. Beads shall be tapered Aust Oak min 12mm thick. Door glazing pocket and glazing beads shall be individually pre painted with finished coat. Beads shall be neatly mitred into rebate.
Shop Drawings
Provide shop drawing of door elevation showing setout of viewing panel / kickplates / hardware / applied finishes.
Painting
Provide 2mm dia coloured silicone bead to junction of glazing and timber bead all around on all external timber doors. Mask glass as required to obtain uniform paint edge against bead

1.04 ACCESSORIES / FITTINGS

Refer

Door and Hardware Schedule and Metal fixtures section for specification and extent of door hardware / kickplates / grilles etc to doors.

Co-ordinate

Installation of doors with Carpenter and Painter for pre priming / painting of doors and provision of cutouts to doors prior to installation. Remove hardware for painting of existing / new doors

1.05 FRAME / DOOR TYPES

Shop Drawings

Provide shop drawing of all door and window installations complete for approval indicating all components / building in details and linings to conceal tracks (where applicable). Lintel over to engineers details.

(A) Full Glass Sliding Door / Sidelight (Acoustic rated)

Sliding door frames shall be Capral aluminium 900 series frames with medium interlocking door stile. External sidelight and window frames shall be fitted with subsill section. Fit acoustic seals to all frames as specified.

Where glazing differs and windows are adjacent, glazing shall selected to the higher specification for both – unless glazing is not noticeable different in appearance.

(B) Full Glass Sliding Door / Sidelight

Sliding door frames as noted above (no acoustic rating)

(C) Full Glass Alumin Framed Door / Alumin Frame Sidelight

Frames shall be Capral aluminium Series 400 with Capral 275 series door frames and 4 off McCallum alumin hinges complete with sidelight framing to match. External sidelight frames shall be fitted with subsill section. Fit brush seals to all external doors with threshold plates as specified. Provide wide lock stiles to doors (as applicable). Push pull handles where scheduled.

(D) Solid Core Door / Metal Frame

Solid core and metal frame as previously specified. Co-ordinate installation with wall linings and skirtings as scheduled.

(E) Solid Core Door / Alumin Frame

Solid core and aluminium frame as previously specified. Co-ordinate installation with wall linings and skirtings as scheduled.

(F) Fire Rated Door and Metal Frame

Purpose made proprietory fire rated door and frame (to suit wall thickness) certified in accordance with Australian Standards. Provide all smoke seals / threshold sill and seals. Fix frame into reveal of opening to maintain fire rating.

Check all details on site. Build in fire alarm cabling / reed switches etc where applicable.

(G) Steel Roll Up Shutter

A proprietary fire door roll up shutter system (Airport Doors) 2 hour rated. Door shall be fitted with guide styles, commercial locking bar, galv steel bottom rail / tapered curtain rail (as applicable) and windlocks. Support door off wall using proprietory galv support bracket purposed made for application. Guide channels shall be roll formed galv steel channel section securely fixed to wall or jamb lining at 750 centres max using appropriate fixings for application. Door shall be 3 phase electrically operated. Manual chain override shall be fitted. Shutter curtain shall be galvanised with powdercoated finish.

(H) Gates / Tubular Framed Screens

Proprietory gate and fence system. Galvanised steel framed gates with tubular vertical rails and caps with adjacent fence and sliding gate as shown. (Refer Metalwork section / Refer drawings)

(J) Gates and Screens (services enclosure / Courtyard)

Proprietory framed gates and fencing system with composite timber slats. (Refer Metalwork section / Refer drawings)

1.06 ACOUSTIC DOOR SCHEDULE

(A) Extent
Acoustic Doors and Windows

SEC	Frame Type	Glazing	RwCTr	Extent of Door / Windows
4	sliding door	C	34	D2.1, ,D4.1
4	sliding door	D	34	D3.1
3	sliding door	A	28	D9.1,D8.1,D14.1,D13.1

Glazing Legend (acoustic)			
A	-6mm thick safety glass	C	-10mm thick safety glass
B	-8mm thick safety glass	D	-12.5mm thick VLam Hush safety glass

Extent

All Apartments (Fixed / Sliding / awning / Windows / Doors)	- Performance glass as specified (Min SHGC 0.58 / U5.4)
Common Area (other areas)	-Clear toughened / laminated glass
Ground floor entry Doors / shopfront	-Clear toughened / laminated glass

Performance Glass Types

Viridian Glass	(SolTech Neutral) 6mm Laminated and toughened glass	SHGC 0.53 / U3.7
Viridian Glass	(Comfort plus Neutral 59) 8-10mm Laminated glass	SHGC 0.51 / U3.6
Viridian Glass	(VLam Hush) 12.5mm thick safety glass	

Seals
All openable windows and doors shall be fitted with the following acoustic seals or equal approved :

Frame	Seals / Other
900 series sliding door	Schlegel Q-Ion T-Slot seals / Fin seal
950 series Awning window	Schlegel Q-Lon T-slot seals
950 series Sliding window	Schlegel Q-Ion T-Slot seals / Fin seal to suit

1.07 DOOR AND FRAME TYPE SCHEDULE

Refer Appendix A and drawings for full Schedule of all doors and windows
(D)Double door / (F) Fanlight / (S) Side light / Fire rating (FR)

	Type			Comments
(A)	Full Glass Sliding Door / Sidelight (Acoustic rated)		D2.1,,D4.1,D3.1 D9.1,D8.1,D14.1,D13.1	Acoustic rated door and frame (Glazing as previously noted)
(B)	Full Glass Sliding Door / Sidelight (non acoustic)		D5.1,D6.1,D7.1,D10.1, D11.1,12.1,D15.1,D16.1	
(C)	Full glass Alumin door / Framed sidelight		DG05,	Entry door
(D)	Solid Core Door / Metal Frame		DG04, DG6X2,DG07,DG10 DG08	 Fire hose reel cupbd
(E)	Solid Core Door / Aluminn frame		DG01	
(F)	Fire Rated Door and Frame	Exit Apartment door Stair Stair 2	DG02 D2.2, D3.2,D4.2, D5.2, D6.2, D7.2, D8.2, D9.2, D10.2, D11.2, D12.2, D13.2, D14.2, D15.2, D16.2, DC1.1,DC2.1,DC3.1 **DG09**	1Hr fire rated 1Hr fire rated 1Hr fire rated **2hr fire rated door**
(G)	Roll Up fire Shutter		DG03	2Hr Fire Rated Shutter
(H)	Gates / Tubular framed fences		G04,G03	Refer Metalwork section
(J)	Gates Tubular framed / Composite timber linings		DG01,DG02,G05	Refer Metalwork section

1.08 ALUMINIUM CAPPINGS / FLASHINGS

Extent

All window / door openings (Refer Drawings)

Provide

Aluminium angle trims and purpose made aluminium brackets and flashings (full length) as required for building in and water proofing of all window and door frames. Fold cappings / flashings to profile generally as shown on the drawing and as required. Conceal all fixings. Exposed capping / flashings / angle trims etc shall match adjacent frame finishes.

Co-ordinate all detailing and building in of window frames with specialist wall cladding contractor

Joints

Provide flexible sealed joints where frames abut adjacent building components / materials. Provide backing rods and proprietory joint fillers as recommended for application. Mask adjacent surfaces to obtain full / smooth / straight / uniform sealant finish. Sealants shall be paintable unless specified otherwise.

Cappings

1.2 thick purpose made aluminium capping (full length) to juctions where shown. Fold to profile as required for filling in or making good openings. Conceal all fixings and provide full support to capping as required using Comtex fibre cement sheeting / marine ply lining as required. Check final dimension / details on site.

Installation
Install linings in conjunction with door and window frames in order to conceal all edges where possible. Seal all top and bottom edges and ensure exposed edges are finished smooth (no sharp edges) Silicone seal all junctions to provide waterproof joint.

Linings shall be shop fabricated and installed by a specialist contractor using approved adhesive materials as recommended for application.

Protection
All sheet materials shall be plastic coated during the construction works. Provide additional protection as required to prevent damaged to the aluminium surfaces. Damaged surfaces shall be replaced at Builders cost.

WINDOWS

1 GENERAL

1.1 AIMS

Responsibilities
Conform to the **Selections**.

Maintenance
Product design: Provide windows with sashes capable of being opened to satisfy the documented maintenance requirements.

1.2 CROSS REFERENCES

General
Refer to Preliminaries / General Requirements / Special Conditions Of Contract

Associated worksections
Refer to Doors and Hatches section and Glazing

1.3 STANDARDS

General
Selection and installation: To AS 2047.

Glazing
Glass type and thickness: To AS 1288, where no glass type or thickness is nominated.

Materials and installation: To AS 1288.

Quality requirements for cut-to-size and processed glass: To AS/NZS 4667.

Terminology for work on glass: To AS/NZS 4668.

1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.

- Louvres:
  - Horizontal: Louvres span between frame stiles or mullions.
  - Continuous horizontal: Louvres run continuously past, and are supported by, concealed mullions.
  - Vertical: Louvres span between frame heads and sills.
- Window: The term 'window' used in this worksection also means 'louvre grille' where the grille forms part of the window assembly.
- U-value: Total U-Value as defined by BCA and determined in accordance with NFRC 100.
- SHGC: Solar heat gain coefficient as defined by BCA and determined in accordance with NFRC 200.

1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:

- Openings prepared to receive windows (where windows are to be installed in prepared openings).
- Fabricated window assemblies at the factory ready for delivery to the site.
- Fabricated window assemblies delivered to the site, before installation.
- Commencement of window installation.

1.6 SUBMISSIONS

Samples
Submit samples of window and door framing as follows:

- Accessory and hardware items documented descriptively or by performance (i.e. not documented as proprietary items) including locks, latches, handles, catches, sash operators, anchor brackets and attachments, masonry anchors and weather seals (pile or extruded).

- Colour samples of prefinished production material (e.g. anodised or organic coated extrusions and sheet) showing the limits of the range of variation in the selected colour.
- Joints made by proposed techniques.
- Sections proposed to be used for frames, sashes, louvres and slats.
- Label each sample, giving the Series code reference and date of manufacture.

Submit samples of glazing materials, each at least 200 x 200 mm, showing documented visual properties and the range of variation, if any, for each of the following types of glass or glazing plastics:

- Tinted or coloured glass or glazing plastics.
- Surface modified or surface coated glass.
- Patterned or obscured glass or glazing plastics.
- Ceramic coated glass.
- Wired glass.
- Mirror glass.

Sealant compatibility

Compatibility statements: Submit statements from all parties to the installation that certify the compatibility of sealants and glazing systems to all substrates.

Shop drawings

Submit shop drawings showing the following information:

- Full size sections of members.
- Hardware, fittings and accessories including fixing details.
- Junctions and trim to adjoining surfaces.
- Layout (sectional plan and elevation) of the window assembly.
- Lubrication requirements.
- Methods of assembly.
- Methods of installation, including fixing, caulking and flashing.
- Provision for vertical and horizontal expansion.
- Method of glazing, including the following:
  - Rebate depth.
  - Edge restraint.
  - Clearances and tolerances.
  - Glazing gaskets and sealant beads.

Certification: Submit an engineers' certificate confirming compliance with AS 2047.

Subcontractors

General: Submit names and contact details of proposed manufacturers and installers. Have windows and glazed doors installed by their manufacturer or by a subcontractor recommended by the manufacturer.

Type-test reports

General: Submit type-test reports verifying conformance to AS 2047 and the **Window and glazed door performance schedule** as follows:

- Fire resistance level: To AS 1530.4.
- Weighted sound reduction index: To AS/NZS 1276.1 or AS/NZS ISO 717.1.

High performance glass

Ceramic-coated spandrel glass: Submit a report certifying that the glass meets the Fallout Resistance Test requirements of ASTM C1048.

Opacified glass

General: Submit a statement by the manufacturer certifying that the proposed method of opacifying the glass will not be detrimental to the glass or detract in any way from the glass product warranty.

2 PRODUCTS

2.1 GENERAL

Standards
Flashings: To AS/NZS 2904.

Aluminium extrusions: To AS/NZS 1866.

2.2 GLASS

Glass types and quality
Standard: To AS/NZS 4667.

Glazing plastics
General: Free from surface abrasions, and warranted by the manufacturer for 10 years against yellowing or other colour change, loss of strength and impact resistance, and general deterioration.

Bullet-resistant glazing panels
Standard: To AS/NZS 2343.

StandardsMark: Required.

Safety glasses
Standard: To AS/NZS 2208.

StandardsMark: Required.

Type: Grade A.

Heat soaking: Required for toughened glass in curtain walls.

Ceramic coated glass
Heat strengthened or toughened glass with a coloured ceramic coating fused to and made an integral part of the surface: To ASTM C1048, Condition B.

Opacified glass
Glass with an opacifier permanently bonded to the inner face.

Unacceptable blemishes in heat-treated flat glass (including tinted and coated glass)
Standard: To AS/NZS 4667.

Insulating glass units (IGU's)
Selection and installation: To AS/NZS 4666.

2.3 GLAZING MATERIALS

General
Glazing materials (including putty, glazing compounds, sealants, gaskets, glazing tapes, spacing strips, spacing tapes, spacers, setting blocks and compression wedges): Appropriate for the conditions of application and the required performance.

Jointing materials
Provide recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

Priming
Apply the recommended primer to the surfaces in contact with sealant materials.

Movement joints
Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Foamed materials (in compressible fillers and backing rods): Closed-cell or impregnated types which do not absorb water.

Bond breaking: Provide backing rods, and other back-up materials for sealants, which do not adhere to the sealant.

2.4 GLASS IDENTIFICATION

Safety glazing materials
Identify each piece or panel, to AS 1288.

Noise reducing glazed assemblies
Label each panel with a legible non-permanent mark, self-destroying when removed, stating and certifying the R_w rating, and identifying the testing authority. Remove when directed.

Bullet-resistant panels
Marking: To AS/NZS 2343.

2.5 LOUVRE WINDOW ASSEMBLIES

General
Description: Provide louvre blades mounted in a metal surround frame or subframe and able to withstand the permissible-stress-design wind pressure for that location without failure or permanent distortion of members, and without blade flutter.

Adjustable louvres
Description: Provide louvre blades clipped into blade holders pivoted to stiles or coupling mullions, linked together in banks, each bank operated by an operating handle incorporating a latching device, or by a locking bar.

2.6 VENTILATING LOUVRE ASSEMBLIES

General
Description: Provide metal louvre blades mounted in a metal surround frame or subframe and able to withstand the permissible-stress-design wind pressure for that location without failure or permanent distortion of members, and without blade flutter.

Expansion joints
Provide for expansion and contraction in continuous sections (e.g. continuous louvres, interlocking mullions) at spacings not exceeding those recommended by the manufacturer, or 6 m, whichever is the lesser.

Adjustable louvres
Description: Provide louvre blades clipped into blade holders pivoted to stiles or coupling mullions, linked together in banks, each bank operated by an operating handle incorporating a latching device, or by a locking bar.

Framed adjustable louvres
Description: Provide louvre blades beaded into steel blade surround frames (sash) pivoted to pressed steel main frames, linked together in banks, each bank controlled by a proprietary sash operator.

Fixed metal louvres
Provide metal louvre blades mounted in a metal surround frame or subframe, installed as for metal window installations.

Screens
Provide metallic coated steel wire or UPVC mesh screens behind louvres to prevent the entry of vermin, birds, rodents and windblown leaves and papers.

2.7 INSECT SCREENS

Extent : Nil

Aluminium framed screens
General: Provide aluminium extruded or folded box frame sections with mesh fixing channel, mitred, staked and screwed at corners. Provide an extended frame section where necessary to adapt to window opening gear.

- Mesh: Black aluminium -Bead the mesh into the frame channel with a continuous resilient gasket, so that the mesh is taut and without distortion.

Fixed screens
General: Provide fixed screens to the window frames with a clipping device which permits removal for cleaning.

Hinged screens
General: Hinge at the top to give access to opening sash.

Roll up screens
General: Provide a proprietary retractable insect screen comprising aluminium frame with baked enamel finish, fibreglass mesh beaded into the frame, and a retraction system including tension spring, nylon bearings, positive self-locking device, and plastic sealing strip at sill.

Sliding screens
General: Provide a matching aluminium head guide, sill runner, and frame stile sections for screens not part of the window frame.

- Hardware: Nylon slide runners and finger pull handle. Provide pile strip closers against sash where necessary to close gaps.

2.8 BUSHFIRE SCREENS AND SEALS

Requirement
Protection: Protect glazed windows and doors from the ingress of embers.

Standard: To AS 3959.

2.9 SECURITY WINDOW GRILLES

General

Description: Provide proprietary metal security grille screens, or operable screen and frame, fixed to the building structure with tamper resistant fastenings.

Security window grilles: To AS 5040.

Installation: To AS 5039.

2.10 ALUMINIUM FRAME FINISHES

Powder coatings

Standard: To AS 3715.

Grade: Architectural coating.

Anodised

Standard: To AS 1231.

Thickness: 15 microns (internal) to 20 microns (severe exposure).

3 EXECUTION

3.1 GLASS PROCESSING

General

Processing: Perform required processes on glass, including cutting, obscuring, silvering and bending. Form necessary holes, including for fixings, equipment, access holes and speaking holes. Process exposed glass edges to a finish not inferior to ground arrised.

3.2 INSTALLATION

Glazing

General: Install the glass so that:

- Each piece is held firmly in place by permanent means which enable it to withstand the normal loadings and ambient conditions at its location without distortion or damage to glass and glazing materials.
- Building movements are not transferred to the glass.
- External glazing is watertight and airtight.

Temporary marking: Use a method which does not harm the glass. Remove marking on completion.

Toughened glass: Do not cut, work, or permanently mark after toughening. Use installation methods which prevent the glass making direct contact with metals or other non-resilient materials.

Heat absorbing glass: In locations exposed to direct sunlight, provide wheel cut edges free from damage or blemishes, with minimum feather.

Preglazing

Window assemblies and glazed doors: Supply inclusive of glazing, shop preglazed.

External timber framed glazing: Glaze with putty.

Windows and glazed doors

General: Install windows and glazed doors so that the frames:

- Are plumb, level, straight and true within acceptable building tolerances.
- Are fixed or anchored to the building structure in conformance with the wind action loading requirements.
- Will not carry any building loads, including loads caused by structural deflection or shortening.
- Allow for thermal movement.

Weatherproofing

Flashing and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing so that water is prevented from penetrating the building between the window frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

Fixing

Fasteners and fastener spacing: Conform to the recommendations of the manufacturer.

Fasteners: Conceal fasteners.

Packing: Pack behind fixing points with durable full width packing.

Prepared masonry openings: If fixing of timber windows to prepared anchorages needs fastening from the frame face, sink the fastener heads below the surface and fill the sinking flush with a material compatible with the surface finish.

Joints

General: Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Sealants: If priming is recommended, prime surfaces in contact with jointing materials.

Operation

General: Ensure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and are lubricated.

Protection

Removal: Remove temporary protection measures from the following:

- Contact mating surfaces before joining up.
- Exposed surfaces.

Temporary measures: *Provide temporary protection to fabricated windows in the form of strippable plastic sheeting to protect windows during transport and storage prior to installation.*

In situ touch up

Polyester or fluoropolymer coatings: Contact supplier for approval to apply touch up products otherwise replace damaged material.

Trim

General: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the window frames. Install to make neat and clean junctions between frames and the adjoining building surfaces.

3.3 LOUVRE ASSEMBLIES

Installation

General: Screw fix stiles and mullions to the building structure. Provide weather strips to heads and sills.

Framed adjustable louvres

Installation: Screw fix the main frame to the building structure with monel or stainless steel screws or masonry anchors of the type recommended by the louvre manufacturer.

Metal louvres

General: Provide metal louvre blades mounted in a metal surround frame or subframe, installed as for metal window installations.

3.4 COMPLETION

Trade clean

Method: Clean with soft clean cloths and clean water, finishing with a clean squeegee. Do not use abrasive or alkaline materials.

Extent: All frames and glass surfaces inside and out.

Maintenance manual

General: Submit the window and glazed door manufacturer's published product warranties.

Warranty

Cross reference: *General requirements.* Consult manufacturers for available combinations. If the units are intended for noise reduction, it may be necessary to specify a weighted sound reduction index (R_w) rating for the assembly. See AS/NZS 1276.1.Coating type: e.g. 'Solar reflective' or 'Low emissivity'. Delete if no coating required. State which surface of which pane is to be coated.

DETAILED INSTRUCTIONS

1.01 ALUMINIUM WINDOW FRAMES

Generally

Supply and install aluminium framed windows and doors to positions as shown. Frames shall be Alspec or equal approved

Adjoining sidelight window frames shall dimensionally match door frames unless noted otherwise.

Finish

Natural anodised finish. (20 microns) – unless noted otherwise
Powdercoat finish (25 microns) Dulux Fluoroset PVF2 - externally

Angles / Trims

Allow to provide aluminium angle trims to internal / external perimeter of frames to match frame finish.

Glazing

All glazing shall be minimum 6mm laminated glass in accordance with AS1288 (Refer Glazing specification)

Door Hardware

Provide all internal / external hardware, furniture, locks etc. Provide master keyed locks to sliding windows.

Weather Seals

Provide heavy duty dust and brush seals to all sections. Confirm all setout dimensions prior to fabrication.

Install

All windows to manufacturers details and specification. Adjust sashes, seals etc on completion.

Protection

Protection to frames during construction as required.

- All windows/doors shall be plastic wrapped in areas work with bubble wrapping to sills.
- Touching up of prefinished surfaces will not be acceptable in areas of damage.

Provide additional protection as required to prevent damaged to the aluminium surfaces. Damaged surfaces shall be replaced at Contractors cost.

Insect Screens (where scheduled)

Provide black powdercoat aluminium mesh insect screen set to all openable sashes. Provide 25x12 anodised aluminium frame to internal face. Frame shall be removable. Provide window locks keyed alike to all sashes.

Security / Fire screens (where scheduled)

Security and fire screens shall be proprietory items. Security screens shall be Amplimesh Supascreen stainless steel security screens with tamperproof secure fixings. Fire screens shall be Alspec InvisiGard stainless steel screens. Provide tool for removal and maintenance.

Shop drawings

Provide shop drawings of all installations for approval indicating structural support members / linings / flashings / misc packers and brackets etc. (Floor / Head / Jamb / Stile details)

1.02 BUILDING IN

Generally

Build in frames in accordance with manufacturers details and specification. Refer drawings / specification for structural steel supports / lintel beams.

Provide vertical damp proof courses to all new wall openings behind window frames. Provide water stop bars, vertical / horizontal damp proof black embossed flashings, flexible sealants and trimming angles etc as required.

Ensure all frames are flashed and sealed against the building frame for making installation watertight.

Fold cappings / flashings to profile generally as shown on the drawing and as required. Conceal all fixings. Exposed capping / flashings / angle trims etc shall match adjacent frame finishes.

Linings

Co-ordinate installation of windows with wall finishes.

-Lightweight Linings : Liaise with Linings contractor for setting of frames. Externally return linings behind frame and provide aluminium sub sills. Internally finish reveals with Rondo Super Flushing angles (unless shown / noted otherwise .).

-Other : Set frames off side of openings for applied wall finishes. Provide shadowline flusing angle internally against frame.

Joints
Provide flexible polyurethane sealed joints where frames abut adjacent building components / materials. Provide backing rods and proprietory joint fillers as recommended for application. Mask adjacent surfaces to obtain full / smooth / straight / uniform sealant finish.

Columns / Windows etc
Cover plates to columns shall be anodised aluminium sheet supported on 9 thick CFC sheeting or equal. Fold and return sides of capping min 12mm into back of frame void and provide continuous silicone bead for waterproofing junction.

Internally : Provide aluminium purpose made folded cappings to column and window junctions internally. Provide 70x35 MPG10 treated pine packers bolted to columns and roof truss members for support of cappings.

Supports : Provide purpose made folded aluminium brackets off columns and truss members for support of aluminium window frames. Provide infill plates to back of windows for fixing and support of fillers etc. Folded cappings shall be positioned between frames as previously noted and glued into position with rivet fixings top and bottom only.

Externally : Provide compressible foam strips and filler rods to back of frames for provision of continuous polyurethane flexible joint between frame and steel columns and other wall / roof materials

Angle Trims
Allow to provide 20x20x1.6 aluminium angle trims to perimeter of all aluminium frames. Provide timber beads as previously specified for timber windows.

Window Sills / Window Reveals

Provide wall framing for support of all plasterboard reveal and other linings to window openings.

Allow to provide Rondo Super flushing reveal angles to internal perimeter of all window openings for finishing of flushed wall linings. Confirm all details and set out on site prior to installation of windows. Allow to provide 16 thick WR grade MDF sill board with shadow line flushing bead under.

Where scheduled provide 16 thick WR grade MDF reveal linings with shadow line flushing bead and paint finish. Provide Aust Oak 25 thick nom sill board with pencil round edges – clear finish.

1.03 FRAME TYPES

Windows

Frames shall be proprietary sections. Capral series 400 (fixed) / series 50 inserts (awning) / 950 (sliding) aluminium framing designed for application with glazing in accordance with AS1288 and as specified. Provide aluminium sub-sills and window head sections unless detailed otherwise to all windows. Provide all accessories as required for building in and waterproofing of window / façade system. Provide vertical DPC / flashings and angle trims and concealed fixing straps and packers to walls with concealed straps for support of frame.

Where adjacent door frames windows shall have matching sized frame. Apartment windows shall be acoustically rated where scheduled.

Infill Panels
Provide fibre cement infill and insulated board linings to window frame for support of aluminium infill panels and cappings..
Build in ventilation grilles where shown complete with removable insect screens and louvre frames for cleaning. Co-ordinate works with other trades.

Obscure Glazing
Provide obscure (laminated glass with white inner layer) glass to windows above 1700mm AFL where shown on the drawings and as specified. Refer Metalwork section for other aluminium screens and glazing.
Refer Door s specification for decals.

1.04 WINDOW SCHEDULE

Type		Comments
(A) Full Glass / Awning window	W10.1,W11.1,W12.1,W15.1, W5.1,W7.1,W6.1 W16.1,W13.6, W8.6, W4.2,W2.2,W2.3,	Non acoustic windows
	WG04,WG05,	Obscure glass
(B) Full Glass / Sliding Window	W6.2,W11.2	Non acoustic windows
	W13.4, W14.4,W8.4, W12.3, W9.4 W10.3	Obscure glass
(C) Other Windows (Acoustic rated)	See Clause 1.5	Glazing as scheduled
(D) Glazed screens	DP5 / HR3 Privacy screens	Refer Metalwork section

1.05 ACOUSTIC WINDOW SCHEDULE

(A) Extent

Acoustic Apartment Windows (**denotes openable window to be fitted with Fire screens as specified)

SEC	Frame Type	Glazing	RwCTr	Extent of Door / Windows
1	Sliding window **	A	25	W13.5, W16.2, W15.2, W8.5, W12.4, W9.3, W10.4
1	Awning window	A	25	W5.2, W7.2,
1	Sliding window**	A	22	W16.3, W15.3, W12.2
1	Sliding window**	A	22	W10.2,
1	Sliding window**	A	28	W8.3
2	Sliding window**	A	28	W14.3
2	Sliding window **	C	31	W13.3
4	Awning window	C	34	WG01,WG02, W3.1
		A	31	WG03, W4.1, W2.1
3	Awning window	A	31	W9.2, W9.1, W14.2, W14.1
3	Awning window	C	34	W8.1, W8.2, W13.2, W13.1

Glazing Legend (acoustic)			
A	-6mm thick safety glass	C	-10mm thick safety glass
B	-8mm thick safety glass	D	-12.5mm thick VLam Hush safety glass

Extent

All Apartments (Fixed / Sliding / awning / Windows / Doors)	- Performance glass as specified (Min SHGC 0.58 / U5.4)
Common Area (other areas)	-Clear toughened / laminated glass
Ground floor entry Doors / shopfront	-Clear toughened / laminated glass

Performance Glass Types

Viridian Glass	(SolTech Neutral) 6mm Laminated and toughened glass	SHGC 0.53 / U3.7
Viridian Glass	(Comfort plus Neutral 59) 8-10mm Laminated glass	SHGC 0.51 / U3.6

Seals

All openable windows and doors shall be fitted with the following acoustic seals or equal approved :

Frame	Seals / Other
50 series Awning window	Schlegel Q-Lon T-slot seals (or equal performance to suit frame)
950 series Sliding window	As specified for sliding doors (Refer Door specification)

GLAZING

1 GENERAL

1.1 CROSS REFERENCES

General
Refer Preliminaries / General Requirements / Special Conditions Of Contract

Associated worksections
Refer Windows / Doors and Hatches / Window and Door Schedules – Appendix A

1.2 STANDARDS

Glazing
Glass type and thickness: To AS 1288, where no glass type or thickness is nominated.

Materials and installation: To AS 1288.

Quality requirements for cut-to-size and processed glass: To AS/NZS 4667.

Terminology for work on glass: To AS/NZS 4668.

2 PRODUCTS

2.1 GLASS

Glass types and quality
Standard: To AS 1288 and AS/NZS 4667.

Glass and glazing materials
Glass and glazing materials generally: Free from defects which detract from appearance or interfere with performance under normal conditions of use.

Glazing plastics: Free from surface abrasions, and warranted by the manufacturer for 10 years against yellowing or other colour change, loss of strength and impact resistance, and general deterioration.

Safety glasses
Standard: To AS/NZS 2208.

StandardsMark: Required.

Type: Grade A when used in curtain walls.

Heat soaking: Required for toughened glass in curtain walls.

Insulating glass units (IGU's)
Selection and installation: To AS/NZS 4666.

2.2 GLAZING MATERIALS

General
Glazing materials (including putty, glazing compounds, sealants, gaskets, glazing tapes, spacing strips, spacing tapes, spacers, setting blocks and compression wedges): Appropriate for the conditions of application and the required performance.

Jointing materials
Compatability: Provide recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

Glazing tapes
Standards: To AAMA 800, Products coded 804.3, 806.3, 807.3, as applicable.

Elastomeric sealants
General: Provide elastomeric sealants in conformance with the **Elastomeric sealant schedule.**

Sealing compound (polyurethane, polysulphide, acrylic):

- Single component: Type II, Class A.
- Multi component: To ASTM C920.

Sealing compound (silicone):

- Single component: Class A.
- Multi component: To ASTM C920.

Sealing compound (butyl): To ASTM C1311.

Glazing compounds: To AAMA 802.3 (Types I or II), or 805.2, as applicable.

Narrow joint seam sealer: To AAMA 800, Products coded 803.3.

Exterior perimeter sealing compound: To AAMA 800.

Non drying sealant: To AAMA 800.

Expanded cellular glazing tape: To AAMA 800.

Very high bond pressure sensitive tapes: To ASTM D897, ASTM D1002, ASTM D3330M, ASTM D3652M, ASTM D3654M, and ASTM D3715M.

Pile weather strips

Standard: To AAMA 701/702.

Materials: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra violet stabilised.

Finned type: A pile weather seal with a central polypropylene fin bonded into the centre of the backing rod and raised above the pile level.

Extruded gaskets and seals

Type: Non cellular (solid) elastopressive seals.

Material:

- Rubber products (neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber): To BS 4255-1.
- Flexible polyvinyl chloride (PVC): To BS 2571, E type compounds, colour fastness grade B.

Priming

Compatibility: Apply the recommended primer to the surfaces in contact with sealant materials.

Movement joints

Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Foamed materials (in compressible fillers and backing rods): Closed-cell or impregnated types which do not absorb water.

Bond breaking: Provide backing rods, and other back-up materials for sealants, which do not adhere to the sealant.

2.3 GLASS IDENTIFICATION

Safety glazing materials

Identification: Identify each piece or panel, to AS 1288.

Noise reducing glazed assemblies

Identification: Label each panel with a legible non-permanent mark, self-destroying when removed, stating and certifying the R_w rating, and identifying the testing authority. Remove when directed.

3 EXECUTION

3.1 GLASS PROCESSING

General

Processing: Perform required processes on glass, including cutting, obscuring, silvering and bending. Form necessary holes, including for fixings, equipment, access holes and speaking holes. Process exposed glass edges to a finish not inferior to ground arissed.

3.2 INSTALLATION

Glazing

General: Install the glass so that:

- Each piece is held firmly in place by permanent means which enable it to withstand the normal loadings and ambient conditions at its location without distortion or damage to glass and glazing materials.
- Building movements are not transferred to the glass.
- External glazing is watertight and airtight.

Temporary marking: Use a method which does not harm the glass. Remove marking on completion.

Toughened glass: Do not cut, work, or permanently mark after toughening. Use installation methods which prevent the glass making direct contact with metals or other non-resilient materials.

Heat absorbing glass: In locations exposed to direct sunlight, provide wheel cut edges free from damage or blemishes, with minimum feather.

Preglazing

Window assemblies and glazed doors: Supply inclusive of glazing, shop preglazed.

Curtain walls: Supply inclusive of glazing, shop preglazed.

Site glazing

Minimum dimensional requirements (mm): *-to AS1288*

External timber framed glazing: *Approved linoseed based putty*

3.3 MIRRORS

Reflective surface

Type: Silver layer deposited on the glass or glazing plastic.

Protective coatings: Electrolytic copper coating at least 5 m thick, and 2 coats of mirror backing and edge sealing paint having a total dry film thickness of at least 50 m.

Venetian silvered mirror (one way vision glass): 15 mm wide silvered strips alternating with 3 mm wide clear strips.

3.4 FIXING MIRRORS

Screw fixing

Direct to wall plugs with dome-headed chromium-plated screws in each corner and at 900 mm maximum centres around perimeter. Provide polyethylene sleeves and washers to prevent contact between screw and glass. Do not over-tension the screws.

Frame fixing

General: Proprietary aluminium frames to mirror perimeter, corners mitred. Bed glass edges in a continuous resilient gasket. Attach the frame to the substrate with concealed screw fixings. Seal the frame to the substrate with paintable sealant which will not react with the mirror coating. Do not allow the sealant to contact the mirror back.

Backing Boards / Blanket fixing

Generally 12 thick MDF WR grade board screw fixed to substrate with adhesive fixed mirror facing

3.5 COMPLETION

Trade clean

Method: Clean with soft clean cloths and clean water, finishing with a clean squeegee. Do not use abrasive or alkaline materials.

Extent: All frames and glass surfaces inside and out.

Warranties

General: Submit a warranty, signed by the glazing subcontractor, undertaking to repair or replace glass and glazing materials which, within the warranty period, become defective or prove unsuitable for the specified application; provided that the manufacturers' recommendations for the maintenance of the material have been followed during the warranty period.

Glass manufacturer's warranty: An undertaking, conditional only on compliance with the manufacturer's recommendation for installation and maintenance, to supply replacement glass units to the site for replacement of defective units defined as follows:

- IGU units: Units in which the hermetic seal has failed as evidenced by intrusion of foreign matter, or internal condensation at temperature above 2°C.
- Coated glass units (including coated SIG units): Units in which the metallic coating shows evidence of manufacturing defects, including but not necessarily limited to cracking or peeling, as determined in accordance with ASTM C1048.

Toughened glass warranty: The manufacturer's warranty certifying that toughened glass supplied for use in curtain walls has been subjected to a heat soaking process which has converted at least 95% of the nickel sulphide content to the stable beta-phase.

Maintenance manual

Submit manufacturers' published recommendations for service use.

Cleaning

Replace damaged glass and leave the work clean, polished, free from defects, and in good condition.

DETAILED INSTRUCTIONS

1.0 GLAZING GENERALLY

Extent

Refer drawings / Door schedule

Generally

All glazing to all doors and windows shall be laminated glass in accordance with SAA Glass Code. All glazing shall not be less than 6mm thick min. Glazing to new external doors and windows shall be 10mm laminated min.

Timber Glazing (as applicable)

Bed all timber glazing beads in proprietary glazing putty. External glazing provide continuous paint grade silicone bead (2.0mm dia) to junction of glass and glazing bead.

Liase with Painter for painting of all glazing pockets / rebates / Glazing beads etc to doors and windows prior to installation of glazing. (Refer Painting section)

Obscure Glass

Obscure glass shall be laminated with opal opaque inter-layer to match Solaseal Frost.

1.01 VIEWING PANELS

Extent

Viewing Panel Doors - Refer Door Schedule (Doors specification)

Type

Refer drawings for individual viewing panel types. Refer Doors and Access Panels for specification of cut outs. Provide 6mm thick laminated glass with timber bead as previously specified (unless noted otherwise). Obscure where scheduled.

1.02 MIRRORS

Refer Drawings

Location	Type	Size	Fixing
Apartments	Clear	Refer Separate fitout drawings	Concealed

Mirrors Generally

Commercial grade 6mm thick float glass silver mirror with polished edges as previously specified.

Type

Refer Appendix B Materials and Finishes Schedule for mirror types

Fixing

Fixed : Screw fix mirrors to wall using domed headed stainless steel bolts as previously specified.

Concealed : Silicone fix glazing to substrate – Allow 4 thick WR grade MDF backing board screw fixed to wall set back 5mm all around from edge. Paint finish to perimeter edge all around.

Confirm

Setout / details / sizes on site prior to ordering / Provide templates where required

1.03 GLAZING SCHEDULE

Generally

Refer Doors Access Panels / Windows specification for framing specification and acoustic glazing.

Refer drawings for extent of films to glazing.

Contractor shall make allowance for toughened glass where shading may cause thermal stress / fracturing of laminated or performance glass.

Extent

Apartments (Fixed / Sliding / awning / Windows / Doors)	- Performance glass as specified (Min SHGC 0.58 / U5.4)
Common Area (other areas)	-Clear toughened / laminated glass
Ground floor entry Doors / shopfront	-Clear toughened / laminated glass

Performance Glass Types

Viridian Glass	(SolTech Neutral) 6mm Laminated and toughened glass	SHGC 0.53 / U3.7
Viridian Glass	(Comfort plus Neutral 59) 8-10mm Laminated glass	SHGC 0.51 / U3.6

Other Glazing

Virdian colourback glass as selected (refer Separate fitout drawings)

1.04 GLAZING FILMS / DECALS

(A) Extent

All full glass windows and doors (no mid rail)

Type

Provide visual glass indicator decals to complying with glass code and AS1428.1 Clause 6.6

Refer Appendix B Materials and Finishes Schedule for specific design requirements.

1.05 OTHER GLASS

Extent

Apartment joinery – Refer drawings

DOOR HARDWARE

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide door hardware as documented.

Handing: Before supply, verify on site, the correct handing of hardware items.

Hardware specified generically: Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use, suitable for use with associated hardware, and fabricated with fixed parts firmly joined.

Operation: Ensure working parts are accurately fitted to smooth close bearings, without binding or sticking, free from rattle or excessive play, lubricated where appropriate.

Supply

Delivery: Deliver door hardware items, ready for installation, in individual complete sets for each door, as follows:

- Clearly labelled to show the intended location.
- In a separate dust and moisture proof package.
- Including the necessary templates, fixings and fixing instructions.

1.2 REPLACEMENT ITEMS

Door hardware: Match items being replaced with existing unless documented otherwise. Upgrade hinges as necessary to conform to **Hinges table A** and **Hinges table B**.

1.3 CROSS REFERENCES

General

Requirement: Conform to Preliminaries / General Requirements

Related Sections : Doors / Windows

1.4 INTERPRETATION

Abbreviations

General: To AS 4145.1 Appendix D.

Definitions

Glossary of terms: To AS 4145.1 Section 2.

Lock functions: To AS 4145.1 Appendix E.

1.5 SUBMISSIONS

Door-by-door schedule

General: Submit a door-by-door hardware schedule.

Information sources: This worksection and the contract drawings.

Refurbishment and alteration work

Reuse of recovered hardware: Submit a proposal describing the standard of cleaning, repair and testing of recovered items and the location where each is to be reused.

Samples

Generic items: Submit samples of hardware items offered as meeting the description of items not specified as proprietary items.

Refurbished items: Submit samples of hardware items offered as meeting the standard of cleaning, repair and testing of recovered items.

Key control System

New works: Submit details of the proprietary key control security system proposed by the lock manufacturer for locks required to accept a group key (master, grandmaster).

Alterations and additions: Submit details to extend the existing key control security system for locks required to accept a group key.

Subcontractors
Automatic

door operators: Submit names and contact details of proposed supplier and installer.

Pressure floor mat: Submit names and contact details of proposed supplier and installer.

Record documents
Door hardware schedule: Submit an amended schedule, prepared by the door hardware supplier, showing changes to the contract door hardware schedule caused as follows:

- By the approval of a hardware sample.
- By the acceptance of an equivalent to a specified proprietary item.
- By a contract variation to a door hardware requirement.

Keys
Key codes: Submit the lock manufacturer's record of the key coding system showing each lock type, number and type of key supplied, key number for re-ordering, and name of supplier.

Keys: For locks keyed to differ and locks keyed alike, verify quantities against key records, and deliver to the contract administrator at practical completion.

2 PRODUCTS

2.1 LOCKS AND LATCHES

Standard
General: To AS 4145.2.

Padlocks
Standard: To AS 4145.4.

2.2 HINGES

Butt hinge sizes
Size for door types: Conform to tables as follows:

- Timber doors in timber or metal frames: **Hinge table A**.
- Aluminium framed doors in aluminium frames: **Hinge table B**.
- Cupboard doors: Not included in hinge tables.

Measurement: Length (l) is the dimension along the knuckles, not including hinge tips, if any, and width (w) is the dimension across both hinge leaves when opened flat.

Butt hinge materials
Timber doors in timber or steel frames: Stainless Steel

Aluminium framed doors in aluminium frames: Aluminium or Stainless Steel

Doors fitted with closers: Provide low friction ball bearing hinges.

Fire doors: To AS 1905.1.

Power transfer hinges: Ensure they do not assume any load and are installed with other compatible hinges.

2.3 HINGE TABLES

Hinge table A
Application: Solid core doors. The table can be used to determine the quantity of hinges required for the nominated door leaf sizes and weights only. For door leaf sizes not specified or with applied finishes use the weight of the door to determine the quantity of hinges required. For door leafs over 80 kg, nominate pivot hinges.

The size of the hinge is determined by the door leaf thickness:

- 35 - 43 mm thick door: 100 x 75 mm # butt hinges with a minimum thickness of 2.5 mm.
- 44 - 55 mm thick door: 100 x 100 mm # butt hinges with a minimum thickness of 2.5 mm.
- > 55 mm thick door: Refer to the door by door hardware schedule.

Hinge pin: The symbol # refers to the pin type. Supply fixed pins to doors opening out or designated as a security doors.

Wide throw: If necessary, provide wide throw hinges to achieve the required door swings in the presence of obstacles such as nibs, deep reveals and architraves.

Hinge table A

Nominal door leaf size (H x W x T) (mm)	Door leaf weight (kg - approx)	Number of hinges
2040 x 400 x 35	19	2
2040 x 600 x 35	29	2
2040 x 720 x 35	35	3
2040 x 820 x 35	39	3
2040 x 920 x 35	44	3
2040 x 1020 x 35	49	4
2040 x 720 x 40	37	3
2040 x 820 x 40	42	3
2040 x 920 x 40	48	3
2040 x 1020 x 40	52	4
2040 x 720 x 50	45	3
2040 x 820 x 50	50	3
2040 x 920 x 50	57	3
2040 x 1020 x 50	68	4
2400 x 720 x 40	50	4
2400 x 820 x 40	52	4
2400 x 920 x 40	55	4
2400 x 1020 x 40	60	4
2400 x 1220 x 50	72	5
2040 x 920 x 70	88	Nominate pivot hinges

Hinge table B

Application: Aluminium hinges for aluminium doors, or for doors of other materials in aluminium frames.

Nominal hinge size (L x W x T) (mm)	Door leaf weight (kg – approx)	Minimum construction	
		Knuckles	Screws/hinge leaf
100 x 70 x 3	30	3	3
100 x 80 x 3.5	50	5	4
130 x 50 x 3.4	75	Interfold	3

2.4 DOOR HANGING SYSTEMS

General

General: Provide sliding door tracks in conformance with the **Sliding track schedule**.

2.5 ANCILLARIES

Bolts

General: Provide bolts including barrel bolts, flush bolts and tower bolts with keepers, including lock plates, staples, ferrules or floor sockets.

Mortar guards

General: For steel door frame installations, provide mortar guards designed to enable the full extension of the lock tongue or similar devices and the correct operation of the locking mechanism.

Rebated doors

General: For mortice locks or latches to rebated doors, provide purpose-made rebated pattern items.

Strike plates

General: Use strike plates provided with the locks or latches. Do not provide 'universal' strike plates.

Recess all hardware flush with door frame and edges.

2.6 DOOR CONTROLLERS

General

Performance: Provide door controllers, pivots, flow or overhead door closers, and automatic door operators, which are suitable for the door type, size, weight and swings required and the operating conditions, including wind pressure.

Automatic door operators

General: Provide complete automatic door operators for opening and closing doors, including door hanging (hinges, pivots or sliding gear) and electrical connection to distribution board.

Installation: Provide necessary recesses and cores, grout in components where required, and make good. Provide cover plates for access to units in door heads, frames or transoms.

Automatic adjustable function: If the door opening angle or width is manually set below the maximum possible, under conditions of continuous traffic the doors must automatically creep to full opening, returning to reduced opening on the next cycle.

Radio remote door controllers: Provide a device, comprising a radio receiver and separate transmitter, for activating a motorised door operator so as to open and close the door by remote radio signal.

Key switch: If there is no separate access to the enclosure, provide a key switch mounted externally for opening and closing the door from outside the enclosure without the transmitter. Provide two keys.

Light: Provide an internal light which any signal to the receiver also switches on and which remains on for not less than 2 minutes and switches off automatically.

Receiver: House within a wall unit incorporating a push-button switch permanently illuminated. Mount within the enclosure and connect to power.

Transmitter: Portable battery-powered unit sending a coded signal effective up to not less than 12 m from the receiver.

Pressure floor mats: Automatic door activating system consisting of a mat which when deflected by foot pressure operates a switch which activates the door or doors.

Closers

Hinged and pivot doors:

- Fire rated doors: Provide closers tested and certified for use as components of fire door assemblies:
  - Standard: To AS 1905.1.
  -

2.7 ELECTRONIC CONTROL DEVICES

General

General: Provide electric strikes, electric locks, drop bolts, or similar devices to suit door construction and hardware.

Electromagnetic hold-open devices: To AS 1905.1 and AS 1670.1.

Fail-safe: Connect door control devices in a fail-safe mode to permit egress in the event of power failure.

Fail-secure: Connect door control devices in a fail-secure mode to prevent egress in the event of power failure.

Authorised products: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

Glass doors: Provide tumbler, drop bolts or magnetic holders.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

Activation

Activation device: Provide keypads, card readers or other activation devices, and locate next to entry points.

External: Provide weatherproof (IP56) hoods or housings for external units.

Mounting height: 1200 mm from floor level.

2.8 KEYING

Temporary construction keys and cylinders

Requirement: Provide one of the following:

- Loan cylinder: Install for construction locks and replace at practical completion.
- Construction keyed master key cylinder: Keep up-to-date records of keys issued including recipient's name, company and contact details, date issued and date returned.

-

Delivery of keys

Great grandmaster, grandmaster and master keys: Arrange for the manufacturer or supplier to deliver direct to the principal.

Number of keys: Conform to the **Number of keys table**.

Group keying

Keying system: Provide a group keying system in conformance with the **Key codes schedule**.

Existing system: Obtain the details of existing group or master key systems to which a new system is required to be an extension.

Future extensions: Provide master and grandmaster group keying systems which are capable of accommodating future extensions.

Keying control security system: If cylinder or pin-tumbler locks accept a group key (e.g. master key, maison key) provide to those locks a proprietary keying control security system.

Stamping: Stamp keys and lock cylinders to show the key codes and/or door number as scheduled.

Identification

Labelling: Supply each key with a purpose-made plastic or stamped metal label legibly marked to identify the key, attached to the key by a metal ring.

Key material

Lever locks: Malleable cast iron or mild steel.

Pin tumbler locks: Nickel alloy, not brass.

Number of keys table

Code	Key type	Minimum number of keys
GGMK	Great grandmaster keys	2
GMK	Grandmaster keys	2
MK	Master keys	2 per code group
KD	Locks keyed to differ	2 per lock
KA	Locks keyed alike:	
	2 locks in code group	4
	3 to 10 locks in code group	6
	11 to 40 locks in code group	10
	41 and over locks in code group	1 per 4 locks or part thereof

3 EXECUTION

3.1 INSTALLATION

Mounting height

Locks and latches: Centreline of the door knob or lever spindle above finished floor:

Door stops

Fixing: Fix on the floor, skirting or wall, as appropriate, to prevent the door or door furniture striking the wall or other surface.

Fasteners

Materials: Provide materials compatible with the item being fixed, and of sufficient strength, size and quality to perform their function.

- Concealed fixings: Provide a corrosion resistant finish to concealed fixings.
- Exposed fixings: Match exposed fixings to the material being fixed.

Security: Locate exposed fixings to lock furniture on the inside faces of external doors and on the inside faces of internal doors to lockable rooms.

Support: Provide appropriate back support (for example lock stiles, blocking, wall noggings and backing plates) for hardware fixings.

- Hollow metal sections: Provide backing plates drilled and tapped for screw fixing, or provide rivet nuts with machine thread screws. Do not use self tapping screws or blind rivets.

-

Floor springs

General: Form a recess in the floor slab for the floor spring box and grout the box in place so that the cover plate is flush with the finished floor.

Hinges

Metal frames: Fix hinges using metal thread screws.

Timber doorsets: Install butt hinges in housings equal in depth to the thickness of the hinge leaf (except for hinges designed for mounting without housing), and fix with countersunk screws.

3.2 COMPLETION

Adjustment

General: Leave the hardware properly adjusted with working parts in working order, and clean, undamaged, properly adjusted, and lubricated where appropriate.

Automatic door operators: Maintain and adjust the system throughout the defects liability period.

Keys

Contractor's keys: Immediately before practical completion, replace or reset cylinders to which the contractor has had key access during construction and ensure the exclusion of the contractor's keys.

Maintenance

Automatic door operators: Submit the installer's proposal for continuing maintenance after completion on an annual renewal basis.

Manual: Submit the manufacturer's published recommendations for use, care and maintenance of the hardware provided.

Product warranties

Warranty: Cover materials and workmanship in the terms of the warranty in the form of interlocking warranties from the manufacturer or distributor and the applicator.

Automatic door operators: Submit a warranty (or interlocking warranties) from the supplier and installer for the system and its installation, for a period of at least twelve months from the date of practical completion.

DETAILED INSTRUCTIONS

1.01 KEYING SYSTEMS / DOOR HARDWARE

Extent

All new doors

Keying

Allow to provide restricted keying system (Bilock or equal) to all new doors unless noted otherwise.

Individually key for each apartment.)

Master key system to restrict access to all floors (except Building Managerx2 / Cleanersx2 / Maintenance access x2)

All fire escape doors shall be lock free in direction of egress and comply with BCA requirements. In the event of power loss (lifts not in operation) allow keyed access to apartment levels from outside / lobby areas via stairs.

Access Systems

Allow to provide an approved commercial audio / visual intercom and approved key card / fob access systems to lobby / lift / apartment floor levels and secure carpark areas. Provide laptop computer , hardware and software program for encrypting access cards / fobs. Provide data base for recording all keying / cards / fobs issued. . Provide 100 spare access cards / fobs.

Refer Consultants specification for detailed requirements.

Security Systems

Allow to provide an approved commercial security camera / reed access system to all entry building entry point and lobby / foyer areas. Provide recording hardware and software for and monitoring reviewing.

Refer Consultants specification for detailed requirements.

Compatibility / Management

All security and access software / hardware shall be unlocked and universal allowing systems to be maintained and parts accessed and replaced by individual contractors without any contract agreement. Provide 12 month maintenance with all systems including setup / testing / training / issuing of initial handover keys / cards / fobs.

Hardware

Allow to install all Door Hardware and Furniture as scheduled including mortice locks / closers / hinges / other items as noted.

Allow to provide 3 sets of all keys / cards / fobs upon handover (pre programmed)

Refer

Refer Appendix A Door and Hardware Schedule

Refer Doors / Windows / Timber Fixtures specification

PC ITEM

-Builder shall nominate PC Sum in Tender for supply only of all door hardware (installation included in Builders work).

-Provide separate costings for all Access / Security hardware / software as specified above

(excludes cabling and terminations)

LINING

1 GENERAL

1.1 AIMS

Responsibilities
General: Provide internal lining systems to the **Selections**.

1.2 CROSS REFERENCES

General
Refer Preliminaries / General Requirements / Special Conditions Of Contract / Light Steel Framing

Associated worksections
Refer Timber Fixtures / Suspended Ceilings / Light Steel Framing / Partitions / Painting

1.3 INSPECTION

Notice
Inspection: Give sufficient notice so that inspection may be made of substrate or framing before installation of linings.

1.4 TOLERANCES

Surface
Flatness, twist, winding and bow: ≤ 1.5 mm deviation from a 1.5 m straightedge placed in any position.

1.5 SUBMISSIONS

Type-test reports
General: Submit type-test reports to verify conformance with the **Partition performance schedule** and as follows:

- Fire hazard properties:
  - Average specific extinction area (non-sprinklered buildings): < 250m^2/kg to AS/NZS 3837.
  - Group number: To AS/NZS 3837 and BCA Specification A2.4, or AS ISO 9705.
  - Smoke growth rate index (non-sprinklered buildings): < 100 to AS ISO 9705 and BCA Spec A2.4.
- Fire resistance level: To AS 1530.4.

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Plasterboard
Standard: To AS/NZS 2588.

Fibre cement

Standard: To AS/NZS 2908.2.

Wall and ceiling linings: Type B category 2.

Minimum thickness: 6 mm.

Tongue and groove boards
Hardwood: To AS 2796.1.

- Grade to AS 2796.2:
- Seasoned cypress pine: To AS 1810.

Softwood: To AS 4785.1.

- Grade to AS 4785.2:

Plywood and blockboard
Interior use: To AS/NZS 2270.

Exterior use: To AS/NZS 2271.

Visible surfaces with a clear finish: Veneer quality A.

Other visible surfaces: Veneer quality B.

Back/face veneer: Veneer quality C or D.

Bond: Type A.

- Preservative treatment (if applicable):

Presealed plywood: Plywood pre-sealed both sides and edges with a machine applied sealer.

Wet processed fibreboard (including hardboard)
Standard: To AS/NZS 1859.4.

- Interior use generally: General purpose.
- Interior use heavy duty: Tempered (MR).
- Interior moisture area: Tempered (MR).
- Veneered hardboard: General purpose with a timber face veneer bonded to one side.

Wet-processed fibreboard (including softboard): To AS/NZS 1859.4.

Dry-processed fibreboard (including medium density fibreboard)
Standard: To AS/NZS 1859.2.

Melamine overlaid medium density fibreboard: Medium density fibreboard (STD MDF) overlaid on both sides with low pressure melamine.

Decorative overlaid wood panels
Standard: To AS/NZS 1859.3.

Certification
General: Brand panels under the authority of a recognised certification program applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

Certification programs:

- Plywood and blockboard: Engineered Wood Products Association of Australia (EWPAA) Quality Control and Product Certification Scheme.
- Wet processed fibreboard, dry processed fibreboard, particleboard and decorative overlay wood panels: Australian Wood Panels Association AWPA JAS-ANZ Scheme.

Plywood certified formaldehyde emission level to AS/NZS 2098.11:

Wood panel certified formaldehyde emission level to AS/NZS 4266.16:

High pressure decorative laminate sheet
Standard: To AS/NZS 2924.1.

Particleboard
Standard: To AS/NZS 1859.1.

Coated steel
Standard: To AS 1397.

Fasteners
Steel nails: Hot dip galvanized.

Adhesives
For wallboards: Gunnable synthetic rubber/resin based mastic contact adhesive formulated for bonding flooring and wallboards to a variety of substrates.

Sealants
Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.

Acoustic sealant: Non-hardening sealant compatible with the materials to be sealed and having a specific gravity of not less than 1.5 gm/cubic centimetre and of 100% polyurethane mastic.

3 EXECUTION

3.1 CONSTRUCTION GENERALLY

Conditions
Do not commence lining work until such time as the building or zone in question is enclosed and weathertight and all wet trades have been completed.

Substrates or framing
General: Before fixing linings check and, if necessary, adjust the alignment of substrates or framing.

Battens

General: Fix at each crossing with structural framing members, or direct to solid walls or ceilings. Provide wall plugs in solid backgrounds.

Ceiling linings

General: Do not install until at least 14 days after the timber roof structure is fully loaded.

Accessories and trim

General: Provide accessories and trim necessary to complete the installation.

Adhesives

General: Provide adhesives of types appropriate to their purpose, and apply them so that they transmit the loads imposed, without causing discolouration of finished surfaces.

3.2 PLASTERBOARD LINING

Supports

General: Install timber battens or proprietary cold-formed galvanized steel furring channels as follows:

- Where framing member spacing exceeds the recommended spacing.
- Where direct fixing of the plasterboard is not possible due to the arrangement or alignment of the framing or substrate.
- Where the lining is the substrate for tiled finishes.

Transverse walls: Locate noggings as follows:

- At least 150 mm from the horizontal joint.
- Ensure that noggings do not protrude beyond the face of studs.

Installation

Gypsum plasterboard: To AS/NZS 2589.1.

Wet areas: Do not use adhesive fixing alone

Multiple sheet layers

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Joints

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

Butt joints: Make joints over framing members or otherwise provide back blocking.

External corner joints: Make joints over metallic-coated steel corner beads.

Dry joints: Provide square edged sheet and finish with a UPVC joining section.

Control joints: Install purpose-made metallic-coated control joint beads at not more than 12 m centres in walls and ceilings and to coincide with structural movement joints.

Wet areas: Install additional supports, flashings, trim and sealants as required.

Joints in tiled areas: Do not apply a topping coat after bedding perforated paper tape in bedding compound.

3.3 FIBRE CEMENT LINING

Supports

General: Install timber battens or proprietary cold-formed galvanized steel furring channels as follows:

- 6 thick CSR Soffitline / flush jointed proprietary system supported at 450 centres
- 6 thick CSR fibre cement lining / Pvc jointed supported at 600 centres
- 6 thick villaboard 600 centres (Timber) 450 centres (Steel) / flush jointed
- 9 thick villaboard 600 centres / flush jointed supported at 600 centres
- 7.5 thick Harditex 600 centres / flush jointed proprietary system supported at 600 centres
- 9 thick CSR Express Wall / expressed sheet joints supported at 600 centres
- 8 thick CSR Renderline / flush jointed proprietary system supported at 600 centres

Installation

General: In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.

Timber framed construction: Nail only or combined with adhesive.

Steel framed construction: Screw only or combined with adhesive.

Wall framing:

- Do not fix to top and bottom plates or noggings.
- In tiled areas: Provide an extra row of noggings immediately above wall-to-floor flashings. Fix sheet at 150 mm centres to each stud and around the perimeter of the sheet.

Masonry wall construction:

- Fix using adhesive direct to masonry, but do not fix direct to masonry as a substrate for tiled finish.
- Fix to furring channels using screw or screw and adhesive.

Ceilings: Fix using screw or screw and adhesive to ceiling furring members. Do not fix sheets to the bottom chords of trusses.

Wet areas: Do not use adhesive fixing alone.

Multiple sheet layers

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Joints

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

- Movement joints in walls: Position a stud parallel to the joint on each side.
- Movement joints in ceilings and soffits: Provide movement joints to divide ceilings into bays not larger than 10.8 x 7.2 m and soffit linings into bays not larger than 4.2 x 4.2 m or 5.4 x 3.6 m. Provide framing parallel to the joint on each side. Do not fix the lining to abutting building surfaces.

External corner joints: Make joints over metallic-coated steel corner beads.

Dry joints: Provide square edged sheet and finish with a UPVC joining section.

Control joints: Provide purpose-made metallic-coated control joint beads at ≤ 7.2 m centres in walls and ceilings and to coincide with structural movement joints.

Wet areas: Provide additional supports, flashings, trim and sealants as required.

Joints in tiled areas: Bed perforated paper tape in bedding compound. Do not apply a topping coat.

- Movement joints: Space to suit joints required in tiling.
- Internal corners: Reinforce with metallic-coated steel angles. In corners subject to continuous moisture, flash over the angle and under the sheeting with continuous bitumen coated aluminium flashing.

3.4 TONGUE AND GROOVE / TIMBER LININGS

Installation

General: Provide single lengths of boards when installed horizontally or vertically. Install boards so that butt joints are in compression. - Internal corners: Scribe - External corners: Mitre.

Stained or clear finished boards: Select board to give a random pattern. At corners return the same board to give a continuous grain pattern.

Fixing: Nail twice to each crossing except for secret nailed profiles.

Nailheads: Treat visible nailheads as follows:

- In stained or clear finishes: Drive flush.
- In opaque finishes: Punch below surface and fill flush with putty after the surface has been primed

Screw fixing: Provide counter sunk washer to stainless steel screw fixings. Setout evenly / uniform / aligned.

Provide : Sample sheet showing fixings and finishes on specified timber lining

3.5 TRIM

General

Provide all trims and angles as required for finishing of fibre cement and plasterboard edges for completion of wall linings and to make neat junctions between lining components, finishes and adjacent surfaces.. (Type Rondo or equal)

1. Bulkhead trim	294, support clip 291	4. Shadow line stopping bead	P50 / P60
2. Shadow line angle	235	5. External corner bead	P32
3. Casing bead	P03	6. Stopping bead	P13
		7. Expansion joints	P33 P45..

Control joints: Install Rondo control joints at not more than 12m centres in walls and to coincide with structural movement joints in accordance with sheet manufacturers recommendations.

DETAILED INSTRUCTIONS

1.01 WALLS / LININGS / INSULATION

Generally

Linings shall be installed by a suitable qualified tradesperson. Walls shall be constructed to achieve the required water resistance / impact resistance and acoustic ratings using lining combinations as shown on the drawings and specified below.

Refer Insulation / Barriers section for wall insulation / Light Steel Framing section for steel stud wall framing / Suspended Ceilings section for plasterboard ceiling linings.

All wall / ceiling linings / wall framing systems / insulation barriers etc shall be installed in accordance with the sheet manufacturers details and recommendations in order to achieve the required performance ratings (Boral / CSR or equal approved) Insulation types where specified shall not be substituted. Install sheeting on top hat and stud framing systems and suspended framing systems as recommended by the sheet manufacturer. (Design Cat2 / UWS47 / SWB38)

(A) FRAMED WALLS

Extent

Provide new lightweight steel framed walling systems with linings as detailed to positions as shown on the drawings.

Generally

Line wet area walls with lining combinations to achieve water resistance / impact resistance and acoustic ratings to positions as shown on the drawing. Provide flushing angles / trims etc to all perimeter sheet edges (where applicable).

Membranes / Wet Area Walls

Apply non toxic water based latex (rubbered) emulsion incorporating elastomers and reinforcing agents (ABA Superflex or equal) for a durable and flexible waterproof membrane to all wet area wall and floor junctions and behind tiling in accordance with regulation requirements.

Wet area wall construction shall be carried out strictly in accordance with Ministers Specification F1.7 and the manufacturers details and specifications. (Refer Appendix) Wet area walls shall be 9 thick fibre cement lined unless noted otherwise.

Acoustic Partitions / Walls

Acoustic walls and partitions shall extend to underside of slab unless noted otherwise. Provide polyester blanket 60kg/m2 packer between top of sheeting and underside of slab at top to provide an airtight / sound proof acoustic seal (unless noted otherwise) Class 2 : Acoustic separation shall comply with BCA Part F5.

Timber Wall Framing

Generally 90x35 MGP10 timber stud framing at 600 centres with 90x45 MPG10 studs at sides of all openings. Where opposing door jambs abut (internal corner) provide additional 90x35 MPG10 timber jamb stud to side of one opening to separate door frames. (confirm set out of door frames for disabled access prior to commencement – refer drawings)

Steel Stud Wall Framing

Provide 92/76/64 x 0.75 BMT internal Rondo steel stud framing at 600 centres (span 3.6-3.9m) with double boxed studs at sides of all openings. Brace walls to adjacent structure for stability. Provide boxed studs between aluminium frames where required for stabilising window walls. All frames / stud / nogging junctions shall be screw fixed to achieve maximum amount of rigidity. Install deflection heads. Frame studwork around internal steel wall bracing.

External Steel Framed Walls

Provide 92 x 1.15 BMT external Rondo steel stud framing at 450 centres (2 rows nogging) to all external walls fixed between structural steel framing. Extend studs to underside of perimeter roof girt and support studs of structural tie beam or roof beam adjacent wall. Provide steel stud framing between parapet wall girts above roof level for support of top hat framing. Steel studs shall not exceed manufacturers design spans for application. All frames / stud / nogging junctions shall be screw fixed to achieve maximum amount of rigidity. Frame studwork around steel wall bracing.

Top Hat / Furring Channel Framing

Provide 35 Rondo furring channel framing at 450 / 600 centres and to suit sheet joint setout. Install framing in accordance with sheet manufacturers details and specification.

Refer sheet manufacturers specification and details for specific framing requirements. Use manufacturers top hats and framing components for fibre cement wall linings. Provide 1.15 BMT guage framing members to withstand sheet deflection and avoid popping of flushed fixings.

Allow to provide furring channel framing to all external walls where structural columns are to be concealed (where zero cavity).

Metal Door Frames

Plasterboard wall linings : Size door frames to suit new wall thickness Except for fire door frames, set door frame flush with wall lining with Rondo P50 flushing angle to perimeter unless noted otherwise. Provide polyurethane bead to junction.

Plaster walls : Return plaster linings to face of frame using shadowline flusing bead against frame. Refer Plastering specification.

Aluminium Door / Window frames

Lightweight walls : Return plasterboard linings to inside of frame on public side. Return linings into reveal of opening on opposite side and finish plasterbd reveal and sill flush using Rondo super bead or equal. Provide continuous infill plates to rear of frames for support of flashings / filler rods etc and fixing to stud framing. Provide head and sill sub sections to all external openings.

Provide 32mm thick Aust Oak timber sill boards where scheduled (Refer Timber Fixtures / Windows).

Plaster walls (as applicable) : Return plaster linings into reveals of opening to face of frame using shadowline flusing bead or to reveal linings where scheduled. Refer Plastering specification.

(B) WALL TYPES Refer drawings

Refer other trades for scope of works and co-ordination (Painting / Skirtings etc)

Refer Insulation / Sisilation section for wall insulation.

External

	Precast Concrete Walls
WT01	150 thick off form precast concrete panel / 1.5Hr fire rating / RW50 / SEC 1-4
WT01A	As per WT01
	Add internally 76 steel studs internally / 600 centres / 13 thick p/board internally
WT01-C	As per WT01
	Add Externally 75 thick Hebel panel externally on 35 top hat framing 1000 centres
WT01-D	As per WT01
	Add internally 20mm gap / 92 steel stud 600 centres / 13 thick plasterbd (discontinuous construction)
WT01-25	As per WT01
	Add internally 10 thick MR plasterboard of 25 top hat framing 600 centres / Tiling as selected
-/B	As per WT01
	Add externally selected brick tile facing (confirm module size and door window opening setouts) 10mm
WT02	75 thick Hebel panel externally on 35 top hat framing 1000 centres
	Internally 90 steel studs 600 centres staggered in 150 steel track with 2x13 thick Fyrchek linings
WT02A	75 thick Hebel panel externally on 35 top hat framing 1000 centres
	Internally 90 steel studs 600 centres with 2x13 Frychek linings on 35 top hat framing
WT02B	As per WT2A except delete top hat framing internally
WT02C	75 thick Hebel panel externally on 35 top hat framing 1000 centres
	Internally 90 steel studs 600 centres with 13 plasterboard linings (non fire rated)
-/ HR	75 thick Hebel panel externally on 35 top hat framing 1000 centres
	Internally 90 steel studs 600 centres with linings to match main wall
	Texture finish and paint system – Acratex or equal
WT03	Longline colourbond vertical sheeting on 35 top hat framing at 1200 centres externally
	Internally 2x13 frychek linings on 90 steel studs at 600 centres with 2x13 thick frychek on 35 top hat framing
WT03A	Longline colourbond vertical sheeting on 35 top hat framing at 1200 centres externally
	Internally 2x13 frychek linings on 90 steel studs at 600 centres staggered in 150 track with 2x13 thick frychek
WT03B	Longline colourbond vertical sheeting on 35 top hat framing at 1200 centres externally
	Internally 2x13 frychek linings on two rows 90 steel studs at 600 centres with 2x13 thick frychek on 35 top hat framing

Continued

WT3C	As per WT3B except no top hat framing inetrnally
WT3D	As per WT03 except no top hat framing internally
WT3E	Longline colourbond vertical sheeting on 35 top hat framing at 1200 centres externally Extend external linings behind to maintain wall alignment. Provide 90 steel studs at 600 centres with 2x13 between structural steel framing. Provide 8 thick Scyon Matrix fibre cement sheet lining on 25 top hat framing to exposed eaves side. Cap with composite fascia / barge lining.
SRS 01	76 steel stud framing (non fire rated service riser) 13 thick MR Soundchek lining RWCTr 25 (Riser within wet area)
SRS 02	76 steel stud framing (non fire rated service riser) 13 thick MR Soundchek lining RWCTr 40 (Riser in or adjacent Habitable room) Add Raupiano pipework or 75 thick 11kg/m3 insulation to wall fully supported.
WT04	Double 90 steel stud wall framing at 600 centres with 20mm gap between (Discontinuous construction) 1x16 thick fyrchek linings either side RWCTr 50
WT05	Externally 75 thick Hebel panel fixed to steel stud wall framing. Wall framing behind as previously specified.

Internal

PT01	90 steel stud partition wall with 13 thick plasterbd either side
PT02	Wet area wall As per PT01 except 13 thick MR grade plasterboard – tiling as selected Alternatively :10 thick plasterboard with 6 thick fibre cement sheet over. – Tiling as selected.

Insulation

Refer Insulation Barriers specification for insulation to walls and required acoustic ratings. External walls shall be meet the following requirements – Concrete walls R2.3 / Lightweight walls R2.8

Refer

Acoustic report for SEC acoustic requirements (Appendix C)

1.02 SERVICE DUCTS

Extent

Refer Drawings

Provide

Framed acoustic rated service duct risers where shown using shaft wall or other proprietory wall framing systems (floor to ceiling). Provide steel stud framing with linings as noted. Provide acoustic insulation between studs where scheduled.

Liase

With Electrical / Plumbing contractor for reticulation and installation of new services to labs.

Fire Rating

Refer others for coring of service holes in slab. Provide 1 hour fire rating and fire collars to all service penetrations.

1.03 FIBRE CEMENT WALL LININGS

Generally

Install sheeting and top hat framing / ceiling suspension systems strictly in accordance with sheet manufacturers details and specification complete with all accessories required for the application.

Framing

External linings shall be braced against wind uplift off structure. Provide fixings strictly as recommended. Ensure all wall framing is adequate braced and framing to walls (top hats etc) shall be 1.15 BMT guage members to withstand sheet deflection and avoid popping of flushed fixings.

Shop Drawings

Contractor shall provide shop drawing of all sheeting installations. Indicate layout identifying position of all structural support points for top hat framing and details of all sheet joints for approval. The installation Contractor shall be a suitable qualified and authorised installer of the façade / walling system as approved by the sheet manufacturer.

Openings

Co-ordinate install of wall linings with Aluminium window contractor for supply and installation of purpose made folded cappings and flashings etc to perimeter of window openings.

Provide aluminium angle behind compressed sheet edge to perimeter of window and other openings in accordance with sheet manufacturers details. Rebate sheet into window frame. Seal perimeter wall sheet / window frame junction watertight.

Joints / Fixings

Joints shall be constructed to prevent the holding of water and the egress of water into the structure / building. Tape and adhesive fixings shall be as recommended and installed in accordance with the sheet manufacturers details. Pre prime all steelwork prior to application of adhesive tapes etc. Screw fixings shall be stainless steel

Install continuous horizontal / vertical gaskets and backing strip to all joints in accordance with the sheet manufactures details.

Provide proprietory support angles at all sheet corners and junctions. Provide flashings and sealed junctions around sheet penetrations (window / door frames etc). Provide aluminium support angles against frames.

All sheets / expressed joints should be straight and uniform and constructed in accordance with sheet manufacturers details. Obtain approval for setout and position of all expressed joints.

Finish

Provide Dulux Acrashield paint finish – Refer Painting specification

Insulation

Refer Insulation and Barriers section for sisilation / insulation requirements

(A) External Eaves Linings

Horizontal soffit linings - Refer Drawings (Building wings)

Type

General Soffits - 6 thick soffit sheeting system (horizontal – not exposed)

Install sheeting on Rondo 25 top hat suspended ceiling framing system supported off steel framed structure at 450 centres. Brace ceiling against wind uplift and deflection. Set out sheets in a uniform pattern generally as shown on the drawings.

Joints

Expressed - Provide rigid pvc v-joint gasket to all sheet joints. Alternative provide backer strip and finish with 3mm silicone paint grade joint between sheets. Flush and conceal all fixings in accordance with manufactures instructions.

Flush – flush all joints in accordance with manufactures details and instruction.

Finish

Paint finish as scheduled.

(B) External Eaves Linings

Vertical soffit linings – Refer Drawings (Building wings)

Type

Vertical Soffits – 8mm prefinished Scyon or equal Expressed Sheet system (vertical –exposed)

Installation

Install sheeting and top hat framing strictly in accordance with sheet manufacturers details and specification complete with all accessories required for the application.

Support top hat framing on timber framed stud walls and noggings as required. Top hat sections shall be as recommended by the sheeting system manufacturer. Liaise with wall framing contractor for provision of structural steel framing. Confirm set out on site.

Joints

Provide full sheet lengths to minimise horizontal sheet joints. Expressed joints in accordance with manufactures details.

Finish

Paint as specified.

(C) External Canopy Linings

Canopy fascia and soffit linings – Refer Drawings (Main Entry)

Type

12 thick Exotec prefinished Expressed Sheet system

Installation

Install sheeting and top hat framing strictly in accordance with sheet manufacturers details and specification complete with all accessories required for the application.

Support top hat framing on timber framed stud walls and noggings as required. Top hat sections shall be as recommended by the sheeting system manufacturer. Liaise with wall framing contractor for provision of structural steel framing. Confirm set out on site.

Fixings

Allow to tape and fix sheeting from behind where access is available (refer manufacturers recommendations). Provide colour matched exposed fixings (where necessary) set out uniformly at max centres.

Joints

Provide full sheet lengths to minimise horizontal sheet joints. Finish expressed joints in accordance with manufactures details. Refer ceiling plan for setout of sheets.

Graphics

Allow to provide laser cut rebated signage to face of canopy (168) as approved.

Finish

Apply factory applied paint finish as selected.

1.04 COMPOSITE ALUMINIUM LININGS

Extent

Refer drawings

-Roof fascia / barge capping	- folded sheet	(PCL) Building wings – ends
-Roof fascia / barge capping	- folded sheet	(PCL) Apartment 13-14 roof

Type

Provide Composite Aluminium sheet cappings (as approved) to position as shown on the drawings. Support sheeting on proprietory 35 angle / top hat framing fixed to structural steel framing at 600 centres. Horizontal joints to suit max sheet length. Align sheet joints with adjacent materials / junctions in structure. Seal penetrations watertight.

Fabrication / Joints / Fixings

Panel thickness shall be as recommended by the sheet manufacturer for the location and application. Provide folded interlocking panels to suit installation fixed to supporting framework with polyurethane sealed joints. Set out sheet joints to provide uniform layout.

All fixings shall be stainless steel and concealed. Provide drip joints along horizontal leading edges and provide joints in linings to suit sheet modules and junctions with dis-similar materials. Set out joints to uniform design with 10mm wide polyurethane joint.

Fire Performance

Composite linings shall comply with BCA Performance requirement CP2 and specifically Clause C1.1(2.4) ii and iii including Clause 2.4(b) for fixings. Composite cores where deemed combustible by AS1530.1 shall not be deemed to meet the requirements of BCA Clause C1.12(f).

Installation

Shall be in accordance with the manufacturers details and specification and standard details. Provide all accessories as required for installation of wall cladding system and other items as detailed on the approved shop drawings. Liaise with with Roofing / Walling contractor for provision of wall framing and wall cladding systems (LongLine colourbond sheeting)

Shop Drawings

Provide shop drawings for approval showing all details and sheeting setout prior to construction for detailing and setting of all steelwork / top hat framing. Fall horizontal surfaces at grade 2 degree pitch minimum away from building.

Finish

Refer Appendix B Materials and Finishes Schedule.

1.05 SKIRTINGS

Extent

Generally allow to provide skirtings to base of all internal walls. Refer Resilient Finishes / Carpet Floor Finishes for extent

PVC Skirtings

Refer Resilient Finishes Specification

Aluminium Skirtings

Refer Metal work specification

Timber Skirtings

Refer Timber Fixtures specification

1.06 FLUSHING ANGLES / TRIMS ETC

Extent

Generally provide trimming angles to perimeter of all external / internal wall and ceiling linings / soffit etc and at junctions with dis-similar materials.

Junctions / Sheet edges

Provide Rondo P50 / P60 shadowline stopping angle to perimeter flush plasterboard ceilings where abutting wall surfaces unless noted otherwise.

Partition Walls

Provide Rondo P50 / P60 shadowline stopping angle to tops of partition walls where abutting ceilings over to form shadowline (ceiling continuous over).

Door Frames

Provide Rondo P50 (plasterboard) / P60 (fibre cement sheet) shadowline stopping angle to perimeter door frames unless noted otherwise. (timber architraves where scheduled)

Window Sills

Provide Rondo super bead or equal flushing angle to aluminium window and door reveal and sill openings. Provide infill plates to aluminium frames for support off stud framing.

Provide 32mm thick Aust Oak timber sill boards as previously specified where scheduled (Refer Windows / Timber fixtures).

Partition Walls / Window junctions

Provide flush stopping bead to end of wall linings where intersecting aluminium window frames.

Where partition walls intersect glazed partitions and / or external glazed aluminium windows provide colourbond folded capping over end of stud framing wall and fix Capral galzing adaptors to suit glazed or MDF panel infill. Scribe infill to window and glass profile and provide template to glazing contractor to suit.

Co-ordinate

With other trades for installation and fixing / Refer Glazing specification

Corners

Provide Rondo P32 or equal approved corner beads to all external sheet edges set square and flush.

Control Joints

Provide Rondo P35 control joints to all Villaboard / Plasterboard / Fibre Cement wall linings in accordance with sheet manufactures recommendations. Finish all joints straight, smooth and flush.

Obtain approval for setout and final position of all exposed joints prior to commencement.

PARTITIONS

1 GENERAL

1.1 CROSS REFERENCES

General

Refer to Preliminaries / General Requirements / Special Conditions of Contract

Related worksections

Conform to associated worksections as follows:

- *Doors and hatches* for doors and frames in partitions.
- *Light Steel Framing* for steel stud framing
- *Glazing* for glass to glazed partitions and doors
- *Linings* for sheet linings to framed partitions.

1.2 PERFORMANCE

General

Provide partitions in conformance with the **Partition performance schedule** and as follows, where H is the height of the partition:

- To remain stable and do not show signs of deflection, permanent deformation, or rattling
- To support structural design actions, including designated eccentric loads (e.g. loads on attached shelves or brackets), so that deflections will not exceed:
  - H/180 in door frames.
  - H/500 for eccentric loads on partitions.
  - The lesser of H/240 or 30 mm for partitions subjected to wind actions and lined with a flexible cladding.
  - The lesser of H/360 or 20 mm for partitions subjected to wind actions and lined with a brittle material.

2 QUALITY

2.1 INSPECTION

Witness points / Hold points

Refer to Contractors approved inspection and test plan for witness and hold points

3 EXECUTION

3.1 MATERIALS AND COMPONENTS

Metal frames

Aluminium alloy: 5005.

Coated steel: To AS 1397.

3.2 PARTITIONS

General

Provide proprietary non-load-bearing partition wall framing and lining comprising cold formed steel or extruded aluminium members, or both, in conformance with the **Partition construction schedule**.

Building movements

Provide clearances or movement joints so that partitions are not damaged by structural building movements such as long term slab deflection. Where fire resistance or acoustic properties are specified provide a resilient foam or mastic seal having properties equal to those required for the partition.

Control joints

Provide for control joints in sheet finishes where required by the structural frame or the *Lining* worksection.

Erection

Install the partitions so they:

- Are plumb, level, on their correct alignments, and firmly fixed.
- Have adequate top support by fixing the top plate to the ceiling structure or slab soffit, or are stabilised by lapping and fastening intersecting or butting plates together.
- Have bottom plates at 600 mm maximum centres generally, and 100 mm maximum from ends.
- Have studs fixed to the bottom plates at door frames, corners and intersections with self-tapping screws, not with pop rivets or crimping.
- Have studs spaced as required by the lining, but in any case at 600 mm maximum centres.

Fastening

Assemble the frames at door openings with self-drilling self-tapping screws or with blind rivets.

Fixing

General: Conceal fixings. For demountable items provide fixings capable of being repeatedly removed and replaced without damage to finishes.

Fixing to masonry: Provide expansion type masonry anchors. Do not provide explosive-driven fastenings.

Fixing to suspended ceilings: Provide adequate top support to the partition without damage to the ceiling components.

Preparation

Prepare the base to receive the partitions. If fixing partitions on carpet, fix bottom track over polyethylene film.

Protection

Protect existing work from damage during the installation and make good any damage. Provide temporary coverings if necessary.

Services access

Conceal reticulation of associated building services, either within cavities in the partition structure, or within ducted skirtings supplied as part of the partition system, or both. Provide removable or demountable components of the partition system, for access to services concealed within partition cavities.

Service holes

For services within the partition provide either factory precut flared holes, or site cut holes punched or drilled on the centreline of the member. Provide proprietary plastic bushes or grommets to site cut holes. Where service holes cut on site exceed D/3 provide additional strengthening to the member. D is the depth of the member.

Set out

Set out the partitions so that the partition grid, as expressed in panel joints and centrelines of frame members, coincides with the ceiling grid and the building grid, as applicable.

Splicing

Splice plates at ends to maintain continuity and alignment.

Sound properties

General: Preserve the sound reduction properties of R_w rated partitions by sealing flanking sound transmission paths during installation, including junctions between partitions and other building surfaces, air gaps around doorsets, recesses, such as pelmets and blind boxes and cut-outs for services. Avoid cut-outs next to or back-to-back with each other.

Sealing methods: Use appropriate sealing methods, such as purpose-made solid profiled inserts, durable resilient gaskets or closed cell foam strips. Provide solid resilient materials in preference to foamed materials whenever possible.

Support

General: Provide additional support in the form of noggings, trimmers and studs for fixing hardware, fixtures and fittings. Box studs to frame door openings, and provide additional top support independent of the ceiling, where the studs are fixed to the underside of an exposed grid ceiling.

Bracing: Independently brace the partition if sufficient bracing is not provided by the building structure.

Tolerances

Deviation (from true grid lines and planes): 1:1000 up to 3 mm maximum.

Misalignment (of adjoining surfaces at grid junctions): 1 mm maximum.

Panel thickness: + 1 mm maximum, - 0.

SUSPENDED CEILINGS

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide suspended ceilings to the **Selections** and as follows.

- Consistent in finish treatment.

1.2 CROSS REFERENCES

General

General: Conform to Preliminaries / General Requirement

Related sections : Linings / Light Steel Framing / Insulation

Refer Appendix H seismic ceiling design

1.3 STANDARDS

General

Suspended ceilings: To AS/NZS 2785.

Luminaire and air diffuser interface: To AS 2946.

1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of:

- The suspension system before the installation of ceiling tiles or panels.
- The ceiling assembly before the installation of fittings and site painting, if applicable.
- The completed ceiling.

1.5 SUBMISSIONS

Samples

General: Submit samples as follows:

- Suspension system: Sections proposed for the suspension system, including wall angles and trim.
- Ceiling material: Sheet, panel, tile and strip, with insulation, showing the extremes and mean of variation in colour, pattern, or texture of the proposed finish.
- Methods: Methods of jointing, fixing, height adjustment, retaining and removing panels.

Installation

Set-out: Submit proposed set-out indicating cut panels if any, before installation.

Cutting strawboard panels

General: If cutting is unavoidable, submit details of the methods proposed for maintaining the integrity of the boards at cut edges.

Type tests

General: Submit type-test reports to verify conformance as follows:

- Fire hazard properties:
  - Average specific extinction area (non-sprinklered buildings): < 250 m^2/kg to AS/NZS 3837.
  - Group number: To AS/NZS 3837 and BCA Spec A2.4, or AS ISO 9705.
  - Smoke growth rate index (non-sprinklered buildings): < 100 to AS ISO 9705 and BCA Spec A2.4.
- Fire resistance level: To AS 1530.4.
- Weighted suspended ceiling normalized level difference: To ISO 717-1 or AS/NZS ISO 717.1.
- Weighted sound absorption coefficient: AS/NZS 1276.1AS ISO 11654, as tested to AS ISO 354.
- Insulation values

2 PRODUCTS

2.1 SUSPENSION SYSTEM

Proprietary system

General: Provide in conformance with the specification (detailed instructions).

Protective coatings for steel components: To AS/NZS 2785 Table F1.

2.2 CEILING TILES

Tiles

General: Provide in conformance with the specification (detailed instructions).

2.3 LININGS

Plasterboard

Standard: To AS/NZS 2588.

Fibre cement

Standard: To AS/NZS 2908.2.

Wall and ceiling linings: Type B category 2.

Minimum thickness: 6 mm.

Sealants

Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.

Acoustic sealant: Non-hardening sealant compatible with the materials to be sealed and rated to R_w 65.

2.4 PROPRIETARY CEILING SYSTEMS

Proprietary systems

Consistency: Provide suspended ceilings as complete proprietary systems, each fabricated by one manufacturer and installed by a specialist installer of demonstrated capacity.

System: Provide panel, strip, tile or open grid ceilings in conformance with the specification (detailed instructions).

Support: Complete proprietary suspension system fixed to the structural soffit.

3 EXECUTION

3.1 SUSPENSION SYSTEM

Alterations

General: Dismantle and re-use ceiling suspension system members and supplement them with compatible members as required.

Ceiling grid

General: Set out the ceiling grid so that tile or panel joints and centrelines of visible suspension members coincide with grid lines shown on the drawings. If not otherwise shown, set out so that opposite margins are equal.

Suspension system

Failure: Provide a ceiling system such that failure of any one suspension point does not cause a progressive failure of the ceiling.

Height adjustment: Provide height adjustment by means of a length adjustment device at each suspension point, permitting length variation of at least 50 mm.

Grid members: If required, notch grid members at the junction with the perimeter trim to ensure the panels lie flat on the perimeter trim.

Fixing: Ceiling hangers are to be screw fixed with AS 3566 fixings to webs of steel purlins where fixing is required to roof structures. Where fixings are required to concrete slab structures, secure with appropriate sized 'Loxin' or similar masonry anchors.

Restriction: Do not attach the suspension system to the lip of purlins.

Services

Support: Space the support members as required by the loads on the system and the type of ceiling, and allow for the installation of services and accessories, including ductwork, light fittings and diffusers. Provide additional back support or suspension members for the fixing of such items to ensure that distortion, overloading or excessive vertical deflection is prevented. Do not fix suspension members to services (e.g. ductwork) unless the service has been designed to accept the ceiling load. In locations where services obstruct the ceiling supports, provide bridging and suspension on each side of the services. Do not support services terminals on ceiling tiles or panels.

Partitions

General: If partitions are attached to the underside of the ceiling systems include the partition mass in the seismic mass of the ceiling.

Protection

General: Protect existing work from damage during the installation.

Stability

General: Install the ceilings level; and fix so that under normal conditions there is no looseness or rattling of ceiling components.

Structure-borne sound

General: Provide a ceiling system which does not amplify structure-borne sound. Provide suitable proprietary products or systems for reducing contact vibrations between structure and ceiling.

Bracing

General: Provide bracing to prevent wind uplift (external soffits) lateral movement and to resist the imposed horizontal seismic force.

Bulkheads

General: Construct bulkheads and other similar ceiling formations as an integral part of the ceiling structure. Brace bulkheads to prevent lateral movement. If the ceiling is terminated at a bulkhead, provide for seismic requirements.

External suspended soffits

General: Support external suspended soffits on rigid members capable of carrying the loads from imposed actions. Install members to minimise any eccentricity, and ensure that the upward and downward loads from wind actions are carried through to the supporting structure.

Fasteners

General: Install fasteners so that they are not visible in the finished ceiling. Do not use screw fasteners in materials supporting hangers less than 3 mm thick.

Control of movement

Abutments: Install the ceiling to allow for differential movement at abutting surfaces.

Alignment: Install the ceiling with control joints to correspond in location and direction to the structural control joints. Do not bridge any structural control joint.

Tolerance

Suspension system bearing surface: To AS/NZS 2589 Table 4.2.2.

Prefinishes

General: Repair damaged prefinishes by recoating.

Curtain recesses

General: Provide curtain recesses, including:

- Lining / Curtain track support / Accommodation for motors and cabling

3.2 TILES

Alterations

General: Re-use existing tiles and supplement them with new ceiling tiles to suit the suspension system as required.

General

Fitting: Fit tiles accurately and neatly, free from air leakage and staining.

Lock clips: If tiles are exposed to loads from wind actions or if required for security, insert lock clips at the junction of carrier rails and tiles.

Pattern and texture: Set out patterned or heavily textured materials to give consistency in direction of pattern or texture.

Service penetrations

General: Provide openings for, and fit the ceiling up to, all services elements such as light fittings, ventilation outlets, detectors, sprinklers and loudspeakers.

Cut tile edges

General: Conceal, or finish to match prefinished edges.

3.3 PLASTERBOARD LINING

Installation

Gypsum plasterboard and fibre reinforced gypsum plaster: To AS/NZS 2589.

Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.

Multiple sheet layers

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Joints

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

Butt joints: Make joints over framing members or otherwise provide back blocking.

External corner joints: Make joints over metallic-coated steel corner beads.

Control joints: Provide purpose-made metallic-coated control joint beads at not more than 12 m centres in ceilings and to coincide with structural control joints.

Wet areas: Install additional supports, flashings, trim and sealants as required.

3.4 FIBRE CEMENT LINING

Installation

General: Install in accordance with sheet manufacturers recommendations / specification.

Run sheets across the framing members. In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.

Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.

Wet areas: To AS 3740.

Multiple sheet layers

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Material

Proprietory manufactured boards CSR / Hardies or equal approved

Type / Support

6 thick villaboard 600 centres (Timber) 450 centres (Steel) / butt jointed (silicone control joint)

9 thick villaboard 600 centres / flush jointed

7.5 thick Harditex 600 centres / flush jointed proprietary system

Sheet Size

Minimise number of joints by using as large a sheet as possible.

Fixing

Fix in accordance with manufacturers recommendations. All fixings shall be galvanised.

Adhesive fix direct to masonry. Mechanical fix to masonry in area of tiling.

Joints

Provide Rondo flushing angles to all exposed edges

Control joints: Install Rondo control joints at not more than 7.2m centres in walls and ceilings and to coincide with structural movement joints in accordance with sheet manufacturers recommendations.

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

Movement joints in ceilings and soffits: Provide movement joints to divide ceilings into bays not larger than 10.8 x 7.2 m and soffit linings into bays not larger than 4.2 x 4.2 m or 5.4 x 3.6 m. Provide framing parallel to the joint on each side. Do not fix the lining to abutting building surfaces.

External corner joints: Make joints over metallic-coated steel corner beads.

Dry joints: Provide square edged sheet and finish with a UPVC joining section.

Wet areas: Provide additional supports, flashings, trim and sealants as required.

3.5 ACCESS PANELS

Generally
Provide all openings / penetrations / access panels as required for all electrical, Mechanical, Fire and Hydraulic services and fittings (as applicable). Provide collar / escutcheon plates around ceiling penetrations for finishing of sheet edge.

Co-ordination
Refer drawings and other trades for extent of penetrations to ceilings.

Manholes / Access Panels
Opening size: 600 x 600mm unless otherwise shown on the drawings. Provide MDF access panels which match the ceiling panels in appearance. Provide prefinished metal angle trim to perimeter of opening or proprietary fire rated access panel where scheduled. Provide structural framing to perimeter of opening for support of ceiling linings and access requirements.

3.6 PROPRIETARY LINING UNITS

General
Fitting: Fit ceiling lining units accurately, neatly and without distortion. *Provide backing support via suspension system and bracing to lining units required to carry dead loads other than their own weight (eg. Downlights)*

Panel lock clips: If panels are exposed to loads from wind actions or if required for security, insert panel lock clips at the junction of carrier rails and panels.

Accessories
General: Provide accessories as part of the proprietary assembly necessary to complete the installation.

Service penetrations
General: Provide openings for, and fit the ceiling system up to, all services elements such as light fittings, ventilation outlets, detectors, sprinklers and loudspeakers.

3.7 TRIM

Trim Generally
Provide matching trims / angles etc at junctions with other building elements and surfaces. Provide concealed proprietary reinforcing angles to all external corners and edges of all flush jointed wall , ceiling and bulkhead linings.
Junctions / Sheet edges
Rondo P50 shadowline stopping angle to ceilings where abutting wall surfaces.
Corners
Rondo P32 or equal approved corner beads to all external sheet edges set square and flush.
Control Joints
Provide control joints to all new flushed wall / ceiling linings in accordance with manufactures recommendations. Obtain approval for setout and final position of all exposed joints prior to commencement.
Provide control joints in sheeting at ends of intersecting walls or where unavoidable provide Rondo expansion joint beads to joints between end of walls or at sides of window openings (as applicable). Finish all joints straight, smooth and flush.
Ceiling Trims
Provide aluminium shadow line cornice to match 'T' bar finish where ceiling abuts perimeter walls and window frames. Provide all trims and angles as required for finishing of tile, fibre cement and plasterboard edges for completion of ceiling and bulkhead work. (Type Rondo or equal)

1. Bulkhead trim	294, support clip 291	4. Shadow line stopping bead	P50 / P60
2. Shadow line angle	235	5. External corner bead	P32
3. Casing bead	P03	6. Stopping bead	P13
		7. Expansion joints	P33 P45..

Control joints: Install Rondo control joints at not more than 12m centres in walls and ceilings and to coincide with structural movement joints in accordance with sheet manufacturers recommendations.
Plasterboard cornices
Fixing: Adhesive fix with the supplier's cornice cement. Pin in place at cornice edges until adhesive sets, remove pins and fill holes.

Fibrous plaster cornices and roses
Accessible ceiling spaces: Pin or prop in place and fix with wet plaster of Paris and scrim straps over framing members.

Fire rated walls
Seal to soffit with sealant of matching fire rated level prior to fixing decorative cornices.

3.8 SEISMIC RESTRAINT OF CEILINGS

General: Ceiling systems shall be designed and installed to resist seismic forces in accordance with AS 1170.4. Securely fix all members and provide additional bracing as necessary back to the building structure in both directions. Do not rely on gravity and/or friction to resist seismic forces.

3.9 COMPLETION

Maintenance manual

General: On completion, submit a manual of recommendations for the care and maintenance of the ceiling, and operating instructions for demounting if applicable.

Spares

General: Supply spare matching lining units and accessories of each type for future replacement purposes. Store the spare materials on site where directed.

Lining units: One spare tile for every 50 units (or part thereof) installed in the ceiling.

DETAILED INSTRUCTIONS

1.01 FLUSH PLASTERBOARD CEILINGS

(A) Extent

Refer drawings

Type

13mm thick flush plasterboard ceiling on galvanised steel crossrail / furring channel system (Rondo part 127/129 or equal) fixed / suspended from structure.

Wet areas

To wet areas provide moisture resistant plasterboard

Finish

All joints flush and smooth in accordance with sheet manufacturers details/specification. Provide control joints to ceiling where required (obtain approval for setout)

Bulkheads / Borders

Provide flush plasterboard bulkheads to ceiling system to positions as shown on the drawings. Provide aluminium trims and flushing angles to edges as previously specified.

Cornices

Rondo shadowline stopping angle P50 to perimeter of flushed plaster'd ceilings unless noted otherwise.

Insulation

Refer Insulation specification for insulation over ceilings (Acoustic / Thermal).

Services

Provide cutouts for Mechanical / Electrical / Hydraulic services as previously specified. Refer drawings for recessed fittings / penetrations.

Roller Security Grilles

Form framed slot to ceiling for door curtain and tracks . Provide 12mm wide powdercoat angles either side of ceiling slot set level. Confirm set out and details on site. Liaise with Door / Steelwork contractor for setout of steel support beams over above ceiling for support of roller grille.

Recessed ceilings

Recessed ceilings (light troughs) shall be closed off from main ceiling space (airtight)

Access

Provide MDF access panels (manholes) as specified for maintenance access.

Finish

Paint as selected

1.02 SUSPENDED T BAR CEILINGS

(A) Extent

Refer drawings

Grid

1200x600 alumin main / cross runner system with factory applied powder coat finish to all exposed surfaces supplied with all accessories etc as required for completion. Suspend from roof framing over at 1200 centres. Install ceiling in accordance with manufacturers details / instruction.

Ceiling Tile

1200x600 Armstrong prefinished plasterboard - vinyl (white) finish to match existing

Confirm

Setout of all service, fittings penetrations on site with other trades prior to commencement. Confirm grid setout

Cornices

Provide recessed shadowline angle to perimeter of suspended T bar ceilings

Insulation

Refer Insulation section for specification of ceiling insulation .

Supports

Support all ceilings off structural building frame only and provide all structural trimming / framing as required

Borders / Penetrations

Provide cut tiles to perimeter where shown set out uniformly generally as shown on the drawings. Provide aluminium trims / flushing angles / escutcheon cover plates to penetrations.

1.03 FIBRE CEMENT CEILINGS

Generally

Install ceiling in accordance with manufacturers details / instruction. Refer Linings specification for specification of fibre cement wall linings.

Installation

Install sheeting and top hat framing / ceiling suspension systems strictly in accordance with sheet manufacturers details and specification complete with all accessories required for the application. External linings brace against wind uplift off structure. Provide fixings strictly as recommended. Brace framing rigid and use 1.15 BMT guage members to withstand sheet deflection and avoid popping of flushed fixings.

Cornices

Provide shadowline stopping angle P50 to perimeter unless noted otherwise.

Services

Provide cutouts for Mechanical / Electrical / Hydraulic services as previously specified. Refer drawings for recessed fittings / penetrations.

(A) Extent

Horizontal external soffit linings - Refer Drawings

Type

General Soffits - 6 thick CSR Soffitline sheeting system (horizontal – not exposed)

Install sheeting on Rondo 25 top hat suspended ceiling framing system supported off steel framed structure at 450 centres. Brace ceiling against wind uplift and deflection. Set out sheets in a uniform pattern generally as shown on the drawings.

Joints

Expressed - Provide rigid pvc v-joint gasket to all sheet joints. Alternative provide backer strip and finish with 3mm silicone paint grade joint between sheets. Flush and conceal all fixings in accordance with manufactures instructions.

Flush – flush all joints in accordance with manufactures details and instruction.

Finish

Paint finish as scheduled

(B) External Eaves Linings

Vertical external soffit linings - Refer Drawings

Type

Refer Linings specification

1.04 PLASTERBOARD BULKHEADS / SUPPORT FRAMING

(A) Extent

Ceiling Bulkheads / Recessed Ceiling - Refer Drawings

Provide

13 thick flush jointed plasterboard linings on rigid furring channel framing at 600 centres to form bulkheads and borders and recessed ceilings as shown on the drawings. Provide propreitory finishing angles and other trims / flushing angles etc to all edges as previously specified.

Support

Provide rigid light steel framing for support of linings. Cantilever ceiling framing for forming of ceiling recesses where shown. Provide adequate bracing off building structure for support and stability.

Finish

Paint as selected

1.05 PENETRATIONS

Extent

Refer site / drawings

Provide

Purpose made penetrations to all plasterboard / fibre cement and ply timber ceilings to suit fittings and fixtures.

Services

Support : Provide timber trims and other framing above the ceiling for support of electrical and mechanical fixtures / fittings etc. Modify framing as required for the full support of ceiling perimeter.

Provided angle trims / shadowline angles / purpose cut panels and tiles etc as required to accommodate oversized fittings / plant etc recessed into the ceiling. Provide split tiles / collars / escutcheon plates to all service penetrations. (powdercoat)

Refer Electrical / Mechanical drawings for extent of new fittings and other attachments.

Insulation

Allow to reinstate insulation to ceilings where disturbed by other trades.

Liase

With other trades and confirm set out and installation details on site

1.06 CEILING ACCESS / MANHOLES

Extent

Refer Electrical / Mechanical Hydraulic drawings

Refer Ceiling plan

Allow

To provide access panels / manholes as shown on the drawings and as required for all electrical / Mechanical / Fire / Hydraulic and other services for maintenance purposes. Co-ordinate with other trades for final position / set out.

Type

Opening size shall be (generally) 600 x 600mm clear unless noted otherwise. Provide structural framing to perimeter of opening for support of ceiling linings and access requirements. Make good and trim framing and other ceiling support members as required.

Plasterboard Ceilings : Provide powdercoated mitred metal angle trim to perimeter of opening. Provide removable manhole cover 12mm MDF painted to match the ceiling

1.07 CEILING LADDER

Extent

Refer Roof plan / Ceiling plan (Refer drawings)

Provide

Retractable ceiling access system to positions as shown on the drawings.

Type

Sayfa or equal approved compact fold down ladder 1200x600 installed in accordance with manufacturers details and specification. Provide structural timber frame support for fixing.

Co-ordinate

Installation and setout of access system with Roofing / Timber ceiling / Structural timber and steel framing contractors. Provide misc support framing for support of ladder and frame including access to same.

Setout

Setout ladder and adjust ladder angle to ensure extended ladder does not encroach or block egress into stair.

Refer
Roofing section for fixed ladder access to roof in accordance with AS 1657.

1.08 COMPLETION

Completion

Ensure all ceilings are free from damage / marks etc on completion. Builder shall be responsible for making good prior to completion etc. Liaise with Painting contractor where applicable.

WATERPROOFING – WET AREAS

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide wet area waterproofing systems which:

- Are graded to floor wastes to dispose of water without ponding.
- Prevent moisture entering the substrate or adjacent areas.

Selections: As documented.

1.2 CROSS REFERENCES

General

Requirement: Conform to the Preliminaries / General Requirements

Related Sections : Linings / Tiling

1.3 STANDARDS

Wet areas

Standard: To AS 3740 / AS4654.2

Definitions

General: For the purposes of this worksection the definitions given in AS 3740and the following apply:

- Substrates: The surface to which a material or product is applied.
- Bond breaker: A system preventing a membrane bonding to the substrate, bedding or lining.
- Membranes: Impervious barriers to liquid water which may be:
  - Installed below floor finishes.
  - Installed behind the wall sheeting or render and termed External.
  - Installed to the face of the wall sheeting or render and termed Internal.
  - Liquid applied in liquid or gel form and air cured to form a seamless film.
  - Sheet in sheet form with joints lapped and sealed.
- Preformed shower base: A preformed, prefinished vessel (including integral upstands) installed as the finished floor of a shower compartment, and provided with a connection point to a sanitary drainage system.
- Shower tray: An internal or external liquid or sheet membrane system used to waterproof the floor and the wall/floor junctions of a shower area.
- Waterproof (WP): The property of a material that does not allow moisture to penetrate through it.
- Waterproofing systems: Combinations of membranes, flashings, drainage and accessories which form waterproof barriers and which may be:
  - Loose-laid.
  - Bonded to substrates.
- Water resistant (WR): The property of a material that restricts moisture movement and will not degrade under conditions of moisture.
- Wet area: An area within a building supplied with a floor waste.

1.4 INSPECTION

Notice

Inspection: Give notice so inspection may be made of the following:

- Substrate preparation completed.
- Secondary layers preparation completed.
- Before membranes are covered up or concealed.

1.5 SUBMISSIONS

Shop drawings

Submit shop drawings showing:

- Junctions with vertical surfaces and upstands.
- Junctions at perimeters.
- Drainage details.
- Control joints.
- Flashings.
- Penetrations.
- Corners.
- Terminations and connections.

Execution records

Placing records: Photographically record the application of membranes and information as follows:

- Date.
- Portion of work.
- Substrate preparation.
- Protection provided from traffic.

For large or complex projects consider adding the following requirement:

- 'Personnel: Employ a suitably qualified person to monitor the placing and protection of the membrane and prepare a daily report.'

Samples

General: Submit 300 x 300 mm samples of each type of membrane.

Products documentation

General: Submit copies of product manufacturers:

- Product technical data sheets.
- Material safety data sheets (MSDS).
- Type tests certificates verifying conformance to AS/NZS 4858.

2 PRODUCTS

2.1 PRODUCTS

Membranes

Standard: To AS/NZS 4858.

Membrane systems

Requirement: Proprietary membrane systems having a manufacturers certification that the system is suitable for the intended wet area waterproofing

Shower tray

General: Purpose-made jointless shower tray, with wall upstands at least 50 mm higher than the hob upstands. Set hob masonry on the inside of the tray upstands.

Water stop angles

Material: Rigid, corrosion resistant angles compatible with the waterproof membrane system.

Bond breakers

Requirement: Compatible with the flexibility class of the membrane to be used.

Material: Purpose made bond breaker tapes and closed cell foam backing rods or fillets of sealant.

Flashings

Requirement: Flexible waterproof flashings compatible with the waterproof membrane system.

Liquid membrane reinforcement
Requirement: Flexible fabric compatible with the waterproof membrane system.

Sealants
Requirement: Waterproof, flexible, mould-resistant and compatible with host materials.

Adhesives
Requirement: Waterproof and compatible with host materials.

3 EXECUTION

3.1 PREPARATION

Substrates
General: Make sure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion of membranes.
- If walls are plastered, remove loose sand.
- If walls or floors are framed or discontinuous, support members are in full lengths without splicing.
- If floors are solid or continuous:
  - Excessive projections are removed.
  - Voids and hollows > 10 mm with abrupt edges are filled with a cement:sand mix not stronger than the substrate nor weaker than the bedding.
  - Depressions < 10 mm are filled with a latex modified cementitious product with feathering eliminated by scabbling the edges.
  - Cracks in substrates wider than 1.5 mm are filled with a filler compatible with the membrane system.

External corners: Round or arris edges.

Moisture content
Concrete substrates: Cure for > 21 days.

Moisture content: Verify that the moisture content of the substrate is compatible with the water vapour transmission rate of the membrane system by testing to AS/NZS 2455.1 Appendix B.

Test type:

- Hygrometer test: Seal a hygrometer to the substrate for > 16 hours and measure the relative humidity of the air between the instrument and the slab.
- Electrical resistance test: Connect a resistance meter to the slab and read the moisture content.

Falls
Substrate: If the membrane is directly under the floor finish ensure the fall in the substrate conforms to the fall nominated for the finish.

Sheet substrate fastening
Requirement: Fasten or adequately fix to the supporting structure.

Control joints
Finishes: Align control joints in finishes and bedding with control joints or changes in materials in the substrate.

Water stop angles
Requirement: Provide water stop angles at door thresholds and shower enclosures to support the waterproof membrane at junctions between waterproofed and non-waterproofed areas.

Sizing: Size the vertical leg of the water stop angle to conform to the requirements of AS 3740.

Corners: Cut the horizontal leg and bend the vertical leg at corners instead of forming vertical joints between separate lengths of angle.

Fixing: Fix water stop angles to the substrate with compatible sealant or adhesive and corrosion-resistant countersunk or wafer head screws.

Priming
General: If required by the membrane manufacturer, prime the substrates with a primer compatible with the membrane system.

Bond breakers

Requirement: After the priming of surfaces, provide bond breakers at all wall/floor, hob/wall junctions and at control joints where the membrane is bonded to the substrate.

Sealant fillet bond breakers:

- Application: Form a triangular fillet or cove of sealant to internal corners within the period recommended by the membrane manufacturer after the application of the primer.
- Widths: 5 mm x 5 mm to vertical corners. 6 mm x 6 mm – 9 mm x 9 mm to horizontal corners.

Backing rod bond breakers: Retain in position with continuous length of tape pressed firmly in place against the surfaces on each side of the rod.

3.2 APPLICATION

Protection

General: Protect membrane from damage during installation and for the period after installation until the membrane achieves its service characteristics that resist damage.

Extent of waterproofing

Waterproof or water resistant surfaces: To the requirements of BCA 3.8.1.2 and Ministers Specification and AS4654.2.

Sheet membrane joints

Bituminous sheet membranes:

- Side laps > 75 mm.
- End laps > 100 mm.

Synthetic rubber membranes:

- Factory-vulcanized laps > 40 mm.
- Field side laps > 50 mm for side laps.
- Field end-laps > 100 mm for end laps.

PVC membranes:

- Factory welded laps > 30 mm.
- Field–welded laps > 75 mm.

Vertical membrane terminations

Upstands: At least 150 mm above the finished tile level of the floor or 25 mm above the maximum retained water level, whichever is the greater.

Anchoring: Secure sheet membranes along the top edge.

Edge protection: Protect edges of the membrane.

Flashings

Junctions between waterproof surfaces: Provide a bond breaker at internal corners behind flashings.

Junctions between waterproof surfaces and other surfaces: Provide a bead of sealant at the following junctions:

- Waterproof and water-resistant surfaces.
- Water-resistant and water-resistant surfaces.
- Water-resistant and non water-resistant surfaces.

Perimeter flashings: Provide continuous flashings to the full perimeter of waterproof areas at wall/floor junctions and to water stop angles.

Vertical flashings: Provide vertical corner flashings continuous across wall/wall junctions to at least 1800 mm above finished floor level.

Vertical liquid applied flashings:

- Return legs at least 40 mm on each wall.
- Overlap the vertical termination of the floor waterproofing membrane at least 20 mm.

Vertical sheet flashings:

- Return legs at least 50 mm on each wall.
- Overlap shower tray upstands at least 50 mm.
- Do not penetrate flashing with wall lining fasteners.

Reinforcement: At coves, corners and wall/floor junctions with gaps greater than 3 mm reinforce liquid applied membranes with reinforcement fabric tape recommended by the membrane manufacturer. Fold the tape in half lengthways and imbed it in the first flashing coat of membrane with one half of the tape on each side of the corner or joint. Apply a second coat of liquid membrane to seal the fabric.

Doorjambs and architraves

Requirement: Where the bottom of doorjambs and architraves do not finish above the floor tiling, waterproof their surfaces below tile level to provide a continuous seal between the perimeter flashing to the wall/floor junction and the water stop angle.

Drainage connections

Floor wastes: Provide floor wastes of sufficient height to accommodate the thickness of floor finishes and bedding at the outlet position. Position drainage flange to drain at membrane level. Turn membrane down 50 mm minimum into the floor waste drainage flanges, and adhere to form a waterproof connection.

Floor wastes in shower trays: Provide drainage of the tile bed and a waterproof connection between the tray and the drain.

Preformed drainage channels with continuous drainage flanges: Provide a continuous waterproof connection between the membrane and the channel.

Preformed drainage channels without drainage flanges: Provide continuous waterproofing under the channel and terminate the membrane at a floor waste with a recessed drainage flange.

Enclosed showers with hobs

General: Construct from masonry, concrete or corrosion-resistant metal. Fix securely to the floor, seal against walls and make flush all gaps, joints and intersections prior to application of the membrane.

Autoclaved aerated concrete hobs: Do not use for external membrane systems. Prime prior to the application of the membrane.

Internal membranes: Extend membrane over the hob and into the room at least 50 mm.

External membranes (hob located inside membrane tray): Dress membrane up outside of hob and finish at the underside of tiles capping the top of the hob.

Enclosed showers with step-downs

Levels: Conform to AS 3740 Figure 3.5 and as follows:

- Finish the highest level of the shower area at a level at least 15 mm below the finished floor level outside the shower.
- Extend the membrane at least 10 mm above the maximum retained water level in the area outside the shower or 150 mm above the finished floor level of the shower area, whichever is the greater.

With framed shower screens: Terminate the membrane directly below the floor tiles below the shower screen sill mounted on the upper level of the step-down. Support and adhere the membrane to a water stop angle fixed securely to the upper level substrate.

With frameless shower screens: Install the shower screen with the inside face flush with the step-down. Terminate the membrane outside the shower screen at least 1500 mm from the shower rose outlet on the wall. Support and adhere the membrane to a water stop angle fixed securely to the substrate. Finish membrane flush with the underside of tiles.

Enclosed hobless showers with framed shower screens

Requirement: Conform to AS 3740 Figure 3.6 and as follows:

- Turn the membrane up against a water stop angle fixed securely to the substrate directly below the shower screen sill.
- Size the angle so that the vertical leg finishes at least 5 mm above the level of the tiles.

Support and adhere the membrane to the angle and finish it flush with the top of the vertical leg.

Enclosed hobless showers with trench drain located below screen

With framed or frameless shower screens: Install a water stop angle where the outer edge of the trench drain to the perimeter of the shower will be installed. Size the angle so that the vertical leg finishes at the underside of the tiles. Support and adhere the membrane over the water stop angle and terminate the membrane at floor wastes as described in **Drainage connections**. Install the trench drain with the shower screen located vertically above it.

Unenclosed showers

Requirement: Extend membrane at least 1500 mm into the room from the shower rose outlet on the wall.

Preformed shower bases

Support: Fully support shower bases without causing distortion or cracking.

Junction with walls for bases with integral perimeter upstands: Conform to AS 3740 Figure 3.1 and as follows:

- Recess shower base into walls or batten off wall lining sufficiently to allow water-resistant wall finishes to overlap the integral upstands along the top edge of the shower base.
- Maintain the structural integrity of walls that are rebated.

-

Baths and spas

Junction of walls with baths: Conform to AS 3740 Figure 3.2 and as follows:

- Baths with integral upstands: Recess bath edges into walls or batten off wall lining sufficiently to allow water-resistant wall finishes to overlap the bath's integral perimeter upstands. Maintain the structural integrity of walls that are rebated.
- Baths without integral upstands or with showers over – rendered masonry walls: Form or chase a rebate in the render to receive the bath edge. Waterproof the wall above and below the rebate, including the rebate, and the floor area under the bath. Seal the edge of the bath into the rebate.
- Baths without integral upstands or with showers over – framed and lined walls: Form a rebate in the wall lining with a corrosion-resistant lipped channel to receive the bath edge. Waterproof the wall above and below the rebate, including the rebate, and the floor area under the bath. Seal the edge of the bath into the rebate.

Plinth-mounted insert baths and spas: Conform to AS 3740 Figure 3.2 and as follows:

- Line framed enclosures for insert baths.
- Form an upstand on the inside edge of the enclosure opening to receive the bath with an angle or compressible foam rod.
- Waterproof walls abutting the enclosure, the top of the plinth and the interior and exterior of the enclosure.
- After tiling the walls, outside of the enclosure and plinth top, install the bath with its downturn edge lip outside the upstand formed on the edge of the opening and seal the lip to the tiles.

Taps and spouts

Requirement: Waterproof penetrations for taps and spouts with proprietary flange systems or a sealant.

Provision for servicing: Install taps in a manner that allows tap washers or ceramic discs to be serviced without damaging the waterproofing seal.

Recessed soap holders

Construction: Support all faces of the recess and line with the same sheet material as the adjacent wall. Fall base of recess towards the shower area. Flash all junctions and waterproof all surfaces.

Membrane horizontal penetrations

Sleeves: Provide a flexible flange for all penetrations, bonded to the penetration and to the membrane.

Membrane vertical penetrations

Pipes, ducts, and vents: Provide separate sleeves for all pipes, ducts, and vents and have fixed to the substrate.

Curing of liquid applied systems

General: To the manufacturers instructions.

Curing: Allow membrane to fully cure before tiling.

Overlaying finishes on membranes

Requirement: Protect waterproof membranes with compatible water-resistant surface materials that do not cause damage to the membrane.

Suitable materials: Conform to AS 3740.

Bonded or partially bonded systems: If the topping or bedding mortar is required to be bonded to the membrane, provide sufficient control joints in the topping or bedding mortar to reduce the movement over the membrane.

3.3 FLOOD TEST

General

Application: Perform a flood test before the installation of surface finishes.

Moisture measurement method: Conform to AS/NZS 2455.1 Appendix B.

Set-up:

- Measure the wall/floor junction of adjacent spaces and the floor soffit below for dryness.
- Record the result for each area.
- Dam the doorway(s) and seal floor wastes and drainage outlets to allow 50 mm water level.
- Fill space with clean water and leave overnight.

Evaluation:

- Make a visual inspection of the wall/floor junction of adjacent spaces and of the floor soffit below for obvious water or moisture.
- Test the same areas for dryness and compare the results to the measurements taken prior to flooding.

-

Compliance:

- Evidence of water from the visual test: Failure.
- No visual evidence of water: Proceed with moisture measurements.
- Test results indicating an increase in moisture before and after flooding: Failure.

Records:

- Submit records of all flood tests.

3.4 COMPLETION

Protection

General: Keep traffic off membrane surfaces until bonding has set or for 24 hours after laying, whichever period is the longer.

Reinstatement: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

Warranty

Waterproofing: Cover materials and workmanship in the terms of the warranty in the form of interlocking warranties from the supplier and the applicator.

- Form: Against failure of materials and execution under normal environment and use conditions.
- Period: As offered by the supplier.

DETAILED INSTRUCTIONS

1.01 WATERPROOF LININGS

Generally

Provide waterproofing to substrates for carrying out of new works. Ensure all membranes are applied in accordance with manufacturers details and instructions and are compatible with applied finishes.

Location	Extent	Type
Wet areas	Tiled areas	- Ardex Wet Seal or equal wet area membrane system
All areas	Walls (in ground)	- Bituthene sheet / Gripset / concrete encasement
Balconies	Tiled areas	- Ardex / ABA WPM2 waterproof membrane system or equal

Refer

Tiling specification for floor drains and waterproof systems to balconies

Balconies Thresholds

Refer AS4654.2 for waterproofing balcony thresholds. Provide aluminium cover angles to threshold to cover waterproofing to sill where exposed. Maintain min 10mm clearance between base of frame and top of tiling as per code.

RESILIENT FINISHES

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Install resilient floor coverings to substrates as follows and/or to **Selections**:

- To remain secured for the warranty life of the covering.
- To remain consistently smooth for the warranty life of the covering.
- To form the pattern required.

1.2 CROSS REFERENCES

General

Requirement: Conform to the Preliminaries / General Requirements

Related sections : Tiling / Carpet

1.3 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Resilient floor coverings classification: To BS EN 685.
- Substrate: The surface to which a material or product is applied.
- Underlay: A layer of sheet material or in situ filling on the substrate that modifies the behaviour of the subsequent finish.

1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Completion of laying underlay, if any.
- Substrate immediately before fixing resilient finishes.
- Finished surface before applying sealers or polishes (if any).
- Completed installation.

1.5 TESTS

Slip resistance

Submit tests as follows:

- Type test slip resistance of flooring product to AS/NZS 4586.
- Site test completed surfaces to AS/NZS 4663.

1.6 SUBMISSIONS

Samples

Range: Submit labelled samples of resilient finishes illustrating the range of colour, pattern or texture as seen in the finished work.

Minimum size per sample:

- Sheet: 450 x 450 mm.
- Tiles: A whole tile or 0.09 m^2, whichever is the greater.
- Linear accessories (coving, skirting, stair nosing, protection strips, and the like): A piece 300 mm long.

Welded joints: Submit a sample joint 300 mm long.

Identification

Labelling: Label each sample, giving brand, product name, and manufacturer's code reference (including the code for each coat of multi-coat work).

Trial set-out: Prepare a trial set-out before fixing.

Subcontractors

General: Submit names and contact details of proposed suppliers and installers.

Tests

Manufacturer's test data: Submit independent testing authorities' reports of factory or type tests showing that materials comply with cited standards.

Materials and components

Manufacturer's data: Submit the manufacturer's published product data for each type of finish, and recommendations for its application in the project including, where relevant, the following:

- Thickness and width of sheet or size of tile.
- Adhesive and jointing method.
- Resistance to wear, indentation, chemicals, light and fire.
- Flexibility and bending strength.

2 PRODUCTS

2.1 GENERAL

Critical radiant flux

Standard: To AS ISO 9239.1.

Floor finishes: Conform to the values of critical radiant flux nominated in **Selections**.

Smoke development rate

Standard: To AS ISO 9239.1.

Floor finishes in non-sprinklered buildings: 750 percent-minutes.

2.2 MARKING

Identification

General: Deliver materials to the site in the manufacturer's original sealed containers legibly marked to show the following:

- Manufacturer's identification.
- Product brand name.
- Product type.
- Dimensions and quantity.
- Product reference code and batch number.
- Date of manufacture.
- Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern.
- Handling and installation instructions.

2.3 UNDERLAYS

Cementitious

General: Polymer modified cementitious self smoothing and levelling compound.

- Thickness: 3 mm minimum.

Fibre cement underlay

Standard: To AS/NZS 2908.2, Type B, category 2 minimum.

Thickness: 5 mm minimum.

Wet processed fibreboard (hardboard) underlay

Standard: To AS/NZS 1859.4.

Classification: General purpose medium board, manufactured specifically as flooring underlay.

Thickness: 5.5 mm.

2.4 SHEETS AND TILES

Edges of sheets and tiles
General: Ensure edges are firm, unchipped, machine-cut accurately to size and square to the face, and that tile edges are square to each other.

Cork tiles
Standard: To BS EN 12104.

Linoleum
Standard: To BS EN 548.

Corklinoleum
Standard: To BS EN 688.

Rubber
Standard: To BS EN 12199.

Polyvinyl chloride (PVC)
Resilient floor covering, jute or polyester felt backing: To BS EN 650.

Resilient floor covering, with foam layer: To BS EN 651.

Vinyl bench topping
General: Fully flexible homogeneous sheet.

Adhesives
General: As recommended by the resilient finishes manufacturer. Except for Kangaroo Island, the Adelaide Hills and in the South East of SA, below Meningie, where waterproof screed (Carson 244™ or equal approved) shall be applied. The floor coverings shall then be installed using the appropriate compatible adhesive. All adhesives shall be applied at full strength.

Flexible terrazzo tiles
General: Marble or granite chips bedded in a flexible thermoset resin matrix, precision ground and polished.

Static control flooring
General: Unbacked flexible PVC or linoleum sheet with carbon particles permanently heat and pressure fused throughout the thickness of the material with electrical resistance within the range of surface resistance specified in AS 2834 clause 2.1.2, when tested to AS 4155.6.

Acoustic sheet vinyl
General: Unbacked flexible sheet vinyl laid over separate closed cell foam underlayment.

Underlayment thickness: 2 mm.

Slip resistant sheet vinyl
Verification: A product type tested to confirm the stated slip resistance classification.

Inlaid vinyl sheet
General: A layer of vinyl chips inlaid in a translucent vinyl matrix, bonded to a moisture resistant backing.

2.5 SYNTHETIC SPORTING SURFACES

Standard
General: To AS 3541.1.

3 EXECUTION

3.1 SUBCONTRACTORS

General
General: Use specialist installers recommended by the materials manufacturers.

3.2 PREPARATION

Substrates
General: To AS/NZS 2455.1 Section 2.

Tolerance: Conform to the **Substrate tolerance table**.

Substrate tolerance table

Property	Length of straight edge laid in any direction	Max. deviation under the straight edge
Flatness Class A	3 m	3 mm
Smoothness	150 mm	1 mm
Projections	50 mm	0.5 mm

Cleaning concrete surfaces: Mechanically remove the following surface treatments:

- Sealers and hardeners.
- Curing compounds.

Cleaning timber surfaces: Remove oil, grease and traces of applied finishes.

Concrete substrate correction: Remove projections and fill voids and hollows with a levelling compound compatible with the adhesive.

Timber substrate correction: Remove projections. If conformance to the **Substrate tolerance table** can not be achieved fix an underlay in brick pattern with joints avoiding substrate joints.

Moisture content: Do not commence installation unless:

- Concrete: The moisture content of the concrete has been tested to AS/NZS 2455.1 Appendix B and the values in clause 2.4.2 (c) have been obtained. Moisture content shall not exceed 5% at the time of laying the floor covering.
- Plywood and timber: The moisture content of battens/joists or plywood background has been tested to AS/NZS 1080.1 and values obtained as follows:
  - Air conditioned buildings: 8 to 10%.
  - Intermittently heated buildings: 10 to 12.5%.
  - Unheated buildings: 12 to 15%.

Working environment

General: Do not start work before the building is enclosed, wet work is complete and dry, and good lighting is available. Protect adjoining surfaces.

Conditioning

General: Stabilise the room temperature for seven days before, and two days after, installation of resilient finishes, as follows:

- Areas with air conditioning installed: Run air conditioning at operational temperature.
- Air conditioned areas not operational: Maintain a room temperature range of < 30º > 18ºC.
- Underfloor heating: Turn off heating and allow background to stabilise at the temperature recommended by the carpet manufacturer.
- Non-air conditioned areas: Install at < 30º > 18ºC.

Underlay: Expose both faces of each sheet for > 24 hours before fixing.

Resilient sheet and tile floor covering: Stack for > 48 hours before installation.

3.3 SHEET AND TILE INSTALLATION

Sheet set out

General: Set out sheets to give the minimum number of joints. Run sheet joints parallel with the long sides of floor areas, vertically on walls.

Tile set out

General: Wherever possible cut tiles at margins only, to give a cut dimension of at least 100 mm x full tile width. Match edges and align patterns. Arrange the material so that variation in appearance is minimised.

Joints

Non-welded: Butt edges together to form tight neat joints showing no visible open seam.

Junctions

General: Scribe neatly up to returns, edges, fixtures and fittings. Finish flush with adjoining surfaces.

Rolling

General: Where rolling is required, roll the finish in 2 directions before the adhesive sets, using a 70 kg multi-wheeled roller.

Change of finish

General: Maintain finished floor level across changes of floor finish including carpet.

Cleaning

General: Keep the surface clean as the work proceeds.

3.4 TILING

Cork tiles

Laying: Provide a water-based latex adhesive. Do not use pins.

Finishing: Sand after laying.

Rubber tiles

General: Keep tiles flat during storage. Before laying allow the tiles to relax and decompress, and ensure that the backs are free of loose material.

Adhesive:

- Horizontal surfaces: Solvent-free epoxy mechanically mixed and used only within the limit of pot life.
- Stair skirtings, stop ends, external mouldings and vertical surfaces: Neoprene contact adhesive applied to both the tile or accessory and the substrate surface. Fix when both surfaces are touch dry.

Laying: Lay tiles in stretcher bond. Match edges and align joints and studs. Ensure that the whole surface of the tile or accessory is in contact with the substrate.

Finishing: Sweep, vacuum, and wash using clean warm water and household soap only, to remove foreign matter, including protective wax coating. Buff when dry. Provide a suitable polish if recommended in conjunction with buffing.

3.5 VINYL SHEETING

Welded joints

Heat welding: After fixing, groove the seams using a grooving tool and weld the joints with matching filler rod and using a hot air welding gun. When the weld rod has cooled, trim off flush.

Cold welding: Apply seaming compound 100 mm wide to the substrate centrally under the seam. Roll the seam until the compound is forced up into the joint. Clean off flush using a damp cloth.

Epoxy jointing: Join seams with epoxy adhesive.

Static control flooring

General: Install conductive vinyl sheet on a copper grid comprising copper tape 80 µm thick x 10 mm wide adhered to the floor with conductive adhesive. Lay copper tape along each length of sheet vinyl and connect it at right angles to a 1 M resistor. Connect to earth with copper tape at 20 – 30 m^2 intervals.

3.6 JOINTS AND ACCESSORIES

Junctions

General: Finish junctions tapered to with adjoining surfaces. Where changes of floor finish occur at doorways locate the joint on the centreline of the closed door leaf.

Accessories

General: Provide purpose-made matching moulded accessories for nosings, coves, skirtings, edge cover strips and finishes at junctions, margins, and angles, if available. Otherwise form accessories from the sheet material. Provide solid backing for radiused coves and nosings.

Edge strips

General: Provide edge cover strips at junctions with different floor finishes and to exposed edges.

Metal cover strip: Extruded tapered strip 25 mm wide, of the same thickness as the sheet or tile. Fix with matching screws to timber bases or to masonry anchors in concrete bases, at 200 mm maximum centres.

UPVC cover strip: Feather-edge strip matching the floor finish, fixed with contact adhesive.

Caulked joints

General: Provide caulked joints filled with sealant and finished flush with the vinyl surface at the junction of built in joinery and other fixtures in contact with the floor.

Control joints

Location: Provide control joints as follows:

- Over structural control joints.
- At junctions between different substrates.

Depth of joint: Right through to the substrate.

Sealant width: 6 – 25 mm.

Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Control joint materials – sheet flooring

Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges to finish flush with the flooring surface.

Vinyl skirting

Feather edge: Moulded PVC skirting section.

Flat skirting: Flat PVC skirting section.

Fixing: Scribe as necessary. Mitre corners. Fix to walls with contact adhesive. When fixed to masonry face walls, fill and perpends and bed joints flush with face of wall prior to fixing skirting.

Minimum height: 100 mm.

Rubber coved skirtings and margins

General: Form from smooth flat sheet matching the colour and total thickness of the rubber flooring. Scribe and mitre at internal corners.

External corners and stop ends: Provide purpose-made matching moulded pieces.

Coved skirtings

Site formed coving: Carry the flooring material up over a profiled coving section to form the skirting and mitre and weld all joints. Ensure the radius of the coving section conforms to the requirements of the supplier for the sheeting material and thickness.

Protection of sheet materials

General: Keep traffic off floors until bonding has set or for 24 hours after laying, whichever period is the longer. Do not allow water in contact with the finish for 7 days.

Reinstatement

Extent: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

Warranties

General: For each type of resilient finish specified, submit the installer's warranty of the workmanship and application.

Certificate of compliance

General: Provide a Certificate of compliance for antistatic and conductive floor installations.

Maintenance manual

General: Submit manufacturer's published use, care and maintenance requirements for each type of finish.

Spare materials

General: Supply spare matching covering materials and accessories of each type for future replacement purposes. Store the spare materials on site where directed.

Quantity: At least 1% of the quantity installed.

Cleaning

General: Clean the finished surface. Buff and polish. Before the date for practical completion, mop and leave the finished surface clean and undamaged on completion.

Cleaning antistatic and conductive flooring

General: Do not use sealers, wax or floor polish. Clean using a mild neutral detergent and lukewarm water. A clean floor may be dry buffed using a normal scrubbing machine and a white nylon pad.

DETAILED INSTRUCTIONS

1.01 GENERALLY

Adhesives / Substrates

Allow to prepare all substrates as required for application of new floor finishes.

Toppings

Allow for feathered proprietory toppings and skim coats as required adjacent dis similar floor finishes etc. in order to ensure an even and smooth crossover. Grade 1:14

Use Vibro Ardur K15 cw Ardion 25 / or equal approved self levelling / topping compounds suitable for application as recommended by manufacturer.

Underlays

Provide 5mm James Hardie or equal approved flush jointed underlay over timber floors ready for new vinyl floor finishes. Refer Timber Fixtures specification for sanding and making good existing timber floors.

Thresholds

Allow to feather floors locally around doorways adjacent to wet area floors / tiled floor junctions / timber floors etc to obtain uniform and level transition. Grade 1:14

Make good concrete thresholds using proprietory topping / levelling compounds as previously specified to obtain required levels.

Angle Trims

Provide brass / stainless steel / aluminium angle trims and threshold plates between all dissimilar floor finishes.

1.02 PROTECTION OF FLOORS

Allow

To provide proprietory self adhesive non slip plastic sheeting (and cardboard protective underlay) where required to prevent physical damage or dust intrusion to floors in area of works. Maintain protective sheeting for duration of works.

1.03 SKIRTINGS

Extent

Refer Floor Finishes Schedule .

Timber Skirtings

Refer Timber Finishes section for specification.

Metal Skirtings

Refer Metal Fixtures section for specification.

Vinyl skirtings

100 high Armstrong Nylex as previously specified. Provide feathered type for vinyl floors.

Coved Vinyl / Rubber

Coved vinyl flooring (skirtings) - Cove vinyl flooring up wall complete with all fillet accessories. Finish edge of vinyl sheeting into surface mounted pvc raglet / cover strip unless noted otherwise.

Co-ordinate

Installation of coved floor finishes with joinery installation

1.04 STAIR NOSINGS

Concrete steps

Provide 3-4mm radius tooled edge to insitu concrete stair nosings with formed grooves setback 20mm from edge 70mm deep.

Stairs

Provide applied stair nosings to all treads and fix in accordance with manufacturers details (to suit substrate)

Extent

Hotel	Service entry steps	Insert type	Concrete treads and risers
Apartments	Stair 1	Edge type	Concrete treads and risers
Carpark	Stair 2	Edge type	Steel treads and risers

Insert Type

Install Latham Asbra safety tread 4935K 50x5 with nonslip inserts as selected into concrete stair treads. Nosing insert shall have 30% colour contrast variation. Adhesive fix locally along length.

Edge type

Install Spectrum Slimline SLC124 aluminium nonslip nosing to stair treads. Nosing insert shall have 30% colour contrast variation. Screw and adhesive fix locally along tread.

1.05 TACTILIE INDICATORS

Extent

Apartments	Stair 01	Nil	Fire isolated stair
Carpark	Stair 02	Nil	Fire stair
Hotel	Steps / Ramp	Tactile indicators TT02	Accessible ramps

Type TT01 (externally)

Proprietory precast concrete tile inserted into concrete paving / pavement where shown. Tactile profile and set out shall comply with AS1428 with 30% colour contrast to background.

Type TT02 (internally)

Provide tactile indicators DTAC stainless steel warning tactiles to positions as shown on the drawings in accordance with AS1428. Drill slab and floor coverings and epoxy adhesive fix tactiles.

Set out

Comply with AS1428. Generally position at top and bottom of stairs for full width generally 600 deep set 300mm off nosing. Confirm setout on site prior to commencement.

1.06 NEW RESILIENT FLOOR FINISHES

Extent

Refer Floor Finishes Schedule .

Note

Resilient finishes section shall be read in conjunction with Carpet Floor finishes.

Preparation

Carryout all preparation works as previously specified

Prior to laying of vinyl finishes prepare concrete floors with CARSON ADHESIVES 280 Top-Seal (or equal approved) applied to manufacturer's recommendations

Installation

All flooring systems shall be installed in accordance with the manufacturers details and instructions Direct stick vinyl sheet flooring using commercial grade adhesives as approved by the flooring supplier. Use epoxy adhesives to edges of sheeting and to perimeter of penetrations (service / plumbing risers) in sheeting. Provide all accessories as required for installation including pvc escutcheon plates.

Setting out / Threshold Seals

Set out sheeting to minimise junctions. Co-ordinate works with other trades for installation of doors and setting out of threshold plates at door ways. (setout at centre of doors). Provide aluminium threshold plates at junction of floors. (where not provided by others.)

Joints / Coving

Seam weld all joints where applicable. Install new joinery over new vinyl flooring. Provide continuous 3mm polyurethane sealant bead to base of all joinery where abutting vinyl flooring to provide a water proof joint.

Provide fillers and round all corners (12mm radius) for coving of vinyl to plinths etc. Provide continuous Pvc raglet / capping piece to edge of vinyl sheet where coved up walls / junction with wall vinyl or other.

1.07 FLOOR FINISHES SCHEDULE

Extent

Refer Appendix B – Materials and Finishes Schedule for selection of finishes as follows :

Location	Substrate	Floor Finish	Skirting	Comment
Apartments				
Lounge / Dining	Conc	Timber	T	
Bedrooms 1-2	Conc	Carpet	T	
Kitchen	Conc	Timber	T	
Entry	Conc	Timber	T	
Bathroom	Conc	TL	TL	Full height tiling as selcted
External foyer	Conc	TL	TL	Refer elevations for extent of tiling
Service Areas				
Store Rooms	Conc	Sealed	RF	Feathered pvc skirting
Waste rooms	Conc	epoxy	-	Refer Painting specification
Stairs	Conc	Sealed	-	Non combustrible linings
Stair landings	Conc	Sealed	-	
Ground floor Entry	Conc	DM / TL	AL	
Toilets (Ground floor)	Conc	TL	TL	Full height to side wall

LEGEND

TL	Tiles (ceramic)	RF	Resilient Finish (vinyl)	T	Timber
LA	Laminate	SK	Refer Appendix B	DM	Dirt Mat

TILING

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide tiling systems to walls, floors and other substrates as follows and/or to the **SELECTIONS**:

- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Set out with joints accurately aligned in both directions and wall tiling joints level and plumb.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or adjacent areas.

1.2 CROSS REFERENCES

General

Requirement: Conform to the Preliminaries / General Requirements

Related sections : Waterproofing / Linings

1.3 STANDARDS

Tiling

General: Comply with the recommendations of those parts of AS 3958.1 which are referenced in this worksection.

Slip Resistance

Classification: To AS/NZS 4586 for the classifications noted in **SELECTIONS**.

Slip resistance measurement of existing installations: To AS/NZS 4663.

Minister's Specification SA F1.7

All work under the Development Act must comply with Minister's Specification SA F1.7 – Waterproofing of wet areas in buildings – Additional requirements.

1.4 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Adhesives:
  - Cementitious (C): Adhesives in which the binders are hydraulic, e.g. Portland cement, with aggregates and organic additives.
  - Dispersion (D): Adhesives in which the binders are in the form of aqueous polymer dispersion with mineral fillers and organic additives.
  - Reaction resin (R): Adhesives in which in the binders are synthetic resins with mineral fillers and organic additives. The curing occurs by chemical reaction.
- Substrates: The surface to which a material or product is applied.
- Bedding: Mixtures of materials which are applied to substrates in a plastic state and which dry, cure and adhere tiles to substrates.
  - Adhesive bedding: Tiling adhered by adhesives.
  - Mortar bedding: Tiling adhered in a cementitious mortar bed.
- Pavers: Slabs made from clays, stone, precast concrete and/or other inorganic raw materials generally over 20 mm thick used as coverings for floors and supported over continuous substrates.
- Tiles: Thin slabs made from clays and/or other inorganic raw materials used generally as coverings for floors and walls and adhered to continuous supporting substrates.
  - Cementitious: Cement based pre-finished tiles.
  - Dry-pressed: Tiles made from a finely milled body mixture and shaped in moulds at high pressure. Also known as Type B.
  - Extruded: Tiles whose body is shaped in the plastic state in an extruder then cut to size. Also known as Type A.

- Wet area: An area within a building supplied with a floor waste.
- Acoustic underlay: A resilient underlay providing acoustic isolation.
- Lippage: Height deviation between adjacent tiles.
- Stepping: The relative surface level of adjacent paving elements within the expanse of the main pavement.

1.5 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Substrate immediately before tiling.
- Trial set-outs before execution.
- Control joints before sealing and grouting.
- Grout and sealant colours before application.

1.6 SUBMISSIONS

Samples

General: Submit labelled samples of tiles, including fittings, accessories, grout and sealants, illustrating the range of variation in colour and finish.

Execution

Grouting: Submit proposals for grouting methods and materials.

Margins: If it appears that variations in joint widths or overall dimensions will avoid cut tiles, submit a proposal.

Product conformity

Assessment: Submit current assessments of conformity as follows:

- Declaration of conformity by an AS/NZS ISO 9001 quality management system certified supplier:
  - Slip resistance of the tiles specified in **Selections** to AS/NZS 4586.
- Marking and Classification of tiles with regard to water absorption and shaping to AS 4662.
- Marking and Classification of tile adhesive to AS 4992.1.
- Weighted normalised impact sound pressure level to AS ISO 717.2 as measured for the acoustic underlay as part of the entire tiling system.

1.7 TESTS

General

Tests: Submit tests as follows:

- Type test slip resistance of tiles to AS/NZS 4586.
- Site slip resistance test of completed surface to AS/NZS 4663.

1.8 TOLERANCES

Completed tiling

Standard: To AS 3958.1 clause 5.4.6.

2 PRODUCTS

2.1 MARKING

Identification

General: Deliver materials to the site in the manufacturer's original sealed containers legibly marked to show the following:

- Manufacturer's identification.
- Product brand name.
- Product type.
- Dimensions and quantity.
- Product reference code and batch number.
- Date of manufacture.
- Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern.
- Handling and installation instructions.

-

2.2 TILES AND ACCESSORIES

Tiles

Standard: To AS 4662.

Tactile ground surface indicators: To AS/NZS 1428.4.1.

Coves, nosings and skirtings: Provide matching stop-end and internal and external angle tiles moulded for that purpose.

Exposed edges: Purpose-made border tiles with the exposed edge (whether round, square or cushion) glazed to match the tile face. If such tiles are not available, mitre tiles on external corners.

Accessories

General: Provide tile accessories to the **Accessories schedule** which match the composition, colour and finish of the surrounding tiles.

Coves, nosings and skirtings

General: Provide matching stop ends and internal and external angle / trims moulded for that purpose. Coved tiles as specified

2.3 ADHESIVES

General

Standard: To AS 2358 and AS 4992.1.

Type

General: Provide adhesives to the **Wall tiling schedule** and to the **Floor tiling schedule** and compatible with the materials and surfaces to be adhered.

Prohibited uses: Do not provide the following combinations:

- Cement-based adhesives on wood, metal, painted or glazed surfaces, gypsum-based plaster.
- Organic solvent-based adhesives on painted surfaces.
- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- PVA (polyvinyl acetate) based adhesives in wet areas or externally.

2.4 MORTAR

Materials

Cement type to AS 3972: GP.

- White cement: Iron salts content 1%.
- Off-white cement: Iron salts content 2.5%.

Lime: To AS 1672.1.

Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

Bedding mortar

Proportioning: Select proportions from the range 1:3 – 1:4 cement: sand (by volume) to obtain satisfactory adhesion. Provide minimum water.

Terra cotta tiles: Use proprietary polymer modified mortar.

Mixing: To AS 3958.1 clause 2.15.

Water

General: Clean and free from any deleterious matter.

2.5 GROUT

Type

Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

Terra cotta tiles: Use proprietary polymer modified grout.

Portland cement based grout: Mix with fine sand. Provide minimum water consistent with workability.

- For joints < 3 mm: 1 cement:2 sand (by volume).
- For joints 3 mm: 1 cement:3 sand (by volume).

Pigments
Pigments for coloured grout: Provide colourfast fillers compatible with the grout material. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.

2.6 CONTROL JOINTS

Control joint materials
Control joint strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.

Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges.

Sealant: One-part self-levelling non-hardening mould resistant, silicone or polyurethane sealant applied over a backing rod. Finish flush with the finished surface.

- Floors: Trafficable, shore hardness > 35.

Backing rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

3 EXECUTION

3.1 SUBSTRATES

Drying and shrinkage
General: Before tiling, allow at least the following times to elapse (for initial drying out and shrinkage) for these substrates:

- Concrete slabs: 42 days. / Concrete blockwork: 28 days.
- Toppings on slabs and rendering on brick or blockwork: A further 21 days.
- Rendering on swimming pool shell: A further 28 days minimum.

3.2 PREPARATION

Standard
Preparation: To AS 3958.1 Section 4.

Ambient temperature
General: If the ambient temperature is < 5 or > 35°C, do not lay tiles.

Substrates without wet area membranes
General: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- If framed or discontinuous, support members are in full lengths without splicing.
- If solid or continuous:
  - Excessive projections are removed.
  - Voids and hollows > 10 mm with abrupt edges are filled with a cement:sand mix not stronger than the substrate or weaker than the bedding.
  - Depressions < 10 mm are filled with a latex modified cementitious product with feathering eliminated by scabbling the edges.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not apply mortar bedding to substrates showing surface moisture.

Dense concrete: If not sufficiently rough to provide a mechanical key, roughen by scabbling or the like to remove 3 mm of the surface and expose the aggregate; then apply a bonding treatment.

Substrates with wet area membranes
General: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- Compatible with all components of the floor system.

Trial set-out
General: Prepare a trial tile set-out of each area as follows to:

- Maximise the size of equal margins of cut tiles.
- Locate control joints.
- Note minor variations in joint widths to eliminate cut tiles at margins.
- Mark location of fittings on walls.

-

3.3 FIXING UNDERLAY

Underlay fixed on joists

Installation: Lay the length of the sheets at right angles to the supports. Stagger the end joints and locate them centrally over joists. If panels are not tongue and grooved provide noggings or trimmer joists to support the edges.

Fixing centres: Maximum 300 mm on each support.

- Fibre-cement flooring: Fix sheeting to the supports with adhesive and non-corrosive countersunk screws. Fill the screw holes with sealant before fixing. After fixing, stop the screw heads with the same sealant, finished slightly below the sheet surface.
- Particleboard and plywood flooring: Fix sheeting to the supports with adhesive and nail.

Membranes: If sheet flooring is the substrate for a wet area membrane, fix with stainless steel countersunk head screws.

3.4 TILING GENERALLY

Sequence

General: Fix wall tiles before floor tiles.

Cutting and laying

Cutting: Cut tiles neatly to fit around fixtures and fittings and at margins where necessary. Drill holes without damaging tile faces. Cut recesses for fittings such as soap holders. Rub edges smooth without chipping.

Laying: Return tiles into sills, reveals and openings. Butt up to returns, frames, fittings, and other finishes. Strike and point up beds where exposed. Remove tile spacers before grouting.

Variations

General: Distribute variations in hue, colour, or pattern uniformly, by mixing tiles or tile batches before laying.

Protection

Floor tiles: Keep traffic off floor tiles until the bedding has set and attained its working strength.

Cleaning: Keep the work clean as it proceeds and protect finished work from damage.

Floor finish dividers

General: Finish tiled floors at junctions with differing floor finishes with a corrosion-resistant metal dividing strip fixed to the substrate. If changes of floor finish occur at doorways, make the junction directly below the closed door.

Bath ventilation

General: Ventilate the space below fully enclosed baths with at least 2 vermin proofed ventilating tiles.

Sealed joints

General: Fill joints with silicone sealant and finish flush with the tile surface where tiling joins sanitary fixtures and at corners of walls in showers.

3.5 SETTING OUT

Tile joints

Joint widths: Set out tiles to give uniform joint widths within the following limits:

Floors: Dry pressed tiles: 3 mm / Extruded tiles: 6 mm. / Vitrified: 3 to 5 mm. / Quarry tiles: 6 to 12 mm /
Chemical resistant epoxy jointed tiling: 5 to 6 mm. / Large and/or irregular floor tiles: 6 to 12 mm.

Mounted mosaics: To match mounting pattern.

Walls: Dry pressed tile: 1.5 mm. / Extruded tile: 6 mm.

Joint alignment: Set out tiling with joints accurately aligned in both directions and wall tiling joints level and plumb.

Joint position: Set out tiles from the centre of the floor or wall to be tiled.

Margins

General: Provide whole or purpose-made tiles at margins where practicable, otherwise set out to give equal margins of cut tiles. If margins less than half tile width are unavoidable, locate the cut tiles where they are least conspicuous.

Fixtures

General: If possible position tiles so that holes for fixtures and other penetrations occur at the intersection of horizontal and vertical joints or on the centre lines of tiles. Continue tiling fully behind fixtures which are not built in to the tiling surface. Before tiling ensure that fixtures interrupting the tile surfaces are accurately positioned in their designed or optimum locations relative to the tile layout.

3.6 FALLS AND LEVELS

Grading

General: Grade floor tiling to even and correct falls to floor wastes and elsewhere as required. Make level junctions with walls. Where falls are not required lay level.

Fall, general: 1:80 minimum.

Fall, in shower areas: 1:60 minimum.

Change of finish: Maintain finished floor level across changes of floor finish including carpet.

3.7 BEDDING

Standard

Cement mortar: To AS 3958.1 clause 5.5.

Adhesive: To AS 3958.1 clause 5.6.

Preparation of tiles

Adhesive bedding: Fix tiles dry; do not soak.

Mortar bedding: Soak porous tiles in water for half an hour and then drain until the surface water has disappeared.

Terra cotta tiles: Use pre-sealed tiles or apply a breathable sealer and lay dry. If a final sealed finish is selected, use a compatible laying sealer.

Bedding

General: Use bedding methods and materials which are appropriate to the tile, the substrate, the conditions of service, and which leave the tile firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

Thin adhesive beds

General: Provide only if the substrate deviation is less than 3 mm when tested with a 3 m straight edge. Cover the entire tile back with adhesive when the tile is bedded.

Thickness: 1.5 – 3 mm.

Thick adhesive beds

General: Provide on substrates with deviations up to 6 mm when tested with a 3 m straight edge, and with tiles having deep keys or frogs.

Nominal thickness: 6 mm.

Adhesive bedding application

General: Apply adhesive by notched trowel to walls and floors and direct to tiles if required, to provide evenly distributed coverage after laying as follows:

- Domestic internal walls: > 65%.
- Domestic internal floors: > 80%.
- Other wall and floors: > 90%.
- Wet areas and bench tops: 100%.

Pattern of distribution of adhesive: As described in AS 3958.1 clause 5.6.4.3. Verify by examining one tile in ten as work proceeds.

Wall tile spacers: Do not use spacer types that inhibit the distribution of adhesive.

Curing: Allow the adhesive to cure for the period nominated by the manufacturer prior to grouting or allowing foot traffic.

Mortar beds

For floor tiles: Either lightly dust the screeded bed surface with dry cement and trowel level until the cement is damp, or spread a thin slurry of neat cement, or cement-based thin bed adhesive, on to the tile back. Do not provide mortar after initial set has occurred.

Thick Bed Mortars (Thickness 5mm – 40mm).

Select proportions from the range of 1:3 to 1:4 cement/sand with proprietory additive of rubber latex type as specified.

Thin Bed Mortars (Thickness 1mm – 5mm).

Select proportions from the range of 1:1 to 1:2 cement/sand with proprietory additive of rubber latex type as specified.

Thick reinforced beds: Place mortar bed in two layers, and incorporate the mesh reinforcement in the first layer.

Mechanical fixing

General: Provide a proprietary system of support and fixing appropriate to the type of tile and the substrate conditions.

3.8 CONTROL OF MOVEMENT

General

General: Provide control joints carried through the tile and the bedding to AS 3958.1 clause 5.4.5, the **Control joints schedule** and as follows:

- Floor location:
  - Over structural control joints.
  - To divide complex room plans into rectangles.
  - Around the perimeter of the floor.
  - At junctions between different substrates.
  - To divide large tiled areas into bays.
  - At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.
- Depth of joint: Right through to the substrate.
- Sealant width: 6 – 25 mm.
- Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

3.9 GROUTED AND SEALANT JOINTS

Grouted joints

General: Commence grouting as soon as practicable after bedding has set. Clean out joints as necessary before grouting.

Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.

Edges of tiles: Grout exposed edge joints.

Epoxy grouted joints: Ensure that tile edge surfaces are free of extraneous matter such as cement films or wax, before grouting.

Mosaic tiles

Grouting mosaics: If paper faced mosaics are to be bedded in cement mortar, pre-grout the sheeted mosaics from the back before fixing. After fixing, rub grout into the surface of the joints to fill any voids left from pre-grouting. Clean off surplus grout. When grout has set, wash down. If necessary use a proprietary cement remover.

Sealant joints

General: Provide joints filled with sealant and finished flush with the tile surface as follows:

- Where tiling is cut around sanitary fixtures.
- At corners of walls in showers.
- Around fixtures interrupting the tile surface, for example pipes, brackets, bolts and nibs.
- At junctions with elements such as window and door frames and built-in cupboards.

Material: Anti-fungal modified silicone.

Width: 5 mm.

Depth: Equal to the tile thickness.

3.10 JOINT ACCESSORIES

Floor finish dividers

General: Finish tiled floors at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitably fixed to the substrate, with top edge flush with the finished floor. Where changes of floor finish occur at doorways make the junction directly below the closed door.

Stepping: Less than 5 mm.

Adjustments

If the floor finish divider was installed by the wet area waterproof membrane applicator check that the height is sufficient for the topping and tile thickness. Adjust as required with a matching flat bar adhesive fixed to the divider angle.

Weather bars

General: Provide a corrosion resistant metal weather bar under hinged external doors. Locate under the centres of closed doors.

3.11 COMPLETION

Spare tiles

General: Supply spare matching tiles and accessories of each type for future replacement purposes. Store the spare materials on site.

Quantity: At least 1% of the quantity installed.

Cleaning

General: Clean tiled surfaces using an appropriate tile cleaning agent, and polish.

Operation and maintenance manuals

General: Submit a manual describing care and maintenance of the tiling, including procedures for maintaining the slip-resistance grading stating the expected life of the slip-resistance grade.

DETAILED INSTRUCTIONS

1.01 NEW TILING

Extent

Refer Drawings / Floor Finishes Schedule for extent of new tiled finishes

Type

Refer Appendix B – Materials and Finishes Schedule for selection of tiles

Setdowns

Liase with Carpentry contractor for provision of setdowns and falls to all wet area tiled floors (refer drawings).

Wet Area Floors / Substrates

Refer Timber Fixtures specification for new compressed fibre cement wet area floor linings to wet areas as scheduled (FC).

Waterproof all internal wet areas as previously specified. Refer Appendix - Ministers Specification.

External tiling shall be carried out in accordance with sheet manufacturers details and instructions and AS3958 /AS4654.2.

Door Thresholds

Provide tiled door thresholds to all external door openings. Refer Appendix B Materials and Finishes Schedule. Mitre all edges. Set tiling out in uniform and symmetrical pattern. Finish at centre of door adjacent timber floor with aluminium angle.

Balconies

Fixing

Prepare substrates and lay tiles as previously specified given floor condition / location and application.

(commercial application)

Junctions

Provide stainless steel angles to tile perimeter / dissimilar floor junctions. Terminate tiles into stainless steel angle at middle of hung door. Finish tiling 12mm above finished concrete floor level (to suit carpet finishes – as applicable).

Provide aluminium angle trims / threshold plates between dissimilar floor finishes (Raven RP82) .

Penetrations

Co-ordinate installation of fittings and fixtures. Provide chrome plate escutcheon plates to all service penetrations. Provide drip collars to all wall outlets and silicone seal against tile to seal substrate. Liaise with other trades.

Setting Out

Setout all tiling to obtain uniform pattern. Mitre all tiles at external corners and provide proprietory pencil round protective insert strip to match tile colour.

Control Joints

Provide flexible joints in tiles to match joints in substructure (thin bed adhesive). Provide control joints in tiles max 4.5 metres and at perimeter wall junctions (existing building).

Provide marine grade 45x15 nominal 316 stainless steel perforated angles fixed to floor either side of joint. Provide bond breaking tape to joint and provide full depth flexible trafficable joint sealant. Products : Parchem / Sika

1.02 TILE ACCESSORIES

Extent

All wet area tiled walls and floors

Tile Accessories

Provide the following accessories to tiled areas :

Wet Areas	Tiled walls	- PVC pencil corner mould
Wet Areas	Floor junctions	-Stainless steel angle to suit
Balconies	Balcony edge	-Alcan aluminium Tee section 38x38x3 (EH2926) all around

1.03 STAIR NOSINGS

Generally

Refer Resilient Finishes specification for stair Nosings and Tactiles.

1.04 FLOOR FINISHES SCHEDULE

Extent

Refer Appendix B – Materials and Finishes Schedule for selection of finishes as follows :

Location	Substrate	Floor Finish	Skirting	Comment
Apartments				
Lounge / Dining	Conc	Timber	T	
Bedrooms 1-2	Conc	Carpet	T	
Kitchen	Conc	Timber	T	
Entry	Conc	Timber	T	
Bathroom	Conc	TL	TL	Full height tiling as selcted
External foyer	Conc	TL	TL	Refer elevations for extent of tiling
Service Areas				
Store Rooms	Conc	Sealed	RF	Feathered pvc skirting
Waste rooms	Conc	epoxy	-	Refer Painting specification
Stairs	Conc	Sealed	-	Non combustrible linings
Stair landings	Conc	Sealed	-	
Ground floor Entry	Conc	DM / TL	AL	
Toilets (Ground floor)	Conc	TL	TL	Full height to side wall

LEGEND

TL	Tiles (ceramic)	RF	Resilient Finish (vinyl)	T	Timber
LA	Laminate	SK	Refer Appendix B	DM	Dirt Mat

1.05 ACOUSTIC UNDERLAY

Extent

All tiled / timber floors in Living / Kitchen / Bedroom areas shall be installed with proprietory acoustic underlay as approved.

Floors shall comply with RW+CTr 50 and Lnw (impact) <62.

1.06 WATERPROOF DECKS AND BALCONIES

Extent

Refer Drawings

Compliance

Install waterproofing to concrete substructure in accordance with BCA Clause / Table F1.7 and AS3740 / AS4654.2 as applicable.

Install

Proprietory stainless steel strip drains to tiled areas. Extend waterproofing under drains or over waterproof skirt flashings where provided.

Drain

Install Creative Drain Solutions Vesatile 316 stainless steel continuous strip drains 106x25 deep with linear 9 bar removal grate. Screw fix and bed drain flat to substrate and provide 50 dia outlets to stormwater connection under. (flying dp under slab). Provide polyurethane sealed joint between tile and upper drain edge.

Tile Screeds / waterproofing

Provide tiling as scheduled at grade (1: 80 min) to external concrete floors.

Provide the following waterproofing and tile bedding system installed in accordance with the manufacturers details and specification. Provide protective covering to waterproof membrane during tile installation.

ABA	WPM300 primer applied to slab with sand seed coat
ABA	A38 screen with Abacrete additive set to grade 1:80 min / 20mm thick min (where applicable)
ABA	WPM2 waterproof membrane 2mm thick
ABA	X77 Tile adhesive
Tiles	Refer Materials and Finishes Schedule
Grout	FG8 Flexigrout (colour as selected)

1.07 FLOOR DRAINS

Extent

Provide falls as previously noted and as shown to tiled floor wet area tiled floors and external decks.

Install

Proprietory stainless steel floor outlets to all tiled and vinyl floor finishes.

Type

Install Creative Drain Solutions 316 stainless steel continuous strip drains with linear removal bar grate. Build body of drain into wet area floor waterproof membrane.

Refer Appendix B -Materials and Finishes Schedule .

1.08 CONTROL JOINTS

Generally

Flexible movement joints shall be designed to suit specific movement and exposure requirements (trafficable / internal / external. Refer engineers drawing for location of movement joints. All movement joints shall be designed and constructed in accordance with the suppliers details and specification for the application.

Tiled Control joints (internal – pedestrian traffic)_

In area of concrete control joints extend joint through tile finishes (cut tiles either side of joint where necessary). Allow to provide marine grade 45x45 nominal 316 stainless steel perforated angles fixed to slab either side of joint. Bed angles over proprietory flexible expansion joint tape epoxy bonded to slab either side of joint. Provide bond breaking tape to joint and provide full depth flexible trafficable joint sealant.

Products : Parchem / Sika

Tiled Balconies

Provide flexible joint to perimeter of tiled area all around where abutting dissimilar services. Sealant to suit application.

(external / pedestrian traffic / flexible / waterproof)

CARPETS

1 GENERAL

1.1 RESPONSIBILITIES

General

Lay carpet to backgrounds as follows and/or to the **Selections**:

- To remain secured for the warranty life of the carpet.
- To remain consistently smooth for the warranty life of the carpet.
- To form the pattern required.

1.2 CROSS REFERENCES

General

Requirement:

Conform to the Preliminaries / General Requirements

Related sections : Resilient Finishes

1.3 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Substrate, subfloor: The surface to which a material or product is applied.

1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Each batch of material upon delivery to the works.
- Subfloor prepared to receive the carpet installation.
- Fixings, edge strips, and underlay installed ready to lay carpet.
- Completed carpet after cleaning and before covering for protection.

1.5 SUBMISSIONS

Samples

General: Submit labelled production run samples illustrating the range of colour, pattern, texture and pile yarn available in the required carpet types.

Sample size:

- Carpet: Manufacturer's standard swatch
- Tiles: 4 x tile size.
- Edge strip: Submit a 300 mm length of each type.
- Underlay: Submit one labelled sample. Size: At least 600x600 mm

Penetrations: Submit one production carpet sample with a penetration access cut .

Accessories: Submit one sample all fixing components and accessories

Stitching: Submit one sample, at least 1 m long, of a stitched seam.

Subcontractors

General: Submit name and contact details of proposed suppliers and installers for approval.

Floor Laying Plan

Submit a floor covering plan for approval prior to installation indicating the setout of the flooring and location of joints. Joints shall be made between full sheets only. The use of off cut / infill pieces resulting in excessive seams / joints in any one area will not be approved.

2 PRODUCTS

2.1 GENERAL

Critical radiant flux
Standard: to AS ISO 9239.1.

Carpet systems and carpet tiles: Conform to the values of critical radiant flux nominated in **Selections**.

Smoke development rate
Standard: To AS ISO 9239.1.

Floor finishes in non-sprinklered buildings: 750 percent-minutes.

2.2 CARPET

Tolerances
Standard: To AS/NZS 1385.

Batching
General: Carpet laid in a single area and of a single specified type, quality, colour and design, must come from one manufacturing batch and dye lot.

Insect resistance
Insecticide: Provide carpets and underlays composed entirely of materials either inherently resistant to insect attack, or treated against insect attack, including by moth and carpet beetle, by application of insecticide to the yarn during the dyeing or scouring process.

Approved insecticides
General: Provide insecticides listed in the **Approved insecticides table**.

Alternatives: Other agents may be used provided they comply with the recommended application levels promulgated from time to time by the Woolmark Company for Level 4 protection.

Approved insecticides table

Insecticide	Minimum level of application (per cent on weight of wool pile fibre)	
	Dyebath application	**Scouring application**
Eulan U33	0.36%	0.45%
Mitin LP	0.44%	0.54%
Perigen	0.25%	0.32%

Electrical resistance
General: Provide carpet which is within the range of surface resistance specified in AS 2834 clause 2.1.2, when tested to AS 4155.6.

Electrostatic propensity
Criterion: Provide a maximum electrostatic propensity value for carpet of 2500 V at a relative humidity of 25%.

Test method: AATCC TM 134.

VOC limits
Total VOC limit:

- Generally: 0.5 mg/m^2.
- Compliance: To the Environmental Classification Scheme operated by the Carpet Institute of Australia.

2.3 CARPET TILES

Carpet tiles
Type: 'Non-stick', non-curling tiles capable of being taken up without damage and then relaid in different positions.

Marking: On the back, showing recommended direction of laying.

Carpet tile tolerances:

- Edge dimensions: ± 2 mm.
- Squareness: Maximum difference of 2 mm between lengths of diagonals.

Sustainable carpet tile backing
Reusable backing: Proprietary vinyl backing to carpet tiles capable of separation and reuse in replacement tiles.

2.4 MATS

Type

Melcor Kencord or equal approved entrance mats at all external doors. Set mats flush with adjacent floor finishes. Provide SF ANT27 aluminium trim to perimeter / edge adjoining adjacent finishes. (Unless noted otherwise)

2.5 UNDERLAYS

Standard

General: To AS/NZS 2455.1.

Fibre cement underlay

Thickness: 5 mm minimum.

Wet processed fibreboard (hardboard) underlay

Standard: To AS/NZS 1859.4.

Classification: General purpose medium board, manufactured specifically as flooring underlay.

Thickness: 5.5 mm.

Soft underlay

Standard: To AS 4288.

2.6 ADHESIVES AND TAPES

Standard

General: To AS/NZS 2455.1.

Adhesives

General: Compatible with the floor covering material, and suitable for bonding it to the subfloor.

Type: [complete/delete]

Friction compound: Suitable for holding tiles in position without permanent sticking.

Hot-melt adhesive tapes

General: Commercial grade glass fibre and cotton thermoplastic adhesive coated tape 60 mm wide on a 90 mm wide metal foil base and backed with silicon-coated release paper.

2.7 STRIPS

Preformed gripper strips

General: Commercial grade plywood carpet gripper strip with 3 rows of rust-resistant angled pins of length appropriate to the carpet type.

Size (minimum): 33 mm wide x 7 mm thick.

Location: At edges, except where edge strips are used. Provide double gripper strips to edges where recommended.

Edge strips

Type: Heavy duty edge strip appropriate to the floor covering type (tackless or adhesive fixed), capable where necessary of accommodating different levels of adjacent floor finishes.

Form: Metal moulding or extrusion, with vinyl inserts. Colour as approved

Location: At exposed edges of the carpet, and at junctions with differing floor finishes or finishes of a different thickness. Where edge strips occur at doorways, locate the junctions directly below the closed door.

2.8 ACCESSORIES

Stair Installation

General: To AS/NZS 2455.1 clause 3.10.

Coves And Nosings

To stair treads provide proprietory stair nosings over carpet finishes unless noted otherwise. Provide Spectrum Multi purpose Slimline nosings to stair treads (Type SC, SD, SLM) complete with durable removable rubber inset.

Edge strips

Generally provide Roberts or equal approved proprietory smooth edge strips to perimeter edges.

To perimeter junctions with dissimilar floor finishes provide aluminium naplocks with vinyl inserts. Where edge strips occur at doorways, locate the junctions directly below the closed door. Finish carpet under Raven threshold plates at external

3 EXECUTION

3.1 SUBSTRATE

Substrates

General: Ensure substrates conform to the **Substrate tolerance table** and are as follows:

- To AS/NZS 2455.1 or AS/NZS 2455.2, as appropriate.
- Clean and free of any deposit or finish which may impair adhesion or location and functioning of control joints.

Substrate tolerance table

Property	Length of straight edge laid in any direction	Max. deviation under the straight edge
Flatness	3 m	6 mm
Smoothness	150 mm	1 mm

Concrete substrate correction: Remove projections and fill voids and hollows with a levelling compound compatible with the adhesive.

Timber substrate correction: Remove projections. If conformance to the **Substrate tolerance table** can not be achieved fix an underlay in brick pattern with joints avoiding substrate joints.

Moisture content: Do not commence installation unless:

- Concrete: The moisture content of the concrete has been tested to AS/NZS 2455.1 Appendix B and the values in clause 2.4.2 (c) have been obtained.
- Plywood: The moisture content of battens/joists or plywood background has been tested to AS/NZS 1080.1 and values obtained as follows:
  - Air conditioned buildings: 8 to 10%.
  - Intermittently heated buildings: 10 to 12.5%

Fixtures: Remove door stops and other fixtures, and refix in position undamaged on completion of the installation.

Conditioning

General: Stabilise the room temperature for seven days prior to, and two days after laying carpet as follows:

- Areas with air conditioning installed: Run air conditioning at operational temperature.
- Air conditioned areas not operational: Maintain a room temperature range of < 35º > 10ºC.
- Underfloor heating: Turn off heating and allow background to stabilise at the temperature recommended by the carpet manufacturer.
- Non-air conditioned areas: Install at < 35º > 10ºC.

Underlay: Expose both faces of each sheet of underlay for > 24 hours before fixing.

Unroll the carpet and soft underlay and allow them to come to the temperature of the in-service environment before laying.

3.2 LAYING CARPET

Standard

General: To AS/NZS 2455.1.

Setting out

General: Lay the carpet in continuous lengths without cross joins in the body of the area. Where unavoidable cross joins occur at doorways, locate the joins directly below the closed doors.

Joints in underlay: Ensure joints in underlay do not coincide with carpet joints. Do not carry underlay over carpet grippers or edge strips.

Partition layout: Confirm that permanent partitions have been installed before starting carpet laying.

Fixing underfelt

To timber floors: Secure underfelt with staples at 100 mm centres at edges and joints, in parallel lines 600 mm apart.

To concrete floors: Glue continuously at edges and joints with a 100 mm wide strip to each piece, and at 600 mm centres both ways with 150 mm diameter patches.

Seaming methods

Woven carpet: Machine or hand sew. Do not provide glued taped seams.

Tufted carpet: Seam with hot-melt adhesive tape.

Carpet installation

Gripper system: To AS/NZS 2455.1 clause 3.5.

Direct stick system: To AS/NZS 2455.1 clause 3.6.

Double bond system: To AS/NZS 2455.1 clause 3.7.

Pre applied underlay adhesive system: To AS/NZS 2455.1 clause 3.8.

Hook and loop system: To AS/NZS 2455.1 clause 3.9.

Cutting laid carpet

Method: Where penetrations through laid carpet are necessary for electrical, telephone or other outlets, cut the carpet either by cross cutting or by cutting rectangular or circular openings.

Cutting holes in concrete floors: Protect the carpet and remove concrete particles and dust on completion. Replace the cut carpet over the opening without any signs of fraying or other damage, and fix with a peel-up adhesive, or resew.

3.3 LAYING CARPET TILES

General

Standard: To AS/NZS 2455.2.

Set out: Do not provide cut tiles which are less than half tile width. Provide full tiles in doorways. Keep joint lines straight.

Laying: Do not allow the pile to catch in the joint when laying. Do not tack or sew the tiles to the floor or to each other.

Pattern: as specified

Fixing

Perimeter and grid system: To AS/NZS 2455.2 clause 7.1.

Fully adhered pressure sensitive system: To AS/NZS 2455.2 clause 7.2.

Double bond system: To AS/NZS 2455.2 clause 7.3.

Fixing cut tiles: Adhesive fix to 100% of tile.

3.4 COMPLETION

Maintenance manual

Contents: Submit a maintenance manual containing a technical specification of the carpet installation and setting out the manufacturer's recommendations, approved by the Australian Wool Corporation in the case of products containing wool, for its use, care and maintenance. Include the names and addresses of the suppliers and manufacturers of each component.

Standard: To AS/NZS 3733.

Spares

Spare material: Supply spare matching materials of each type, colour and design of carpet from the same batch for future replacement purposes.

Labelling: Label spare and offcut material appropriately, including the location of the laid area corresponding to each batch. Securely and separately package each batch in a suitable wrapping.

Quantity of spare material: At least 1% of the quantity installed, in full or part length rolls.

Storage locations: on site as directed

Cleaning

Progressively clean the work. Remove waste, excess materials and adhesive.

Final cleaning: When the installation is complete, clean the carpet as necessary to remove extraneous matter, marks and soiling and to lift the pile where appropriate.

Protection: provide fabric drop sheets. Do not use plastic sheeting. If wheeled traffic is to follow carpet installation protect with hardboard sheets butted and fixed with adhesive tape.

DETAILED INSTRUCTIONS

1.01 GENERALLY

Adhesives / Substrates

Allow to prepare all substrates as required for application of new floor finishes.

Toppings

Allow for feathered proprietory toppings and skim coats as required adjacent dis similar floor finishes etc. in order to ensure an even and smooth crossover. Grade 1:14

Use Vibro Ardur K15 cw Ardion 25 / or equal approved self levelling / topping compounds suitable for application as recommended by manufacturer.

Installation

All flooring systems shall be installed in accordance with the manufacturers details and instructions. Direct stick carpet tiles using commercial grade adhesives as approved by the flooring supplier. Provide heavy duty commercial grade underlay where recommended. Provide all accessories as required for installation.

Setting out / Threshold Seals

Set out sheeting to minimise cut tiles. Co-ordinate works with other trades for installation of doors and setting out of threshold plates at door ways. (setout at centre of doors). Provide aluminium threshold plates at junction of floors.

(where not provided by others.)

Thresholds

Allow to feather floors locally around doorways adjacent to wet area floors / tiled floor junctions / timber floors etc to obtain uniform and level transition. Grade 1:14

Make good concrete thresholds using proprietory topping / levelling compounds as previously specified to obtain required levels.

Angle Trims

Provide brass / stainless steel / aluminium angle trims and threshold plates between all dissimilar floor finishes.

Door Entry Floor Mats

Allow to provide stainless steel angle to floor with feathered screeds to perimeter for matching of entry mat and adjacent carpet tile levels. (6-7mm to 0mm). Mat insert as previously specified unless noted otherwise.

(Refer Materials Finishes Schedule)

1.02 PROTECTION OF FLOORS

Allow

To provide proprietory self adhesive non slip plastic sheeting (and cardboard protective underlay) where required to prevent physical damage or dust intrusion to floors in area of works. Maintain protective sheeting for duration of works.

1.03 SKIRTINGS

Extent

Refer Floor Finishes Schedule .

Timber Skirtings

Refer Timber Finishes section for specification.

Metal Skirtings

Refer Metal Fixtures section for specification.

Vinyl skirtings

100 high Armstrong Nylex as previously specified. Provide feathered type for carpet floors.

1.04 STAIR NOSINGS / TACTILIE INDICATORS

Refer

Resilient Finishes specification for extent

1.05 ENTRY CARPET / DIRT MATS

Refer

Refer Appendix B Materials and Finishes schedule for type and extent

1.06 FLOOR FINISHES SCHEDULE

Extent

Refer Appendix B – Materials and Finishes Schedule for selection of finishes as follows :

Location	Substrate	Floor Finish	Skirting	Comment
Apartments				
Lounge / Dining	Conc	Timber	T	
Bedrooms 1-2	Conc	Carpet	T	
Kitchen	Conc	Timber	T	
Entry	Conc	Timber	T	
Bathroom	Conc	TL	TL	Full height tiling as selcted
External foyer	Conc	TL	TL	Refer elevations for extent of tiling
Service Areas				
Store Rooms	Conc	Sealed	RF	Feathered pvc skirting
Waste rooms	Conc	epoxy	-	Refer Painting specification
Stairs	Conc	Sealed	-	Non combustrible linings
Stair landings	Conc	Sealed	-	
Ground floor Entry	Conc	DM / TL	AL	
Toilets (Ground floor)	Conc	TL	TL	Full height to side wall

LEGEND

TL	Tiles (ceramic)	RF	Resilient Finish (vinyl)	T	Timber
LA	Laminate	SK	Refer Appendix B	DM	Dirt Mat

PAINTING

1 GENERAL

1.1 RESPONSIBILITIES

General

General: Provide coating systems to new or previously painted substrates as follows:

- Consistent in colour, gloss level, texture and dry film thickness.
- Free of runs, sags, blisters, or other discontinuities.
- Paint systems fully opaque.
- Clear finishes at the level of transparency consistent with the product.
- Fully adhered and resistant to environmental degradation within the manufacturer's stated life span.

Selections: Refer Materials and Finishes

1.2 CROSS REFERENCES

General

Requirement:

Conform to the Preliminaries / General Requirements

Related sections : All other trades (substrates) / Appendix J (New Partition walls)

1.3 STANDARDS

Painting

General: Comply with the recommendations of those parts of AS/NZS 2311 which are referenced in this worksection.

1.4 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:

- Adhesion: The sum total of forces of attachment between a dry film and its substrate.
- Finish coat: The final coat of a coating system.
- Gloss: The optical property of a surface, characterised by its ability to reflect light specularly.
- Gloss unit: Numerical value for the amount of specular reflection relative to that of a standard surface under the same geometric conditions.
- Levels of gloss finish: When the specular direction is 60 degrees, a surface with the following specular gloss reading are defined as follows:
  - Full gloss finish between 50 and 85 gloss units.
  - Semi gloss between 20 and 50 gloss units.
  - Low gloss between 5 and 20 gloss units (also known as low sheen).
  - Flat finish < 5 gloss units (also known as matt).
- Opacity: The ability of a paint to obliterate the colour difference of a substrate.
- Paint: A product in liquid form, which when applied to a surface, forms a dry film having protective, decorative or other specific technical properties.
- Primer, prime coat: The first coat of a painting system that helps bind subsequent coats to the substrate and which may inhibit its deterioration.
- Sealer: A product used to seal substrates to prevent:
  - Materials from bleeding through to the surface.
  - Reaction of the substrate with incompatible top coats.
  - Undue absorption of the following coat into the substrate.
- Sheen: Gloss which is observed on an apparently matt surface at glancing angles of incidence.
- Substrate: The surface to which a material or product is applied.
- Undercoat: An intermediate coat formulated to prepare a primed surface or other prepared surface for the finishing coat.

1.5 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:

- Painting stages:
  - Completion of surface preparation.
  - After application of prime or seal coats.
  - After application of undercoat.
  - After application of each subsequent coat.
- Clear finishing stages:
  - Before surface preparation of timber.
  - Completion of surface preparation.
  - After staining.
  - After sanding of sealer.
  - After application of each clear finishing coat.

1.6 SUBMISSIONS

Clear finish coated samples

General: Submit pieces of timber or timber veneer matching the timber to be used in the works, prepared, puttied, stained, sealed and coated in accordance with the specified system, of sufficient size so that, each piece can be cut into 4 segments, marked for identification, and distributed as directed.

Opaque coated samples

General: Submit, on representative substrates, samples of each coating system showing surface preparation, colour, gloss level, texture, and physical properties; to the **Appendix B - Materials and Finishes schedule**.

Paint

General: Submit the selected manufacturer's details at least 3 weeks before the paint is ordered, as follows:

- Paint brand name and paint line quality statement (Premium range only)
- Material safety data sheets (MSDS) showing the health and safety precautions to be taken during application.
- The published recommendations for maintenance.

Specialist applicators

General: Submit name and contact details of proposed specialist applicators for approval.

Tests

Fire retardant systems: Submit type test results to confirm minimum indices, when tested to AS/NZS 1530.3, on a substrate representative of the intended use, for paint systems specified as Low flame spread or Fire retardant:

- Spread of flame index: 3.
- Sum of Ignitability index and Heat evolved index: 7.
- Smoke developed index: 3.

2 PRODUCTS

2.1 PAINTS

Paint brand

Quality: If the product is offered in a number of levels of quality, provide premium quality lines.

Combinations

General: Do not combine paints from different manufacturers in a paint system.

Clear timber finish systems: Provide only the combinations of putty, stain and sealer recommended by the manufacturer of the top coats.

Delivery

General: Deliver paints to the site in the manufacturer's labelled and unopened containers.

Putty and fillers

Material: To the recommendation of the paint system manufacturer, as suitable for the substrate and compatible with the primer.

Tinting

General: Provide only products which are colour tinted by the specified manufacturer or supplier.

Toxic ingredients

General: Comply with the requirements of Appendix I Uniform Paint Standard to the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

Standards

Paint types: Conform to the Australian Standard as referenced in the **Paint type table**.

Paint type table

Paint type	AS/NZS 2311 Paint reference no. (Table 4.2)	Australian Standard
Semi gloss solvent-borne: interior	B3	AS 3730.5
Full gloss solvent-borne: exterior	B5	AS 3730.6, AS/NZS 3750.22
Full gloss solvent-borne: interior	B5	AS 3730.6
Flat latex: exterior	B6	AS 3730.7
Flat latex: interior	B6	AS 3730.1
Low gloss latex: exterior	B7	AS 3730.8
Low gloss latex: interior	B7	AS 3730.3
Semi gloss latex: exterior	B8	AS 3730.9
Semi gloss latex: interior	B8	AS 3730.2
Gloss latex: exterior	B9	AS 3730.10
Gloss latex: interior	B9	AS 3730.12
Wood primer, solvent-borne	B10	AS 3730.13
Wood primer, latex	B10A	AS 3730.17
Metal primer for steel, lead and chromate free	B11	AS 3730.21, AS/NZS 3750.19
Metal primer, latex	B11A	AS 3730.15
Metal primer for metallic-coated surfaces solvent-borne	B12	AS 3730.21
Metal primer for metallic-coated surfaces, latex	B12A	AS 3730.15
Two-pack etch primer for metals, chromate free	B13	AS/NZS 3750.17
Zinc-rich organic binder/primer for steel	B14	AS/NZS 3750.9
Concrete and masonry sealer	B15	AS 3730.22
Undercoat, solvent-borne	B17	AS 3730.14
Undercoat, latex: exterior	B17A	AS 3730.18
Undercoat, latex: interior	B17A	AS 3730.18
Furniture varnish, one-pack	B19	AS 3730.25
Two-pack clear gloss floor finish	B20	AS 3730.27
Exterior latex stain, opaque	B22	AS 3730.16
Exterior stain, lightly pigmented	B23	AS 3730.28
One-pack paving paint for concrete	B24	AS 3730.29
Two-pack epoxy enamel	B29	AS/NZS 3750.1
Two-pack high build epoxy	B29	AS/NZS 3750.4
Texture finish latex coating for masonry and concrete: exterior	B38	AS/NZS 4548.1-4 incl;
Texture finish latex coating for masonry and concrete: interior	B38	AS/NZS 4548.1-4 incl
Full gloss polyurethane (2-pack) for steel	B44	AS/NZS 3750.6

3 EXECUTION

3.1 PREPARATION

Order of work

Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings, floor sanding and laying flooring materials.

Clear finishes: Complete clear timber finishes before commencing opaque paint finishes in the same area.

Protection

General: Before painting, clean the area and protect it against dust entry. Use drop sheets and masking to protect finished surfaces or other surfaces at risk of damage during painting.

Internal and external fixtures and furniture: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the painting.

Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

'Wet paint' warning

General: Place notices conspicuously and do not remove them until the paint is dry.

Repair

General: Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition. Touch up new damaged decorative paintwork or misses only with the paint batch used in the original application.

Substrates

General: Prepare substrates to receive the painting systems.

Cleaning: Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.

Filling: Fill cracks and holes with fillers, sealants, putties or grouting cements as appropriate for the finishing system and substrate, and sand smooth.

Clear finish: Provide filler tinted to match the substrate.

Clear timber finish systems: Prepare the surface so that its attributes will show through the clear finish without blemishes, by methods which may involve the following:

- Removal of bruises.
- Removal of discolourations, including staining by oil, grease and nailheads.
- Bleaching where necessary to match the timber colour sample.
- Puttying.
- Fine sanding (last abrasive no coarser than 220 grit) to show no scratches across the grain.

Unpainted surfaces

Standard: To AS/NZS 2311 Section 3.

Previously painted surfaces

Preparation of a substrate in good condition: To AS/NZS 2311 clause 7.4.

Preparation of a substrate in poor condition: To AS/NZS 2311 clause 7.5.

Preparation of steel substrates with protective coatings: To AS/NZS 2312 Section 10 and AS 1627.1.

Additional preparation:

- Seal stained ceilings before the application of latex paints.
- Clean PVC with methylated spirit and a nylon scouring pad.
- Remove wall paper and glue size with clean water and seal before painting.
- Remove water based kalsomine or lime wash paints by brushing with warm water.

Cleaning external surfaces

Sound external surfaces other than timber: Remove dirt, grease, loose and foreign matter, efflorescence and mould by water blasting or steam cleaning without damaging the surface. Remove remaining loose material with appropriate hand tools. Use sanding blocks to preserve the arrises of masonry and stone details.

Particular requirements

Refer Detailed Instructions.

3.2 PAINTING

Light levels

General: 400 lux.

Drying

General: Use a moisture meter to demonstrate that the moisture content of the substrate is at or below the recommended maximum level for the type of paint and the substrate material.

Paint application

Standard: To AS/NZS 2311 Section 6.

Timing: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Apply subsequent coats after the manufacturer's recommended drying period has elapsed.

Painting conditions

General: Do not paint in dusty conditions, or otherwise unsuitable weather as follows unless the paint is suitable and recommended for such conditions:

- Relative humidity: 85%.
- Surface temperature 10°C or 35°C.

Priming before fixing

General: Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:

- External fascia boards.
- Timber door and window frames.
- All doors, including top and bottom.
- Skirtings and architraves.
- Associated trims and glazing beads.
- Timber board cladding.

Spraying

Not permitted unless prior approval is obtained.

General: If the paint application is by spraying, use conventional or airless equipment which does the following:

- Satisfactorily atomises the paint being applied.
- Does not require the paint to be thinned beyond the maximum amount recommended by the manufacturer.
- Does not introduce oil, water or other contaminants into the applied paint.

Paint with known health hazards: Provide masking, ventilating and screening facilities generally to the standards set out for spray painting booths, AS/NZS 4114.1 and AS/NZS 4114.2 .

Sanding

Clear finishes: Sand the sealer using the finest possible abrasive (no coarser than 320 grit) and avoid cutting through the colour. Take special care with round surfaces and edges.

Repair of galvanizing

General: For galvanized surfaces which have been subsequently welded, power tool grind to remove all rust and weld splatter. Remove all surface contaminants then immediately prime the affected area.

Primer: Organic zinc rich coating for the protection of steel to AS/NZS 3750.9 Type 2.

Tinting

General: Tint each coat of an opaque coating system so that each has a noticeably different tint from the preceding coat, except for top coats in systems with more than one top coat.

Services

General: If not embedded, paint new services and equipment including in plant rooms, except chromium, anodised aluminium, GRP, UPVC, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Repaint proprietary items only if damaged.

Windows

Operation: Ensure that opening windows function correctly before and after painting.

Door leafs

Drying: Leave doors fixed open to allow drying. Do not allow door hardware, accessories or the like to damage the door finish during the drying process.

4 SELECTIONS

4.1 PAINTING SYSTEMS

New unpainted interior surfaces
Standard: To AS/NZS 2311 Table 5.1.

New unpainted exterior surfaces
Standard: To AS/NZS 2311 Table 5.2.

Specialised painting systems
Standard: To AS/NZS 2311 clause 5.2 for the following final coats:

- High build textured or membrane finishes (B38 to AS/NZS 2311).
- 2 pack gloss pigmented polyurethane (B44 to AS/NZS 2311).
- 2 pack epoxy (B29 to AS/NZS 2311).
- 2 pack water based epoxy (B29A to AS/NZS 2311).

Previously painted surfaces
Standard: To AS/NZS 2311 Section 8.

4.2 PAINTING SCHEDULES

General
Number of coats: Unless specified as one or two coat systems, each paint system consists of at least 3 coats.

Final coat selection: To the Materials and Finishes Schedule

Compatibility
Where required ensure the compatibility of the protective paint coating to steel surfaces with the final specified paint system, all paint systems include a primer/undercoat as specified by the paint system manufacturer.

Low VOC emitting paints
Provide the VOC limits noted in the **Materials and Finishes Schedule**

Paint colours

Method: Paint colour selection unless scheduled will be made from the standard colour chart of the approved paint manufacturer after letting of contract.

Notice: Give two weeks notice in writing before the colour scheme is required. The colour scheme and paint selection will then be prepared from the approved supplier's colour charts and premium range.

Acknowledgement: Before ordering, acknowledge receipt of the colour scheme in writing.

Number of separate colours: Supply paint to the **Materials and Finishes Schedule**.

DETAILED INSTRUCTIONS

1.0 EXCLUSIONS SCHEDULE

Exclude all prefinished surfaces from the paint protection systems unless specifically noted otherwise. The following shall be exclude from the scope of paint works.

- Aluminium Doors and Door frames / Windows
- Colourbond finishes

1.02 PAINT FINISHES SCHEDULE

All paint products shall be Dulux / Solver premium grade (generally 10 year warrantee as applicable).

All paint systems to new and existing substrates shall be approved and as recommended by the paint manufacturer.

Refer Appendix B Materials and Finishes and drawings for scope of painting and colours

EXTERNALLY

Steelwork (exposed to contact)	Galvanised : Primer : 2 coats satin Aquaenamel 100mic (enamel)
Steelwork (exposed not subject to contact)	Galvanised : Primer : 2 coats Dulux Weathersheild 100mic (acrylic)
Steelwork (Inorganic Zinc Silicate)	DurabuildSTE / Weathermax HBR 2coats 100mic (exposed to weather) Luxapoxy Primer : Acrylic / Enamel finishes as noted above (not exposed)
Structural Steel (where on site painting restricted)	Zinc anode 402 75mic / Weatermax HBR 100mic - touch up on completion
Structural Steelwork (below ground)	Bitumen waterproofing / concrete encasement
Handrails / Posts (fabricated) steel	Inorganic Zinc Silicate with Weathermax as noted above
Metal components (new)	Dulux Metal shield Premium system : 2 coats Metal shield enamel
Fibre Cement (soffits)	Sealer : 2 coats Dulux Weathershield low sheen
Fibre Cement (Prefinished)	Primer : Dulux Acrashield 2 top coats
Timber doors	Primer : 2 coats Dulux Weathershield low gloss

INTERNALLY

Plasterb'd / Fibre Cement ceilings	Sealer : 2 coats Dulux Wash Wear - Low Sheen (wet areas)
Plasterb'd / Fibre Cement ceilings	Sealer : 2 coats Dulux flat acrylic ceiling paint
Plasterboard / Villaboard wall finishes	Sealer : 2 coats Dulux Wash Wear (generally)
Villaboard wall finishes (Kennel)	Sealer : 2 coats Dulux Wash Wear - Low Sheen (wet areas)
Timber doors	Primer : Undercoat : 2 coats Dulux Aquanamel semi gloss
Timber work	Primer : Undercoat : 2 coats Dulux Aquanamel semi gloss

INTERNALLY – continued

Timber Ply Ceilings	Sealer : 2 coats Dulux flat acrylic ceiling paint
Timber Joinery	Mirotone Polyurethane clear finish (stain matt low gloss as scheduled)
Metal door frames	Primer : Undercoat : 2 coats Dulux Aquanamel semi gloss
Concrete Floors	Epoxy floor finish as specified (where scheduled)
Concrete Floors (Various)	Sealer / Hardener as specified (where scheduled)
Steelwork (exposed)	Primer : 2 coats Dulux Aquanamel semi gloss
Services (exposed)	Primer : 2 coats gloss enamel (Aust Standard)
Other works	Refer Appendix B Materials and Finishes Schedule Refer drawings

1.03 TIMBERWORK

Extent

Refer Appendix B Materials and Finishes Schedule / Refer Drawings

Generally

Counter sink all nails / fixings and fill all timber surface defects and depressions flush. Sand smooth all timber and subsequent paint coats in accordance with the manufacturers recommendations and as required in order to achieve a uniform paint finish.

Paint timber doors on all surfaces including top and bottom edges with the specified paint system. Textured roller paint finish on doors will not be accepted. All gloss / semi gloss finishes shall be laid off with a brush. Paint all glazing pockets / rebates and glazing beads with finishing coat prior to installation of glazing.

All timberwork including skirtings, architraves, window sub frames, door frames, doors and all exposed external timber shall be pre-primed prior to delivery to site. Protect from the weather until the specified paint systems are applied.

Paint doors prior to final fixing of furniture / fittings etc. Allow to remove door furniture / hardware / kickplates etc prior to painting / reinstate on completion.

Protection

Provide protection to Ply and Two Pack finishes on site (plastic / cardboard cover sheets) to avoid dust and surface staining / marking during construction. Replace damaged boards / joinery.

Timber Ply Linings

Provide Dulux Intergrain Ultra clear coating systems to timber Ply linings as scheduled. Liaise with sheet supplier for cutting and delivery of sheets ready for application of clear coatings. Clear finishes shall be applied in factory off site (spray finish) to obtain uniform / smooth / furniture quality finish free of surface defects . Lightly sand between coats. Apply stain / tint to obtain a uniform appearance. Sand and spray all exposed board edges.

Provide sample of clear finish for approval on sheeting to be supplied.

Timber Ply Linings (Joinery)

Provide two pack clear polyurethane finish to Ply joinery where scheduled in accordance with paint manufacturers instructions. Proprietary System :

Mirotone	Mirothane PU 5545	Clear Sealer	28micron thickness
Mirotone	Mirothane PU 5555	Clear Top coat	2 coats 48 micron thickness
Finish	Gloss level	Satin / Matt	(Provide samples for approval)

Finishes shall be factory (spray finish) to obtain uniform / smooth / furniture quality finish. Two pack finish shall be applied to all joinery ply surfaces including edges

Two Pack Paint Systems

Provide Mirotone two pack polyurethane finish to MDF wall linings and joinery where scheduled in accordance with paint manufacturers instructions. Proprietary System :

Mirotone	Mirothane PU 5626	Primer
Mirotone	Mirothane PU 5650	Top coloured coat
Finish	Gloss level	Satin

Finishes shall be factory (spray finish) to obtain uniform / smooth / furniture quality finish. Two pack finish shall be applied to all surfaces. MDF boards shall be completed sealed whether exposed or concealed. Joinery boards concealed from view may be finished with white melamine finish.

Composite Timber Wall Linings

Provide Innocoat UV stabilising clear coat to all external composite timber wall lining in accordance with lining manufacturers instructions.

1.04 TEXTURED AND FIBRE CEMENT PAINT FINISHES

Generally

Liaise with sheeting / walling contractor the preparation of all surfaces ready for application of textured paint system. Flush all joints and fixings (where applicable) in accordance with manufacturers instructions. Inspect the work prior to commencement to ensure all surfaces are suitable for the application of the paint systems. Textured and paint systems shall be as approved (by substrate manufacturer) for application and exposure. The manufacturers specification and recommendations shall be strictly adhered to. The contractor shall be an approved applicator. (as authorised by manufacturers trade representative) Provide written guarantee on application and performance (min 10 years).

Accessories

Provide Pvc render angles and flushing beads for finishing all edges / corners flush and base

Provide control joints as required and adjacent dis-similar surfaces.

Preparation

Prepare substrate in accordance with manufacturers instructions. Apply primer and sealers where recommended. Apply Acra Patch / Acra Prime as part of the Acratex textured paint system (where appliocable) .

(A) Extent

Fibre Cement Linings – Texture finished

Hebel wall panels – Textured finished

Proprietary Textured System

Apply Acratex Trowel on 351 high build texture system applied in accordance with the manufacturers details and instruction.

Dulux base coats / sealers	(2) Coat	Dulux Acra shield	(2) Coats
Dulux Tuscany Trowel on 351	(1) Coat		

(B) Extent

External Fibre Cement Linings (Façade) – Preprimed sheeting / Expressed jointed sheeting

Ensure all fixing (where to be concealed) are suitable prepared and epoxy filled ready for application of the paint system.

Paint Finish

Dulux Arcrashield paint finish system or equal – colour as selected

Dulux base coats / sealers	(2) Coat	Dulux Acra shield	(2) Coats

1.05 SEALERS / COATINGS

Extent

Refer drawings / Appendix B Materials and Finishes

Generally

Finish polished concrete floors with hydrophobic silicate based deep penetrating repellant sealer
Sealer should provide stain resistance / durability / hardness / UV resistant / Low VOC / improve the cleaning and maintenance of the concrete surface. Sealer should be suitable for exposure and application.

Submissions

Submit samples for approval

Submit technical data sheets of recommended products from commercial manufacturers stating application procedures / chemical resistance / durability / life cycle performance / general product data etc for approval.

Sealer should be as recommended by the manufacturer for the particular application and applied in accordance with the manufacturers detailed instructions.

Application

All concrete finishing shall be carried out by an approved commercial specialist contractor.

Polished concrete

Concrete floors (polished) Kryton Hydrostop water based silane siloxane concrete sealer or equal approved

Concrete Hardener / Sealer

Concrete floors (exposed) Ashford Formula (hardener / sealer) or equal approved

Concrete Epoxy Flooring

Concrete floors (wet area) Parchem Durafloor HP (to match existing)

Concrete Waterproofing

Concrete – Carpark (first floor) Radcon Formula 7 waterproofing sealer

Concrete walls

Precast / insitu concrete walls United Coatings - Canyon tone stain

Tile Sealer

Internal tiled floors : Provide penetrating tile / grout sealer to internal tile floor surfaces. Sealer shall protect tiles and improve cleaning / maintenance of tiled floor without effecting natural visible colour / sheen of tiles or slip resistance

METALWORK

1 GENERAL

1.1 AIMS

Responsibilities
General: Provide metal fixtures that are:

- Undamaged, plumb, level and straight.
- Free of surface defects or distortions.

1.2 CROSS REFERENCES

General
Conform to Preliminaries / General Requirements

Related worksections
Refer Metals and Prefinishes

1.3 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:

- Shop fabricated or assembled items ready for delivery to the site.
- Commencement of shop or site welding.
- Site erected assemblies on completion of erection, before covering up by cladding and encasing.
- Steel surfaces prepared for, and immediately before, site applied finishes.

1.4 SUBMISSIONS

Shop drawings
General: Submit shop drawings showing the following information:

- Details of fabrication and components.
- Details of fabrication involving other trades or components.
- Information necessary for site assembly.
- Proposals for the break-up of large items as required for delivery to the site.
- Proposed method of joining the modules of large items.

Tests
Stainless steel: Before fabrication commences, submit satisfactory evidence that relevant procedure test plates have passed the tests specified in AS/NZS 1554.6.

Materials
Manufacturer's data: Submit manufacturer's published product data including standard drawings and details.

Stainless steel: For each batch of stainless steel supplied to the works, submit the certificate of compliance or test certificate specified in the applicable standard.

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Metals
Performance: Provide metals suited to their required function, finish and method of fabrication, in sections of strength and stiffness adequate for their purpose.

Copper alloys (brass, bronze)
Composition and designations: To AS 2738.

Rivets
General: Blind rivets where available in the required metal.

Masonry anchors
General: Proprietary types comprising screws or bolts in self-expanding sockets.

Masonry plugs
General: Screws in purpose-made resilient plastic sockets.

2.2 STAINLESS STEEL FINISHES

Sample
General: Provide a finish to match the sample in terms of the mill grade and finish process.

3 EXECUTION

3.1 CONSTRUCTION GENERALLY

Aluminium structures
Standard: To AS/NZS 1664.1 or AS/NZS 1664.2.

Metals
Performance: Provide metals so that they transmit the loads imposed and ensure the rigidity of the assembly without causing deflection or distortion of finished surfaces.

Incompatible metals: Separate using concealed layers of suitable materials in appropriate thicknesses.

Fasteners
Performance: Provide non-galvanic corrosion fasteners.

Materials: Provide fasteners in materials of mechanical strength and corrosion resistance at least equal to that of the lowest resistant metal joined.

To copper and copper alloys: Provide copper or copper-alloy fixing devices only.

To aluminium and aluminium alloys: Provide aluminium alloy or non-magnetic stainless steel fixing devices only.

To stainless steel: Provide appropriate stainless steel materials only.

Fabrication
Workshop: Fabricate and pre-assemble items in the workshop wherever practicable.

Edges and surfaces: Keep clean, neat and free from burrs and indentations. Remove sharp edges without excessive radiusing.

Tube bends: Form bends in tube without visibly deforming the cross section.

Colour finished work: Match colours of sheets, extrusions and heads of fasteners.

Thermal movement: Accommodate thermal movement in joints and fastenings.

Fabrication tolerances
Structural work generally: 2 mm from design dimensions.

Joints
General: Fit joints to an accuracy appropriate to the class of work. Finish visible joints made by welding, brazing or soldering using grinding, buffing or other methods appropriate to the class of work, before further treatment.

Self-finished metals: Free of surface colour variations, after jointing.

Joints: Fit accurately to a fine hairline.

Marking
General: Provide suitable and sufficient marks or other means for identifying each member of site-erected assemblies, and for their correct setting out, location, erection and connection. Mark bolted connections to show the bolting category. Do not mark stainless steel by notching.

Splicing
General: Provide structural members in single lengths.

3.2 WELDING AND BRAZING

General

Quality: Provide finished welds which are free of surface and internal cracks, slag inclusion, and porosity.

Site welds: Avoid site welding wherever possible. If required locate site welds in positions for down hand welding.

Butt weld quality level: Not inferior to the appropriate level recommended in AS 1665 Appendix A.

Brazing

General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. Do not used butt joints relying on the filler metal fillet only.

3.3 STAINLESS STEEL FABRICATION

Welding stainless steel

Certification of welders: To AS 1796.

Riveting

General: Riveting may be used only to join stainless steel sheet or strip less than 1 mm thick. Drill (not punch) the rivet hole, and drive the rivet cold. On completion, clean and passivate the riveted assembly.

Soldering

General: Do not solder stainless steel.

3.4 METAL FIXTURES

General

General: Provide metal fixtures noted on drawings as follows:

- Components and their location, indicative construction details, scribes and trims, materials, dimensions and thicknesses, and finishes shall be as detailed.
- All dimensions noted on drawings shall be confirmed on site.
- Finishes selections are noted in a Finishes schedule on the drawings.
- Hardware and equipment.

3.5 COMPLETION

Maintenance manual

General: Submit manufacturer's published recommendations for service use.

Cleaning

Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

DETAILED INSTRUCTIONS

1.01 DOOR / WALL / CEILING GRILLES

Refer Mechanical drawings / specification for grilles / air conditioning registers. Obtain approval for final size of all grilles prior to ordering. Grilles shall be of uniform appearance and size within the same room. Obtain approval for setout of all penetrations priot to framing of ceiling. Refer Appendix A for misc grilles etc.

Type

Doors : Full Chevron aluminium grille. set into perimeter aluminium angle frame inserted into door cut out.

Bulkheads : Linear Chevron aluminium grilles (rectangular) as selected – refer drawings

Liase

With Carpenter for cutting of openings to suit. Liase with Mechanical contractor to confirm all final sizes and individual configurations while trying to obtain uniform sizes where doors are adjacent to each other.

Finish

Powdercoat as selected

1.02 KICKPLATES / SKIRTINGS

Generally

Refer Door and Hardware Schedule – Appendix A

(A) Kickplates

1.2 thick 304 type stainless steel with No. 4 finish.

(A) 150 high nominal and to suit door width less 20mm. Confirm final size prior to ordering.

(B) Other sizes - Refer Drawings

(B) Skirtings

Thickness to suit application

(C) 1.2 thick natural anodised Aluminium / 100 high Confirm final size prior to ordering.

Fixing

Contact glue to doors / walls / joinery (unless directed otherwise).

1.03 HANDRAILS / STAIRS

Extent

Stair 01	- Steel stair / conc treads	HR01	-Galvanised steel rail
		HR01	-Galvanised steel handrail and intermediate rails
Stair 02	-Concrete stair	HR02	-Stainless steel handrail – tension wired
Balcony	-Tiled balcony	HR03	-Aluminium / glass
Foyer	-Tiled floor	HR03	-Aluminium / glass
Plant area	- Roof Access (where required) _		-Galvanised steel handrail and rails (Monowills)

Handrails (generally)

Handrails shall comply with BCA requirements for height / rail spacings and clearances. Handrails shall be 50mm clear of any obstruction.

Handrails (fire stairs)

Handrails at top and bottom shall extend 250mm from last tread riser and be provided with 180 degree returns. Handrails shall be continuous. Handrails shall be 900 above tread nosings and 1000 at landings.

Handrails (Ramps / public stairs / steps)

Handrails to ramps / stairs / steps shall extend 250mm from last tread riser at bottom at grade and extend 300mm top and bottom at 900 above floor level and then provided with return end. Handrails to ramps shall be 900 high min. and comply with AS1428 in all instances. Handrails to steps / public stairs shall be 900 above tread nosings and 1000 at landings. Provide tactile indicators to landings and tactile buttons to rails.

Post Fixing

Fixings to post shall be concealed except where specified otherwise. Waterproofing on external decks / balconies etc shall extend under base plates and be sealed around perimeter with flexible sealant. Provide sealant at tile junction (sealed watertight) with escutcheon plate over.

SSteel Wire Installation

Provide tensioned wire balustrade infill as specified. Install in accordance with manufacturers details and instructions.
Tension wiring to 1837N/ 4mm deflection (7x7 lay 4mm dia) in accordance with BCA requirements.

Wall Supports

Liaise with Wall framing contractor for provision of timber noggings and other framing to walls and floors for support of handrail brackets. (as applicable)

Fixings shall be suitable for application and substrate material. All exposed fixings shall be stainless steel screw or allen key type. Countersink fixings where possible. Provide suitable chemical anchor plugs or other as required.

Shop Drawings

Provide shop drawings for approval prior to ordering of stairs / handrails etc indicating all materials and detailing all junctions and setout for fabrication. Co-ordinate with others for setting out of solid supports for fixings

(A) Extent -HR01

Stair 01 (fire stair) - Galvanised steel posts / rails

Posts / Handrail

Provide 42 x5mm dia galvanised steel posts at 1200 centres max. Weld close top of posts and provide 12dia pin 25mm long welded to underside of 48mm x3mm dia galvanised steel handrail over. Extend posts down outside face of steel plate stringer. Provide welded plate to end of posts for bolted connection to stringer 4x12dia bolts / 150x140x12 plate. Position bolt fixings below tread and landing levels with 50mm vertical spacing between fixings.

Rails

Provide 25NB (32mm) x3mm dia intermediate rails between posts at maximum 460mm centres horizontally set min 150mm above nosing edge.

Wall Handrail

Provide 80dia x 8 thick galvanised steel circular plate to wall at 1200 centres max and fix with 3x 8mm dia countersunk galv screw fixings to concrete wall. Provide 12dia pin centrally to plate and crank to underside of handrail. Handrail set 50mm clear of wall plates.

Finish

All galvanised steel

(B) Extent –HR02

Entry stair 02 – Stainless steel handrail / wire balusters

HR2 Handrail / Posts (external side)

Provide 42mmx5mm dia stainless steel posts at 1200 centres max capped and with 12dia pin pin welded to top for support of 50mm dia stainless steel handrail over. Core posts into thickened concrete edge set back 70mm from edge.

HR2A Handrail (internal Building side)

Provide 80dia x 8 thick stainless steel circular plate to wall at 1200 centres max and fix with 3x 8mm dia countersunk stainless screw fixings to concrete wall. Provide 12dia pin centrally to plate and crank to underside of 50mm dia stainless steel handrail. Handrail set 50mm clear of wall plates.

Stainless Steel Balusters (external side)

Provide 'Ronstan' proprietory stainless steel balustrading system infill to posts and handrails. Pre-drill posts and provide sealed bushes to all post / wire penetrations.

Wire shall be 4mm Dia 7x7 lay 316 grade stainless steel wire with all accessories including threaded terminals and threaded terminal adjusters, bushes etc

Treads and Nosings

Concrete (refer Resilient Finishes specification for nosings / tactiles)

(C) Extent –HR03

Balcony / Foyer areas – Aluminium / glass infill

Balcony – 1000 high

Foyer ends – 1500 high

Type

Provide Hark 6060T6 aluminium posts and rails to positions as shown with powdercoat finish as selected. Install in accordance with manufacturers details with concealed base plates to slab (under tiling).

Glazing

Provide clear toughened glass balustrade infill between posts using aluminium glazing chanel fixed to side of posts. Conceal fix to posts.

Finishes

All aluminium shall be powdercoat finish as selected (Refer Materials and Finishes schedule)

(D) Extent – Roof Access

Roof Hatch access

Type

Provide proprietory galvanised handrail system (Monowills or equal) adjacent roof hatch for access to roof. Fix post uprights to steel walkway platform.

Rails shall be shop fabricated and all materials and fixings hot deep galvanised ready for and assembly on site. Provide 1.0m high rail with intermediate rails at 460 centres and 100mm above platform level.

Check set out of rails on site prior to fabrication.

Finish

All galvanised steel

1.04 PRIVACY SCREENS (DPS)

(A) Extent

Between Apartments

Type

Hark obscure glass privacy screen with obscure safety glass to code. Provide aluminium posts at 1500 centres max. Set screens out equally.

Shop drawings

Provide shop drawings of all componenets including structural design for verification of structural design and compliance. Install screens in accordance with manufactures details and instruction.

Compliance

Aluminium structures shall comply with AS1664.1 / AS1170.2 / AS1170.1 and AS1288

Finish

All aluminium shall be powdercoat finish as selected (Refer Materials and Finishes schedule)

(B) Extent

Balcony ends

Type

Provide Alcon Narrowline framing fixed between steel framing with obscure safety glass to code. Provide aluminium posts at 1500 centres max. Set screens out equally. Provide concealed polyethelene spacers to underside of bottom frame at fixing points for drainage and separation between dissimilar materials. Provide neoprene strip (continuous) vertically between frames and structural support. Provide stiffened double head sections where required.

Shop drawings

Provide shop drawings of all componenets including structural design for verification of structural design and compliance. Install screens in accordance with manufactures details and instruction.

Compliance

Aluminium structures shall comply with AS1664.1 / AS1170.2 / AS1170.1 and AS1288

Finish

All aluminium shall be powdercoat finish as selected (Refer Materials and Finishes schedule)

1.05 EXTERNAL LOUVRE SCREENS (SS1 / SS2)

(A) Extent

Louvre screens SS2– Refer North and South elevations

Description

Provide external horizontal sun screen comprising aluminium interlocking box sections spanning full width of window. Align ends of screen with side window frames. Mount hood at top of window frame for support. Set back of screen min 50mm off wall face (Longline profiled wall sheeting continuous). Seal penetration watertight.

Fix screen off purpose made aluminium bracket fixed to side of window opening framing between wall sheeting ribs. Bolt brackets to wall framing located at sides of window opening (concealed in wall).

Type

Lowline Caprice window hood system Project screens 484mm wide (184+2 increments) to match window width.

Fixings

Liase with wall framing contractor for provision of structural framing in wall for fixing of bracket supports. Liase with window framing contractor for setout of window frames and installation of support brackets to sides of opening.

Shop Drawings

Provide shop drawings detailing louvre setout and building in details to suit application.

Finish

Powdercoat as selected (Refer Appendix B Materials and Finishes schedule)

(B) Extent

Louvre screen SS1 – Refer West elevation

Description

Provide external vertical privacy louvre screen comprising aluminium elliptical blades set into perimeter aluminium frame fixed to structural steel framing. Blades to be mounted at a pitch to prevent overlooking into adjacent property.

Type

Lowline Windsor elliptical blade 91x21 set into 102x35 aluminium perimeter frame section.. Run blades continually between structural frames and provide intermediate support at max 2.4m centres (spaced equally).

Fixings

Provide neoprene strip between alumin frame and steel frame. All fixings shall be stainless steel.

Shop Drawings

Provide shop drawings detailing louvre setout and building in details to suit application.

Finish

Powdercoat as selected (Refer Appendix B Materials and Finishes schedule)

1.06 METAL GATES / FENCES

(A) Extent

Rear access gates and fencing (Door G03 sliding vehicle gate / G04 pedestrian gate)

Generally

Provide screens / fences and gated enclosures to positions as shown on the drawings. Fencing shall be carried out by an approved contractor with suitable commercial experience and registered with the Australia Fence Industry Association.

Co-ordinate setout of posts with site and ground works and the construction of any retaining walls etc. Co-ordinate final details on site prior to ordering materials. All fencing shall be of commercial grade and construction and installed to industry standard. The fencing installation including gates, infill materials and all other components shall be designed and installed as a complete system to suit loadings and use.

Design codes

Fencing design and installation shall comply with Australian and NZ standards as applicable including AS2423-2002 coated steel wire / ASNZ4534-2006 zinc coatings / AS1163-1991 and AS1074-1989 hollow sections / ASNZ4792-2006 - ASNZ4680-2006 hot dipped galv / ASNZ4506-2005 metal finishes / AS1070 and AS1725-2010 particularly Part 1 security fences and Part 5 playing fields . Rating : Heavy duty. Confirm all post and rail sizes as noted.

Materials
One Steel Duragal Plus / Galvabond steel tube to size as noted (galvanised inside and out to AS/NZ 4792).
Chain link mesh fences shall be Australian made 50mm pitch interwoven 3.15dia BMT wire to perimeter security fences and 3.15dia BMT wire to all other fences. (all heavy duty extruded pvc coated wire) . Wire PVC coating shall be .8mm min. to selected colour (black except where noted otherwise).

Finishes
All framing shall be either galvanised (inside and out) or Duragal Plus powdercoated as noted. Powdercoating system shall comprise of suitable prepared galv steel tube prepared to AS4506-2005 (table 2.1, D, high marine / industrial) with polyester powdercoat finishing coat 80micron thickness in nominated colour. The powdercoat top coat specification must exceed the durability / UV stability and colour fastness standards of AS4506 and be suitable for use / application and location.

Conc Pads / Footings
Refer engineers drawing for all pad and concrete strip footing sizes (25mpa concrete). Pads shall be either set below finished pavement levels or set flush with ground level with slayed top to allow water to drain away from post. Confirm concrete pad sizes and requirements with Engineer prior to commencement. Bitumen paint protect all steelwork below finished pavement level. Set all fences 100mm above pavement levels and 150 above natural ground level at base (UNO).

Posts / Rails
Fencing system shall be a standard proprietory post and rail tubular fence system as approved, Posts and rails shall be selected to suit medium rated fencing system. Fence panels shall be generally 2.4m centres (to suit loading). Provide cast alumin powdercoat shrounds to post brackets for tubular fences. Provide welded caps to columns / plastic caps to pickets or spiked. Provide drainage holes or gaps to hollow tubes for drainage.

Tubular intermediate Posts : 75x75x3
Tubular rails : 40x40x3 top and bottom
Corner / Gate posts : upgrade to to next size from intermediate posts (eg 75x75x3 to 90x90x3)
Pickets : 25x25x1.6 (ends as specified – capped / spiked)

Sliding Gates
Tubular Frame : 50x50x3 top and side styles with 100x50x3 bottom rails
Posts : U profile to cantilver gate 100x100x4 posts
Vertical pickets : 25x25x1.6 to face of top and bottom rails (extend 200mm past nominal)

Locking : provide 40x10x50 lug to gate and post with 20mm hole for securing gates in closed and open positions complete with master keyed padlock.

Operation : provide stainless steel double bearing wheels to base with upper nylon roller guides. Galv steel track 90x6mm plate with 20mm solid rod guide with 10dia x50mm galv bolts fixed to concrete strip footing (refer engineer drawing)

Mechanism : Provide drive rail to face of gate with protective cover and install Centurion heavy duty gate drive complete with lockable vandal proof casing / strap. Provide concrete pad for mounting drive unit. Remote control. Galvanised rack and track . Rubber bumper stop and components.

Swing Gates
Gates shall swing through full 90 and 180 degrees (as applicable) for access purposes. Frame and brace gates with intermediate tube framing or pickets to ensure rigidity and prevent sagging. Provide stainless steel bearing wheels for vehicle gates where applicable. Provide gate posts as previously specified to suit load and application.

Tubular Gates : single <1.2m. Frame gates for loading and span. Nom 40x40x3 Duragal plus framing.

Provide lock staple and sliding bolt with masterkeyed padlock. Provide glav slide drop bolts min 400 long (above ground level) with galv sleeve embedded into conc pavement or conc pad locally for gates in open and closed position. Hinges shall be Tuff heavy duty glav hinges suitable for loading and gate width.

Locking

Refer Door Hardware specification for security access systems. Provide locking plates / boxes to suit hardware.

Finish

Powdercoat as selected

(B) Extent

SC02 - Services enclosure (Door G05 HWS enclosure / G01 gas enclosure) – Aluminum metal slat screen
SC01 - Courtyard fencing (Apartment 01) – Aluminium timber look slat fence / screen

Type

Provide proprietory screen / fencing system with aluminium slat linings as noted. Provide aluminium gate and fence posts and rails to form service enclosures and courtyard fencing where shown. Set gate / fencing posts into concrete pad set below final pavement surface. Provide vertical rails between top and bottom rail for fixing of slats as scheduled.

(Refer Appendix B Materials / Finishes schedule) .

Shop drawings

Provide shop drawing of setout / fixings and all components for approval. Work shall be carried out by an approved fencing contractor.

Locking

HWS - Provide dropbolts and eye bolts to hinged gates with lock bolt complete with padlock (master keyed to keying system)

Gas Enclosure – Provide dropbolts and latch for access

Courtyard – provide lock box for mortice lock and master keying / striker plate (all stainless steel)

Finish

Courtyard fencing : Framing shall be powdercoat with timber look finish slats

Service enclosures : Framing shall be powdercoat with powdercoat finish slats

1.07 BICYCYLE FRAMES

Extent

To positions as shown (refer drawings)

Type

Galvanised bicycle frames as selected set into concrete pad (pavers over).

Refer

Appendix B Materials and Finishes schedule

Finish

Galvanised

MISC FIXTURES AND FITTINGS

01 GENERAL

CROSS REFERENCE
Refer to Preliminaries / General Requirements / Special Conditions of Contract
Related worksections
Demolition – existing fittings and fixtures

02 QUALITY

01 QUALITY ASSURANCE
Witness points / Hold points
Refer to Contractors approved inspection and test plan for witness and hold points
02 SAMPLES
Provide samples as specified or directed prior to ordering. – Shower curtain system

03 MATERIALS

01 HAZARDOUS MATERIALS
Fire Hazard
Provide furniture items which do not contain materials which when subject to fire conditions will emit excessive smoke or dangerous fumes.
Compliance
All materials, linings, coverings etc to be used or incorporated in the works shall comply with Building Code Of Australia – Section C : Fire Resistance / Specification C1.10a 'Fire Hazard Properties – Floors, Walls and Ceilings'

Contractor is required to provide manufacturers technical detail sheet or written statement indicating compliance with the BCA prior to ordering of material, linings, coverings etc.

Required Group Reference
Unsprinklered Buildings - Extract from BCA

Class of Building	Group Reference					
	F/isolated Exits		Public Corridors		Specific Areas	
	Wall	Ceiling	Wall	Ceiling	Wall	Ceiling
Class 2-3 (sole occupancy units)	1	1	1-2	1-2	1-3	1-3
Class 3 / 9a (Residential other than class 1 / Health)	1	1	1	1	1-2	1-2
Class 5, 6, 7, 8, 9b (Office, Shop, laboratory, Schools)	1	1	1-2	1-2	1-3	1-2
Class 9b (Assembly building other than Schools)	1	1	1	1	1-2	1-2
Class 9c (Aged care) sprinklered	1	1	1-2	1-2	1-3	1-3

General Requirements	Fire Hazard Properties		
	Flammability Index	Spread of Flame	Smoke developed Index
Class 2, 3, 5, 6, 7, 8, 9 (sarking)	Not more than 5		
Class 2, 3, 5, 6, 7, 8, 9 (other materials)		Not more than 9	Not more than 8 (if FI>5)
Class 2, 3, 5, 6, 7, 8, 9 (Fire isolated exit)		Not more than 0	Not more than 2
Class 2, 3, 9a, 9b (public Corridor)		Not more than 0	Not more than 5
Class 9a (Ceiling) Patient care areas		Not more than 0	Not more than 3
Class 9a (Wall)		Not more than 2	Not more than 5
Class 9a (Floor)		Not more than 3	Not more than 5

Critical Radiant Flux (CRF in KW/m2) of Floor Materials and Floor Coverings

	General	Fire Isolated Exits
Class 2, 3, 5, 6, 7, 8, 9b (excludes aged)	2.2	2.2
Class 3, (aged accommodation)	4.5	4.5
Class 9a (Patient care areas)	4.5	4.5
Class 9a (Other areas)	2.2	4.5
Class 9c (Resident use)		4.5
Class 9c (Other areas)		4.5

Group reference
A material used as a finish, surface, lining or attachment to a wall or ceiling must be a Group 1, 2 or 3 material used in accordance with above table.

Group 01
Material does not reach flashover when exposed to 100kw for 600 seconds followed by exposure to 300kw for 600 seconds.

Group 02
Material reaches flashover following exposed to 300kw within 600 seconds after not reaching flashover when exposed to 100kw for 600 seconds.

Group 03
Material reaches flashover in more than 120 seconds but within 600 seconds when exposed to 100kw.

Group 04
Material reaches flashover within 120 seconds when exposed to 100kw.

and
For buildings not fitted with a sprinkler system have a '*smoke growth rate index'* not more than 100 or an average *'specific extinction area'* less than 250m2/kg.

04 FIRE EXTINGUISHERS / BLANKETS

01 FIRE EXTINGUISHERS / FIRE BLANKETS

Generally
Provide portable fire extinguishers and location signs for compliance with BCA and SAMFS requirements.
Selection and location: To AS 2444.

General requirements: AS/NZS 1841.1
Water: AS/NZS 1841.2.
Wet chemical: AS/NZS 1841.3
Foam: AS/NZS 1841.4.
Powder: AS/NZS 1841.5.
Carbon dioxide: AS/NZS 1841.6.

02 MAINTENANCE
Maintain all fire extinguishers and blankets for the term of the Defects Liability Period and in accordance with the Essential Safety Provisions Schedule.
Standard: To AS 1851.1.

DETAILED INSTRUCTIONS

1.01 SIGNAGE

Generally

Allow to supply and fix signage to positions as directed on site. The contractor is to confirm all signage details prior to commencement of work / ordering of materials. Signage shall be generally uniform in appearance / size and position.

Extent

-Refer Appendix B Materials and Finishes Schedule
-Service cupboards and rooms

Signage Type

Unless noted otherwise provide 25 high Helvetica lettering engraved into aluminium on black engraving grade laminate sheet 120x120 / adhesive fixed to background

Statutory Signage

Provide all signage as required for compliance with Australian Standards / Occupation Health and Safety / Health Standards / Building Code Of Australia.

Fire doors	Fire safety door do not obstruct – do not keep open (BCA D2.23)
Lift	Do not use this Lift if there is a fire (BCA E3.3)
Fire Services	Hose Reels / Extinguishers / Fire Hydrant Booster (
Exit doors	Braille and tactile signage in accordance with AS1428.1 (BCA D3.6)

Service Signage

All services pipework (Mechanical / Electrical / Hydraulic) exposed to view shall be painted to Australian standard. Pipework concealed from view shall be provide with proprietory self adhesive labels identifying the service and direction of flow (as applicable)

Apartment Signage (Apartment Numbers)

Stainless steel cut numbers 100 high – as selected. (Builder to nominate PC sum – supply only) Fixing included in tender.
Mail box signage (adhesive fixed black alumin 25mm)

1.02 PORTABLE FIRE EXTINGUISHERS / BLANKETS

Extent

All areas

Compliance

Provide extinguishers and blankets with signs and wall brackets in accordance with AS2444. Provide extinguishers to suit the fire fighting requirements and type of fire hazard at not more than 20m travel. For Class 2-3 buildings extinguishers shall be located not more than 10m from a door to SOU.
All extinguishers shall have current tags (valid date period) and be positioned and selected to suit hazard

Fixing

Extinguishes shall be mounted between 1000min and 1100max above finished floor level to final positions as directed on site. Provide new signage indicating type of extinguisher to be mounted 100mm above top of unit with 'Fire Extinguisher' symbol located at 2000max above floor level.

Allowance

Provide combination of dry chemical fire extinguishers and water type extinguishers to locations as approved on site.

Confirm

Setout and final position of all extinguishers and signage prior to installation.

1.03 MISC ITEMS / WALL – CEILING HUNG ITEMS

Extent

Refer drawings
Refer Appendix B Materials and Finishes Schedule

Timber noggings / Ceiling Support framing

Set out new timber framing to suit wall and ceiling hung fittings. Provide timber noggings and trims to wall and ceilings to suit general misc equipment / fittings and fixtures.

For heavy wall loads provide vertical stud framing in wall aligning with fixing. Alternatively provide noggings /blocking in wall with vertical blocking down to floor level alongside nearest studs.

For ceiling loads securely fix timber framing so that the load is transferred to the building structural frame without causing deflection. Extend framing to adjacent walls or provide purpose made suspension frames in ceiling off structure for support (threaded suspension rods).

Provide timber sizes to adequately support the required loads with the appropriate fixings as required.

Brackets

Allow to supply and install purpose made steel brackets to positions as shown on the drawings.
Refer Joinery drawing / Timber Fixtures - Joinery specification for bracket notes and details.

Brackets shall be designed to carry the required design loads and fabricated to suit building in and concealment.
All brackets shall be galvanised unless noted otherwise.
Co-ordinate details with other trades (Joinery contractor etc)

Allow

To supply and install misc fittings and fixtures to positions as generally shown on the drawings and / or as directed on site.

Item	Comments
Vanity / basin Brackets / Misc	Refer installation manuals
Kitchen	Wall shelving
Misc Fixtures and Fittings	Refer other trades (Mechanical / Electrical / Plumbing Refer Appendix B - Hardware

TIMBER FIXTURES

1 GENERAL

1.1 CROSS REFERENCES

General

Refer to Preliminaries / General Requirements / Special Conditions of Contract

Related worksections

Door and Hatches / Windows / Linings / Partitions

2 QUALITY

2.1 INSPECTION

Witness points / Hold points

Refer to Contractors approved inspection and test plan for witness and hold points

2.2 SAMPLES

Refer clause 1.11

2.3 SUBMISSIONS

Shop drawings

Provide shop drawings of all fabricated components

3 MATERIALS AND COMPONENTS

01 MOISTURE CONTENT

Requirement

Use only seasoned joinery grade timber for door, window frames, joinery generally.

Timber for general framing trimming etc shall be seasoned softwood F5 / F8.

02 DURABILITY

Generally

Use timbers having natural durability appropriate to the conditions of use, or preservative-treated timber of equivalent durability. Classification: To AS1604 Table F2.

Minimum requirements:

Class 3: Timbers above ground, not in continuous contact with moisture, well ventilated, protected with a finish, and well maintained.

Class 4: Timbers fully protected from moisture, indoors, above ground, and well ventilated.

03 TIMBER SPECIES

Requirement

Do not use rainforest timber species unless plantation grown. Provide source certification as requested.

Acceptable timber species: Australian / Victorian Ash, Aust Oak.

Joinery timber

Hardwood: To AS 2796.3.

Seasoned cypress pine: To AS 1810 / Softwood: To AS 4785.3.

Plywood

Interior use generally: To AS/NZS 2270.

Interior use, exposed to moisture: To AS/NZS 2271.

Wet processed fibreboard
Hardboard: To AS/NZS 1859.4 (Int).

Particleboard
Standard: To AS/NZS 1859.1 (Int).

Melamine overlaid particleboard: Particleboard overlaid on both sides with low pressure melamine.

Dry-processed fibreboard
Standard general purpose medium density fibreboard (STD MDF): To AS/NZS 1859.2 (Int).

Melamine overlaid medium density fibreboard: Medium density fibreboard (STD MDF) overlaid on both sides with low pressure melamine.

Decorative overlays
Standard: To AS/NZS 1859.3.

High-pressure decorative laminate sheets
Standard: To AS/NZS 2924.1.

Thickness (minimum):

- For horizontal surfaces fixed to a continuous background: 1.2 mm.
- For vertical surfaces fixed to a continuous background: 0.8 mm.
- For post formed laminate fixed to a continuous background: 0.8 mm.
- For vertical surfaces fixed intermittently (e.g. to studs): 3.0 mm.
- For edge strips: 0.4 mm.

04 MEDIUM DENSITY FIBREBOARD

Proprietory manufactured boards CSR / Laminex / Formica or equal approved

Grades

Use grades not inferior to those designated by the manufacturer as being appropriate to the conditions of use.

Types

Use Pre-finished boards where possible, otherwise lay laminate finishes as specified.

Use only (MR) Moisture Resistant grade boards throughout for joinery items in kitchens / bathrooms / Bars / wet areas generally etc

Internal pre-finished boards shall be white unless specified otherwise.

Edge strips shall be 2.5mm (nom) PVC (including leading internal shelf edges).

Minimum board thickness to be used in joinery items shall be 16mm.

05 VENEERS

Timber veneer

Premium quality veneer : selected grade as approved

06 LAMINATED PLASTIC SHEET

Material

Proprietory manufactured boards CSR / Laminex / Formica / Abet Laminati or equal approved

Installation

Install in accordance with sheet manufacturers recommendations / specification.

Sheet Size/ Joints

Minimise number of joints by using as large a sheet as possible. Obtain approval for positioning joints in sheets where required.

06 FASTENINGS

Requirement

Provide concealed fixing and fastenings as necessary to transmit the loads imposed and to ensure the rigidity of the assembly. All nail fixings to structural timber framing shall be galvanised.

Staple fixings shall not be used for joinery items.

07 ADHESIVES

Generally

Provide premium grade adhesives of the types appropriate to their purpose, and as recommended by the material manufacturer for the location and use.

Contact adhesive / Laminex 440TMK11 / 1980 MK11

PVA emulsion / AV 101 / AV140 PVA adhesive

Single Pack / AV180

Structural adhesives / Urea Formaldehyde AV201 / AV56

Marine Grade / Resorcinol-phenol resin glue

08 JOINTING MATERIALS

Generally

Use proprietary jointing materials, including primers, polyurethane, silicone sealants, or equal as recommended by the material manufacturers for the location and function.

Sealants shall be mould / mildew / high temperature resistant / fexible.

For bench tops use Laminex Colourfill hard setting resin adhesive / sealant.

04 WORKMANSHIP

01 WORKMANSHIP GENERALLY

Requirement

Provide all accessories necessary for the completion of work. Ease and adjust moving parts, lubricate hardware, and leave the completed work in a sound, clean, working condition.

Seasoned timber

Use only joinery quality selected seasoned timber for joinery applications.

Ploughing

Back plough boards to prevent warping (e.g. if exposed externally on one face). Provide sufficient fixing to prevent warping during fabrication.

Edges

Arris all edges of work to receive paint or similar coatings.

Priming

All exposed external timber work shall be pre primed prior to delivery to site.

Fastenings

Conceal all fixings. Where fastenings are unavoidable on visible joinery faces, sink the heads below the surface and finish flush with a material resin colour match sealant . In surfaces which are to have clear or tinted finish use matching wood plugs or timber fillers compatible with stain / clear finishes.

In internal surfaces which are to have melamine finish use proprietary screws and caps finished to match. Staple fixings shall not be allowed.

Veneer Matching

For surfaces which are to have clear or tinted finish, hand select veneer pieces for consistency in texture, grain and colour.

Timber Joints

Use timber in single lengths whenever possible. Where visible joints are necessary obtain the approval of the Architect before proceeding.

Framing

Trim where necessary for openings including those required by other trades. All structural framing shall be in accordance with the Timber Framing Code Of Australia.

05 CONSTRUCTION GENERALLY (JOINERY)

01 General

Build all components square and install plumb.

Frame and trim where necessary for openings, including those required by other trades. Liaise with other trades for final cut-out sizes/requirements (take delivery of equipment/fixtures/fittings as required).

Accessories and trim

Provide accessories and trim necessary to complete the installation.

Alignment

Scribe benchtops, splashbacks, ends of cupboards, kickboards and returns to follow the line of the structure.

Edge strips

Finish all edges of sheets with edge strips which match sheet faces as previously specified. Adjustable shelves shall have all four edges edge stripped.

02 CUPBOARD, SHELF AND DRAWER UNITS

Plinths

High moisture resistant medium density fibreboard. MR Grade 16mm. thick.

Fabrication:	Front rail supports behind
Finish:	Decorative laminated sheet as selected.
Installation:	Scribe to floor and secure to wall to provide level platform for carcasses.

Carcasses

Proprietary item:	Laminex Lamiwood MR or equal.
Material:	Prelaminated decorative 16mm MDF (MR grade to wet areas).
Joints:	Proprietary screw fixings (not staples) and glue / rebated mitre

Internal Shelves:	Support on proprietary ssteel pins / holes 32mm centres vertically.
Finish:	Melamine sheet on MDF board (White - not exposed / Black - exposed)
Installation:	Secure to joinery walls at not more than 600mm centres.
Edges:	2.5mm PVC edging (horizontal/vertical).
(A)	16 thick MR Lamiwood 2.5mm PVC edging all around 600 span
(B)	25 thick MR Lamiwood 2.5mm PVC edging all around >600 span

Drawer fronts and doors

Proprietary item:	(Doors to be max 450 wide unless shown otherwise)
(A)	16 thick MR Lamiwood 2.5mm PVC edging all around
(B)	Proprietary Hardform 'U' profile / 2.5mm Pvc edge strip top and bottom.

Drawer backs and sides

Proprietary item:

(A)	Metal drawer slide system as approved with extendable guides.
(B)	16 thick MR Lamiwood 2.5mm PVC edging all around

Colour: White

Installation: Mitre corners with glued and screw fixed corners. Button caps to fixings.

Drawer bottoms

Proprietary item: Laminex Lamiwood MR or equal 12mm thick

Drawer and door hardware

Hinges:

Fully concealed commercial spring hinge / Hold open function / swing to suit application

Adjustable / 180 degree throw / Nickel plated min 3 per door (> 900 high)

Slides:

Type (A)	Metal drawer slide system. (telescopic / extendable)
Type (B)	Telescopic / extendable metal runners and guides with plastic rollers. Cowdroy or equal:

Push/Pulls:

Type (A) - Stainless steel D handles with concealed fixings 100 long

Type (B) – Parbury 'C' profile colour co-ordinated handles.

Type (C) – Profiled shark nose edge to frontal panel

Type (D) – Finger pull 35dia hole

Provide rebated shadow line infill panels against side walls / cupboards for door swing (handle)

Locks

Provide locks to all drawers and doors (refer Appendix B Materials and finishes schedule)

03 BENCHTOPS

(A) Laminated benchtops

Proprietary item: 25/ 33 thick structural particleboard MR grade with decorative plastic lam finish

Finish: Decorative laminated sheet. (Purpose laid as required)

Edges: Leading edge post formed / Other edges 2.5mm PVC edge strip.

Sheet Joints : Use full sheets to minimise junctions. Laminate joints not to occur adjacent sinks etc. Obtain approval for all sheet junction positions prior to ordering.

Sealing underside:

Return Laminate edges 50mm to u/side along all exposed edges .

Purpose seal u/side of benchtop in area of open shelves

Seal where subject to excessive moisture from equipment such as dishwashers.

Laminate u/side of the benchtop where exposed to view.

Installation: Scribe to walls and floors. Fix to carcass at 450 centres

Joint sealing: Laminex colourfill resin / clamp sheet joints with proprietary mechanical connectors under. Provide polyurethane sealant to perimeter of all bench tops and up-stands including fixture inserts etc.

Corners : Provide 45 degree cut off at all external exposed corners to all bench tops with edge stripping to match front / leading edge. (Commercial installations)

06 TRIMS / TIMBER MOULDINGS

TIMBER TRIM

Provide

All KDHW / Treated Pine / Aust Oak par 20x20 (as required) timber trims such as beads, mouldings and stops, cover battens to make neat junctions between components and finishes. Pre prime all timber prior to installation as previously specified.

Allow to provide timber beads, mouldings and stops, cover battens to perimeter of new works where abutting existing finishes etc for making good where uniform flushing of materials is not possible.

Finish

Paint / stain all new timber timber trims such as beads, mouldings and stops, cover battens to match adjacent finishes

DETAILED INSTRUCTIONS

1.01 MISC TIMBER FRAMING

Extent

Refer drawings

Timber Wall Framing

Provide timber framed walls to positions as shown on the drawings in accordance with Timber Framing Code AS1684.

Provide 90x35MPG10 stud framing at 600 centres to suit linings unless noted otherwise. Provide 90x45 or double studs to sides of openings.

Noggings

Liaise with other trades for setout of steel wall framing. Provide timber noggings / double stud framing where required for support of wall hung fixtures and fittings. Provide solid fixing for handrail brackets.

1.02 TIMBER SKIRTINGS / ARCHITRAVES

Extent

Apartments (internally)

Type

Provide new 70x16 MR MDF / 70x22 Aust oak skirings and 32x12 Aust oak splayed door architraves to positions as shown.

Refer

Refer drawings for details and Materials and Finishes schedule Appendix B for finishes

Finish

Paint as scheduled. Refer Painting specification

1.03 JUNCTIONS / SEALANTS

Generally

Make good all new and existing junctions to walls / joinery / tiling etc

Provide

Flexible sealant to all existing and new junctions to obtain a waterproof seal.

All areas	Provide polyurethane seal between new joinery / bench tops and adjacent surfaces
Toilets	Provide polyurethane seal to tile control joints / perimeter of fixtures etc
Penetrations	Provide escutcheon plates in combination with polyurethane sealants to prevent egress of water / moisture / dirt / vermin

Type

Use commercial grade proprietory sealants and fillers recommended by manufacturer for application and use in commercial premises. Where sealants / fillers etc are required prepare surfaces in accordance with manufacturers details / instructions. Mask edges to obtain neat / straight / full joints.

1.04 JOINERY SCHEDULE / SPECIFICATION

Extent

Refer drawings

Generally

Supply and install all joinery as specified and as shown on the drawings. Construct joinery in accordance with previous minimum standard specification notes (as applicable) unless noted otherwise.

Materials / Finishes

Refer Appendix B for Materials and Finishes Schedule. Confirm all materials and finishes prior to ordering.

Junctions

Seal all joints / junctions using commercial grade polyurethane sealant and fillers recommended for application and use as previously specified.

Linings

All timber boards and linings shall be WR grade with selected plastic laminate / timber veneer linings unless noted otherwise

Fixtures and Fittings

Provide cut outs to all bench tops for new sinks / tapware / services outlets etc to positions as generally shown on the drawings. Confirm setout and **obtain approval** of same prior to commencement of work.

Build in all fittings and fixtures in accordance with details and best practice. Polyurethane seal to all junctions.

Vinyl Floor Junctions

Co-ordinate installation of new joinery with Flooring contractor. New joinery to be installed over new vinyl floor finishes. Provide continuous 3mm polyurethane sealant bead to junction of new vinyl floor and new / existing joinery. Seal junction watertight. Co-ordinate installation of Pvc skirting to perimeter of all new / existing joinery and new floor finishes.

Framing / End Framing / Junctions

Liase with Metalworker for provision of all support posts / P frames end frames etc for support of new bench / counter tops. Confirm all details and setouts for full support of tops and building in details.

Return frontal finishes into reveal of joinery openings. Provide end framing for support as required.

Shop Drawings

Provide shop drawings of all joinery prior to commencement of work for review and approval. Detail all junctions and construction details with materials and finishes noted. Provide templates for glass fabrication.

Confirm set out and dimension of all new joinery on site prior to commencement of work. Allow to verify all building in details and junctions prior to commencement of work.

Confirm details / sizes / set out / position / and make allowances for all fixtures and fittings / hydraulic and electrical service access.

Co-ordinate with other trades for the supply and installation of fixtures and fittings and building in of all specialist services (data / electrical / hydraulic etc). Provide all penetrations as required and seal / close off as previously specified.

APPENDIX A

DOOR AND HARDWARE SCHEDULE

- DOOR SCHEDULE
- DOOR HARDWARE SCHEDULE

DOOR SCHEDULE

DOOR				FRAME	HARDWARE										
DOOR NO.	SIZE	TYPE	FINISH	TYPE	LOCK	FURN	E/LOCK	CLOSER	BOLTS	K/PLATE	SEAL	GRILLE	D/STOP	VIEWING PANEL	REMARKS
	W x H														
Gates															
DG01	800x1800	G / CT	PWD	M	Y										Gas enclosure gate (Double) / chain stop
	800x1800	G / CT	PWD						Y						
DG02	900x1800	G / CT	PWD	M	Y	Y							Y		Apartment courtyard access / Push Pull handles
DG03	6000x1800	SL/G	PWD												Sliding / vehicle access / security access
DG04	900x1800	G	PWD	M	Y	Y	Y	Y							Pedestrian access gate / security access / Push Pull handles
DG05	625X1800	G / CT	PWD	M	Y										HWS service enclosure
	626X1800	G /CT	PWD						Y						
Ground Floor Doors															
DG01	880x2400	AL/SC	PWD/P	AL	Y	Y		Y			Y		Y		Apartment door
DG02	820x2400	SC	P	M	Y	Y		Y			Y				Exit / external key access only
DG03	2430x2400	RS	PWD	-	Y						Y				2hr fire rated shutter
DG04	820x2400	SC	P	M	Y	Y		Y			Y				Refuse access door / Sign
DG05	920x2400	AL/FG	PWD	AL	Y	Y	Y	Y			Y				Exit / Push Pull handles / security intercom access
DG06	555x2100	SC	P	M	Y			Y							Service cupbd / double doors / flush frame
	555x2100	SC	P						Y						
	555x2100	SC	P	M	Y			Y							Service cupbd / double doors / flush frame
	555x2100	SC	P						Y						
DG07	820x2100	SC	P	M	Y	Y		Y			Y		Y		
DG08	DELETED	SC	P	M		Y					Y				Fire hose reel cupbd / sign / latch
DG09	878x2100	**FD**	**P**	M	Y	Y	Y	Y			Y		Y		2hr Fire door / Push Pull handles / security intercom access
DG10	720x2100	SC	P	M	Y	Y		Y			Y		Y		Unisex Toilet / Privacy indicator lock / Sign
Stair doors															
DC1.1-3.11	820x2100	SC	P	M	Y	Y		Y			Y		Y		Fire stair / free escape / keyed return entry

DOOR SCHEDULE

DOOR				FRAME	HARDWARE										
DOOR NO.	SIZE	TYPE	FINISH	TYPE	LOCK	FURN	E/LOCK	CLOSER	BOLTS	K/PLATE	SEAL	GRILLE	D/STOP	VIEWING PANEL	REMARKS
	W x H														
Apartment Doors															
D2.1	1820x2400	SL/FG	PWD	AL	Y	Y					Y				Apartment sliding door complete with snib lock
D3.1-4.1	As per D2.1														
D5.1-12.1	1800x2400	SL/FG	PWD	AL	Y	Y					Y				Apartment sliding door complete with snib lock
D13.1-14.1	As per D5.1														
D15.1-16.1	2375X2400	SL/FG	PWD	AL	Y	Y					Y				Apartment sliding door complete with snib lock
D2.2	820x2100	FD	P	M	Y	Y		Y			Y		Y		Apartment Entry Door / 1Hr Fire rated door and frame
D3.2-16.2	820x2100	FD	P	M	Y	Y		Y			Y		Y		As above
D2.3	1539x2100	BF	P	T		Y									Laundry / sliding door o/head track / latch / pull handle
D3.3	As per D2.3														
D4.3	1260x2100	BF	P	T		Y									Laundry / sliding door o/head track / latch / pull handle
D5.3	1425x2100	BF	P	T		Y									Laundry / sliding door o/head track / latch / pull handle
D6.3	1290x2100	BF	P	T		Y									Laundry / sliding door o/head track / latch / pull handle
D7.3	As per D5.3														
D8.3	2070x2100	BF	P	T		Y									Laundry / sliding door o/head track / latch / pull handle
D9.3	1190x2100	BF	P	T		Y									Laundry / sliding door o/head track / latch / pull handle
D10.3-12.3	As per D6.3														
D13.3	As per D8.3														
D14.3	As per D9.3														
D15.3	1672x2100	BF	P	T		Y									Laundry / sliding door o/head track / latch / pull handle
D16.3	As per D15.3														
D1.3	720x2100	SC	P	T	Y	Y							Y		Bathroom / Privacy latch
D1.4	720x2100	SC	P	T	Y	Y							Y		Bathroom / Privacy latch
D2.4-8.4	720x2100	SC	P	T	Y	Y							Y		Bathroom / Privacy latch
D9.4	820x2100	SC/SL	P	T	Y	Y									Bathroom / cavity slide / latch
D10.4-13.4	As per D1.4														
D14.4	As per D9.4														
D13.4	As per D1.4														
D14.4	As per D9.4														
D15.4-16.4	As per D1.4														

DOOR SCHEDULE

DOOR				FRAME	HARDWARE										
DOOR NO.	SIZE	TYPE	FINISH	TYPE	LOCK	FURN	E/LOCK	CLOSER	BOLTS	K/PLATE	SEAL	GRILLE	D/STOP	VIEWING PANEL	REMARKS
	W x H														
D1.5-1.6	820x2100	SC	P	T		Y							Y		Bedroom
D2.5	820x2100	SC	P	T		Y							Y		Bedroom
D4.5-16.5	As per D2.5														
D2.6	820x2100	SC	P	T		Y							Y		Bedroom
D4.6-5.6	As per D2.6														
D7.6-9.6	As per D2.6														
D13.6-14.6	As per D2.6														
	CONFIRM ALL DOOR SIZES ON SITE AND CONFIRM ALL HARDWARE ETC PRIOR TO ORDERING														

E / -	EXISTING ITEM (EXTG)
M / -	MODIFY EXTG ITEMS FOR NEW.
R / -	REMOVE EXTG
S	DENOTES SECURITY ITEM BY SEP CONTRACT
Y / ✓	YES – FIT ITEM AS SPECIFIED AND OR SCHEDULED

M	METAL
MF	METAL FLUSHED FRAME
AL	ALUMINIM
T	TIMBER
PL	PLY FACE
CT	COMPOSITE TIMBER

SC	SOLID CORE
HC	HOLLOW CORE
HG	HALF GLASS
FG	FULL GLASS
FP	FIELDED PANEL
G	GATE (M, AL, T)
SL	SLIDING DOOR
RD	ROLLER DOOR
RS	ROLLER SHUTTER
FD	1 HR FIRE DOOR
RG	ROLLER GRILLE
BF	BIFOLDING DOOR

A	ANNODISED
P	PAINT FINISH
2P	TWO PACK PAINT
PWD	POWDER COAT
MC	METAL CLAD PREFINISHED
C	STAIN / CLEAR FINISH
CB	COLOURBOND
G	Galvanised
LVR	LOUVRE DOOR
OW	OPERABLE WALL

Note : All Aluminium doors and pivot doors to be fitted with Astragal door sweeps all around
Schedule to read in conjunction with Doors specification
Reed Switches to doors – Refer Electrical drawings
Fit RP37 to all external SC and MC double doors

SEALS A RP4T-82 B RP13 C RP82 D RP112 E RP4T-116 F RP77-4T G RP38-78SI-95
H RP77-4T-91-26 J K RP78 L RP116-8SI M RP8SI-77

APPENDIX B

MATERIALS AND FINISHES SCHEDULE

- EXTERNAL FINISHES SCHEDULE

NOTE
Confirm all materials and finishes including colours with Architect prior to ordering / commencement of work

STUDIO NINE ARCHITECTS

NUMBER	0901-321
PROJECT	PROSPECT ROAD
ADDRESS	168 PROSPECT RD, PROSPECT SA 5082
ISSUE	FOR PRICING
DATE	28/08/2018

DENOTES FINISHES YET TO BE SELECTED

Notes:
- All schedules are to be read in conjunction with all other Drawings, Specifications and Appendicies.
- All products & substrates to be stored & intalled in accordance with the manufacturer's instructions & comply with the relevant code requirements.
- Installing contractor / subcontractor to ensure all products meet relevant BCA & AS for nominated use & notify designers with any discrepancies.
- Finished samples to be provided by the nominated contractor / sub contractor for approval prior to installation.
- Contractors are to assume a 3-month lead-time on all products. It is the contractor's responsibility to ensure orders are placed to meet delivery & programme dates. Failure to allow for lead-times will not be reasonable grounds for for product substitution.
- Proposed alternatives to products or suppliers nominated below must be submitted & approved by Studio Nine Architect's prior to ordering. It is the Contractor's responsibility to submit sufficient information to the Architect to permit evaluation of the proposed alternatives.
- Finishes locations are nominated, but not limited to area specified.
- Prices listed here are indicative and for rough guide only. Individual contractors / sub contractors are to confirm all costings at time of tender.
- All costs provided are indicative costs only and are subject to builder and installation margins. Prices do not include freight or GST unless otherwise noted.
- Allow for 3mm black anodised angle edge strip to all adjoining floor junctions. UNO

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
PAINT					
1m x 1m sample patch to be applied to wall surface, of each specified colour, prior to commencement of painting works. Paint colours are to be confirmed on site by Client | Architect. Where skirtings occur paint to match wall colour, unless otherwise indicated.					
PA-1	Interior Wall Paint	STOREAGE/ REFUSE	Product: Dulux Wash & Wear Finish: Low Sheen Colour: Lexicon Code: SW1E3 Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats
PA-2	Interior Ceiling Paint	LOBBY	Product: Dulux Ceiling Finish: Flat Colour: Basalt Code: G30 Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats

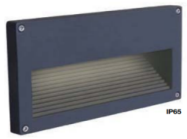
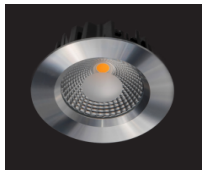
Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
PA-3	Interior Ceiling Paint	STOREAGE/ REFUSE	Product: Dulux Ceiling Finish: Flat Colour: Lexicon Code: G30 Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats
PA-4	Doors/Frames/ Skirtings	GENERAL	Product: Dulux Aquanamel Semi-Gloss Finish: Flat Colour: Black Code: SG6G9 Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats
PA-5	Exterior Paint	CANOPY	Product: Dulux Acrashield (non textured) Finish: low sheen (Factory applied spray finish) Colour: Basalt (to match PA-2) Code: G30 Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats
PA-6	Exterior Steel Paint	GENERAL	Product: Dulux Metalshield Epoxy Enamel Finish: Satin Colour: White Code: Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats
PA-7	Exterior Steel Paint	GENERAL	Product: Dulux Metalshield Finish: Satin Colour: Colorbond Monument Code: C29 Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats
PA-8	Powdercoat	GENERAL	Product: Powdercoat Finish: Matt Colour: Monument Code: 959-9066M Supplier: Dulux		Minimum 3 coats Builder to use approriate prepcoats and undercoats

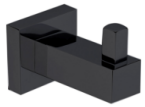
TILES

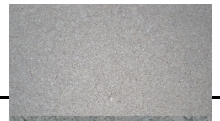
Installation Generally:
Any external corners where 2x walls with ceramic tiles meet- Install natural anodised aluminium corner angle: 2.5mm thick nominal.
To any exposed ends of cut ceramic tiles- Install natural anodised aluminium edge strip (flat bar): 2.5mm thick nominal.
Sample tiles are to be provided by builder on site for approval by Client | Architect.

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
TL-1	Floor finish/Walls finish	LOBBY/WC	Product: Arkitek Grey GL-Porc Textured Rect Size: 600 x 300 Slip Rating: R10 Code: 1000056 Supplier: Beaumount Tiles Grout Colour: Ardex EG15 - 673 Misty Grey		$35.15 m2
ENTRANCE MATTING					
1m x 1m sample to be provided of each product specified, prior to commencement of manufacture for approval by Client | Architect.					
MA-1	Entrance Matting	LOBBY	Product: Link Modular Interlocking Matting Colour: Black/Brush Code: 174992 Supplier: Classic-Arc		
CONCRETE					
WT01/B	Concrete / Brick facing	Ground /First floor	Product: Off form concrete Finish: Brick Facing as scheduled Supplier: TBA		
-	Concrete	Ground /First floor Carpark	Product: Off form concrete Finish: CanyonTone stain (White) Supplier: United coatings		
HANDLE FINISHES					

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
HA-1	Entry Door Handle	GENERALLY	Product: 1.2M Black Pull Handles Dimensions: 1200H x 40W X 20D Colour/ Finish: Matte Black Code: PH-1200-MB Supplier: The Lock and Handle (thelockandhandle.com)		Either side of entry door.
HA-2	Door Handle	GENERALLY	Product: Formae F101 Dimensions: 101H x 12D (98mm Centres) Colour/ Finish: Matte Black Code: F101-96-BL Supplier: Nidus (nidus.net.au)		
LO-01	Lock	GENERALLY	Product: Black Oval Cylinder - Lock Colour/ Finish: Matte Black Code: MB-OC Supplier: The Lock and Handle (thelockandhandle.com)		To services doors where applicable
SKIRTING / THRESHOLDS					
SK-01	Internal Skirting	GENERALLY	Product: 2mm Thick Aluminium Edge Skirting with paint finish (PA-3) Installation: Skirting to sit flush against adjacent wall		
GLASS / MIRRORS					
Glass | Mirros | Glazing to be to AS1288. If product is substitued for an alternative product, builder to supply designer sample for approval by Client | Architect.					
MI-1	Mirror Finish	WC	Product: Mirror Glass with polished edges Finish: 6mm tempered glass mirror to AS1288 Details: Conceal Fix Supplier: Builders prefered supplier	N/A	

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
LIGHTING / ELECTRICAL					
WL-1	Exterior Wall Light	REFER DRAWINGS	Product: Forte Recessed LED Wall Light 1190-3K-6.6W Dimensions: 270H x 143W x 93D mm Finish: Dark Grey Lead Time: Supplier: Gamma Illumination (08 8260 1444)		
DL1	General Downlight	STOREAGE/ REFUSE	Product: Oki 1095-SP-3k-13W-17 Finish: Satin White Supplier: Gamma Illumination (08 8260 1444) Globe: 3000K colour temperature (included).		
DL2	Wet Area Downlight	WC	Product: Apex AADJ15-A Finish: UV Textured Black Supplier: Gamma Illumination (08 8260 1444) Globe: 3000K colour temperature (included).		
LE1	LED Strip Light	CANOPY/LOBBY	Product: Waterproof Flexible SMD LED Strip - mounted on ALP011/Opal diffuser Code: 1167 Supplier: Gamma Illumination (08 8260 1444)	N/A	As recommended by Gamma Illumination.
FL	Batten Light	REFUSE	Product: Diffuesd LED batten Light Finish: Col. White Supplier: Gamma Illumination (08 8260 1444)	N/A	As recommended by Gamma Illumination.

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
SANITARYWARE					
TW-1	Basin Mixer	WC	Product: Sole Basin Mixer w/ Long Outlet Finish: Matte Black Code: 1625164 Supplier: Bathware Direct		RRP $110.00
B-1	Wall Mounted Basin	WC	Product: AXA Centro 450 x 250 Wall Basin Right Hand Overflow inc. Finish: White Code: 9505814 Supplier: Reece Plumbing		RRP $366.99 + matte black pop up plug
B-2	Bottle Trap	WC	Product: Mizu Drift 40mm Round Black Bottle Trap Finish: Matte Black Code: 2280015 Supplier: Reece Plumbing		RRP $116.00 To complete B-2 + B-3 basins
WC1	Toilet Suite	WC	Product: Caroma Luna Finish: Vitreous China Code: Bottom Inlet 829710W (caroma code) Back Entry 829720W (caroma code) Supplier: Reece Plumbing		RRP $639.00
RH	Robe Hook	WC	Product: Innova Square Robe Hook Finish: Matte Black Code: 1623271 Supplier: Bathware Direct		RRP $29.00 Mounting Height: 1800 FFL (Unless otherwise noted)
TRH	Toilet Roll Holder	WC	Product: Moda Matte Black Toilet Roll Holder Finish: Matte Black Code: 1624992 Supplier: Bathware Direct		RRP $49.00 Mounting Height: 900 FFL (Unless otherwise noted)
ROOFING					
MX01	Roof Cladding	GENERALLY THROUGHOUT	Product: Lysaght Kingclip Finish: Colorbond surfmist Supplier: Ltsaght		

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
DPxx	Downpipe	GENERALLY THROUGHOUT	Product: Circular Downpipe Finish: Colorbond Ultra 'Monument' (or Paint to match)		
CBC	Parapet Capping	GENERALLY THROUGHOUT	Product: Parapet Capping Finish: Colorbond Ultra 'Monument'		
PCL	wall barge Capping	Wing Walls	Product: composite aluminium Finish: To match Longline wall sheeting (Basalt)		
	Roof Plant Screen	Roof	Product: Con-form Aluminium Batten Screen Colour & Finish: Colorbond Monument		
RH01	Rainheads	GENERALLY	Product: Feilders Ned Kelly or equal Finish: Colorbond Ultra 'Monument'		
EXTERNAL FINISHES					
-	Concrete	Ground / First Floor carpark	Product: Off form concrete finish to exposed slabs finished with CanyonTone stain (white) including columns to Carpark (provide sample prior to ordering)		
PV-01	Paving	GENERALLY THROUGHOUT	Product: Handipave Size: 240x240MM (60D) Colour: Charcoal Finish: Bevelled Supplier: Boral		

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
GFC	Compressed Fibre Cement	CANOPY	Product: ExoTec - compressed fibre cement panel Size: 12mm Thick (Refer drawings for dimensions) Colour: Pre-finished colour to match PA-5 Supplier: James Hardie	 Image indicative only.	
BT-01	Brick Tile	GROUND + LEVEL 1	Product: Apricot/Tan brick blend Size: 230 x 76 x 16mm Mortar: XXX Finish: Brick tile to match Little Hampton "Siena" Brick - burnt terracotta blend with earthy textures. Supplier: Robertsons		
LL-01	Longline Cladding	LEVEL 2/3	Product: Longline 305 Wall Cladding Finish: Colorbond Basalt Supplier: Lysaght Detail: Conceled clip lock fixing		
F01	Door/Window Frames	GENERALLY THROUGHOUT	Product: Vantage Aluminum Windows & Door Finish: Black (to match PA-4) Supplier: AWS Australia		
SS1	Balcony Louvres	West elevation LEVEL 1/2 louvres	Product: Lowline Elliptical louvre Finish: Powdercoat aluminium PA-8 Dimensions: 100 nominal Supplier: Lowline / MRE Detail: Fixed to alumiium subframe as spec		

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
SS2	Sun hoods	North / South elevations	Product: LowLine Caprice aluminium interlocking slats Finish: Powdercoat Nigh Sky Dimensions: To match window frames Supplier: LowLine Detail: Refer manufactureres shop drawings		
GD	Garage Door	REFUSE DOOR	Product: Airport Doors Fire rated shutter Finish: Colorbond Ultra 'Monument' Dimensions: Refer drawings . Supplier: Airport doors		
GB	Glass Balustrade	GENERALLY THROUGHOUT	Product: Hark balustrade system as spec Dimensions: Tougened Glass Finish: Dulux Powdercoat Monument Supplier: Hark		
SC01	Screens	Courtyard APARTMENT 1	Product: Proprietory Aluminium Slat timber look fence Detail: 72H x 27D Finish: As selected Supplier: W&W Ween Road Pooraka SA		
SC02	Screens	HWS / Carpark	Product: Proprietory Aluminium Slat fence Detail: 72Hx27D Finish: Colorbond Ultra 'Monument' Supplier: W&W Ween Road Pooraka SA		
HB01	Hebel	Foyer Area LEVEL 2 /3	Product: Dulux Acratex textured paint system Finish: To match PA-6 Supplier: Dulux		

Code	Item	Location	Product | Supplier | Description | Details	Image [where required]	Comments
HB02	Hebel	Foyer Area LEVEL 1	Product: Dulux Acratex textured paint system Finish: to match PA-7 Supplier: Dulux		
ST01	Balcony Steel frames	East - Level 2-3 Weat - Level 1-2	Product: PFC edge channels / 150x150 SHS Finish: Metalshield to match PA-6 (low gloss) Supplier:Dulux		
ST02	Balcony Steel frames	West - Level 3 East - Level 1	Product: PFC edge channel / 150x150 SHS Finish: Metalshield to match PA-7 (low gloss) Supplier: Dulux		
HWS	Electric Hot Water Heater	CARPARK	Product: Refer consultants details drawings		
BR	Bicycle Rail	CARPARK	Product: Standard 1 Bike Rail - Base Plate Dimensions: 1200D x 800H Code: BR12B / F Supplier: Securabike		
LB	Letterboxes	Courtyard Screen APRT 01 refer drawings	Product: National Multibank - wall mounted / front opening / key lockable w/ number strips Dimensions: 350W x 195H x 230D Finish: Colourbond Basalt - powdercoated to match PA7 - number colour: white Supplier: Adelaide Letterboxes		Total of 18 letterboxes - refer drawings for configuration.

APPENDIX C

ACOUSTIC REPORT

Resonate acoustics

168 Prospect Road
Acoustic Design Advice

Report Date: Wednesday, 12 April 17
Reference: A17127RP1, Revision 0

Resonate acoustics

www.resonateacoustics.com

Document Information

Project	168 Prospect Road	
Client	Studio Nine Architects	
Report title	Acoustic Design Advice	
Project Number	A17127	
Author	Alex Dundon Associate Director p+61 8 8155 5888 m+61 421 507 201 alex.dundon@resonateacoustics.com	
Reviewed by	Darren Jurevicius	

Revision Table

Report revision	Date	Comments
0	12 April 2017	First issue

Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
Characteristic	Associated with a noise source, means a tonal, impulsive, low frequency or modulating characteristic of the noise that is determined in accordance with the Guidelines for the use of the Environment Protection (Noise) Policy (Noise EPP) to be fundamental to the nature and impact of the noise.
Continuous noise level	A-weighted noise level of a continuous steady sound that, for the period over which the measurement is taken using fast time weighting, has the same mean square sound pressure as the noise level which varies over time when measured in relation to a noise source and noise-affected premises in accordance with the Noise EPP
Day	Between 7 am and 10 pm as defined in the Noise EPP
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of that sound level.
dB(A)	Units of the A-weighted sound level.
Facade sound reduction	means the reduction in external to internal sound level provided by the building envelope.
Floor area	means, in relation to a room, the area of the room measured within the finished surfaces of the walls, and includes the area occupied by any cupboard or other built-in furniture, fixture or fitting.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second.
Indicative noise level	Indicative noise level determined under clause 5 of the Noise EPP.
L90	Noise level exceeded for 90 % of the measurement time. The L90 level is commonly referred to as the background noise level.
Leq	Equivalent Noise Level—Energy averaged noise level over the measurement time.
Lmax	The maximum instantaneous noise level.
Night	Between 10.00 p.m. on one day and 7.00 a.m. on the following day as defined in the Noise EPP
Noise source	Premises or a place at which an activity is undertaken, or a machine or device is operated, resulting in the emission of noise
R_W	Weighted Sound Reduction Index—means a measure of the sound

	attenuation performance of a building element, measured in controlled conditions in a laboratory.
R_W+C_{tr}	means a weighted sound reduction index with spectrum adaptation placing greater emphasis on low frequency performance.
Separation distance	means the shortest distance (to the nearest metre), from an existing or future designated sound source to the nearest exposed point of the building envelope bounding a habitable room.
Sound Exposure Category (SEC)	means the degree to which a habitable room within a building is likely to be affected by external sound received by the building envelope.

Table of Contents

1 Introduction 1

2 Building Code of Australia 2

3 Minister's Specification 78B 4

3.1 Prospect Council – Air and Noise Overlay 4
3.2 Sound exposure categories 4
3.3 Sound insulation ratings 6

4 External constructions 8

4.1 External walls 8
4.2 Roof and ceilings 9
4.3 External doors 9
4.4 External windows 10

5 BCA Requirements 12

5.1 Walls 12
5.2 Apartment doors 13
5.3 Floors and ceilings 13
5.4 Services 14

1 Introduction

This report outlines the acoustic requirements relating to Part F5 of the Building Code of Australia (BCA) *Sound Transmission and Insulation*, as well as an assessment against Minister's Specification 78B *Construction Requirements for the Control of External Sound* for the proposed apartment complex development at 168 Prospect Road, Prospect. It details the acoustic requirements and recommended construction requirements for this proposed development.

The main acoustic issues addressed in this report are:

- acoustic separation between sensitive spaces
- control of air and structure borne noise associated with hydraulic services
- external construction requirements to control noise from traffic on Prospect Road.

2 Building Code of Australia

The 168 Prospect Road apartments are classified as Class 2 under the BCA. Class 2 buildings must achieve the objectives outlined in Part F5 of the BCA *Sound Transmission and Insulation*. The acoustic requirements applicable to this development are outlined in Table 1.

Table 1 BCA requirements for Class 2 and 3 buildings

Building element	Description	Impact noise requirements	Airborne noise criteria
Floors	Separating sole-occupancy units and separating sole-occupancy units and a plant room, lift shaft, stairway, public corridor, public lobby or the like.	$L_{n,w} \leq 62$	$R_w + C_{tr} \geq 50$
Walls	Separating sole occupancy units	—	$R_w + C_{tr} \geq 50$
	Separating a habitable room of a sole occupancy unit from a bathroom, sanitary compartment, laundry or kitchen in an adjacent sole occupancy unit	Discontinuous construction(1)	$R_w + C_{tr} \geq 50$
	Separating a sole occupancy unit and a stairway, public corridor, public lobby or the like	—	$R_w \geq 50$
	Separating a sole occupancy unit and a plant room and lift shaft	Discontinuous construction(1)	$R_w \geq 50$
	A door between a sole occupancy unit and a stairway, public corridor, lobby or the like.	—	$R_w \geq 30$
Ducts, water supply, waste and soil pipes	A duct, soil, waste or water supply pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a habitable room (other than a kitchen)	—	$R_w + C_{tr} \geq 40$
	A duct, soil, waste or water supply pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a kitchen or any other room.	—	$R_w + C_{tr} \geq 25$
Stormwater pipes	If a storm water pipe passes through a habitable room (other than a kitchen).	—	$R_w + C_{tr} \geq 40$
	If a storm water pipe passes through a kitchen or any other room.	—	$R_w + C_{tr} \geq 25$
Services	A duct, soil, waste, water supply pipe and stormwater pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a habitable room (other than a kitchen(2))	—	$R_w + C_{tr} \geq 40$

Building element	Description	Impact noise requirements	Airborne noise criteria
	A duct, soil, waste, water supply pipe and stormwater pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a kitchen(2) or any other room.	—	$R_w + C_{tr} \geq 25$
Pumps	The point of connection between the service pipes in a building and any circulating or other pump.	A flexible coupling at the connection	—

(1) Discontinuous construction is defined such that walls are to have a minimum 20 mm gap between separate leaves. Cavity masonry walls are to have resilient wall ties or no wall ties. For other walls there are to be no mechanical linkages between wall leaves except at the wall periphery. A staggered stud wall is not deemed to be discontinuous.

(2) If the kitchen is open to the living area, the $R_w + C_{tr} \geq 40$ criterion is applicable rather than the $R_W + C_{tr} \geq 25$ criterion.

A wall that is required to have sound insulation is to continue to the underside of the floor or roof above. Alternatively, the ceiling adjacent the walls must be acoustically treated such that the sound isolation provided by the wall is not degraded.

3 Minister's Specification 78B

3.1 Prospect Council – Air and Noise Overlay

The development is located in a 'Designated Area' and adjacent to a 'Designated Road: Type B road' in the Noise and Air Emissions overlay in the Prospect Council Development Plan. Relevant Objectives and Principles of Development Control for sites affected by the overlay are:

> "**OBJECTIVES**
>
> **Objective 1:** Protect community health and amenity from adverse impacts of noise and air emissions.
>
> **PRINCIPLES OF DEVELOPMENT CONTROL 1** Noise and air quality sensitive development located adjacent to high noise and/or air pollution sources should:
>
> (a) shield sensitive uses and areas through one or more of the following measures:
>
> (i) placing buildings containing less sensitive uses between the emission source and sensitive land uses and areas
>
> (ii) within individual buildings, place rooms more sensitive to air quality and noise impacts (e.g. bedrooms) further away from the emission source
>
> (iii) erecting noise attenuation barriers provided the requirements for safety, urban design and access can be met
>
> (b) use building design elements such as varying building heights, widths, articulation, setbacks and shapes to increase wind turbulence and the dispersion of air pollutants provided wind impacts on pedestrian amenity are acceptable
>
> (c) locate ground level private open space, communal open space and outdoor play areas within educational establishments (including childcare centres) away from the emission source."

As part of the Council Development Plan, a Noise and Air Emission Overlay refers to a Minister's Specification SA 78B *Construction Requirements for the Control of External Sound*. An assessment of SA 78B for the development will demonstrate compliance with the Principles of Development Control relating to the Noise and Air Emissions overlay.

To determine the noise impacts of Prospect Road, the assessment methodology outlined in the Minister's Specification SA 78B *Construction Requirements for the Control of External Sound* (SA 78B) has been adopted. SA 78B has been developed to address noise ingress from road, rail and mixed land use into residential developments. The internal noise criteria provided in SA 78B has been approved by the EPA and it is consistent with future policy regarding noise intrusion into dwellings.

3.2 Sound exposure categories

SA 78B specifies minimum construction requirements for building facades based on a 'sound exposure category' (SEC), which is determined based on the separation distance to the road.

Prospect Road is classified as a Type B road in the Prospect (City) Development Plan, and the relevant SEC for different separation distance to the road are shown in Table 1.

Table 2 Sound exposure category for Type B roads, 50-60km/h limit

Sound Exposure Category	Separation distance from road (m)
1	35 < 60m
2	20 < 35m
3	10 < 20m
4	Less than 10m
5	N/A

Due to the complex layout of the development, noise modelling has been performed to determine the appropriate SEC, based on the requirements of SA 78B. Mark-ups showing the applicable SECs are attached to this report as Appendix A. The applicable SECs for the development are SEC 1 through 4.

SA 78B is comprised of *Performance Requirements* and *Deemed-to-Satisfy Provisions* that are designed to achieve an appropriate level of health amenity for building occupants affected by transport noise and noise from mixed use zones. Each SEC requires specific facade treatments to achieve a particular outdoor-to-indoor sound attenuation as described in Table 3.

Table 3 Sound attenuation required for SECs from SA 78B

Sound Exposure Category	Outdoor-to-indoor sound attenuation, dB(A)
1	24
2	28
3	32
4	36
5	40

Note, buildings falling within SEC 5 are outside the scope of the *Deemed-to-Satisfy Provisions.*

3.3 Sound insulation ratings

SA 78B defines acoustic ratings to be achieved by external building elements depending on the applicable SEC. The required acoustic ratings for SEC 1 to 4 are shown in the following Table 4.

Table 4 Minimum acoustic requirements for habitable rooms

SEC	Building element	Location	Acoustic rating
1	External walls	All habitable rooms	$R_W + C_{tr} \geq 45$
	Windows & external glass doors	Refer to Table 5	
2	Ground floor	All habitable rooms	$R_W + C_{tr} \geq 50$
	External walls	All habitable rooms	$R_W + C_{tr} \geq 50$
	Windows & external glass doors	Refer to Table 5	
	External doors other than glass doors	All habitable rooms	$R_W \geq 27$
	Roof and ceiling	Bedrooms	$R_W + C_{tr} \geq 35$
3	Ground floor	All habitable rooms	$R_W + C_{tr} \geq 50$
	External walls	All habitable rooms	$R_W + C_{tr} \geq 50$
	Windows & external glass doors	Refer to Table 5	
	External doors other than glass doors	All habitable rooms	$R_W \geq 30$
	Roof and ceiling	Bedrooms	$R_W + C_{tr} \geq 40$
		All other habitable rooms	$R_W + C_{tr} \geq 35$
4	Ground floor	All habitable rooms	$R_W + C_{tr} \geq 50$
	External walls	All habitable rooms	$R_W + C_{tr} \geq 50$
	Windows & external glass doors	Refer to Table 5	
	External doors other than glass doors	All habitable rooms	$R_W \geq 30$
	Roof and ceiling	Bedrooms	$R_W + C_{tr} \geq 45$
		All other habitable rooms	$R_W + C_{tr} \geq 40$

The sound insulation ratings for windows and external glass doors are outlined in Table 5 based on the area of the window/glass door based on floor area.

Table 5 Minimum acoustic requirements for windows and external glass doors

Room	Area of window and external glass doors as a percentage of the floor area of the room	Designated sound exposure category with associated R_w+C_{tr}				
		1	2	3	4	5
Bedroom and attached non-habitable rooms	Not more than 20%	25	28	31	34	*
	More than 20% but not more than 40%	28	31	34	*	*
	More than 40% but not more than 60%	31	34	*	*	*
	More than 60% but not more than 80%	34	*	*	*	*
	More than 80%	37	*	*	*	*
Habitable rooms (other than bedrooms and enclosed kitchens) and attached non-habitable rooms	Not more than 20%	22	25	28	31	34
	More than 20% but not more than 40%	25	28	31	34	*
	More than 40% but not more than 60%	28	31	34	*	*
	More than 60% but not more than 80%	31	34	*	*	*
	More than 80%	34	*	*	*	*

* Windows and external glass doors are outside the scope of the Deemed-to-Satisfy provisions

4 External constructions

4.1 External walls

External walls for SEC 1 are required to achieve $R_W + C_{tr} \geq 45$, with external walls for SEC 2 to 4 required to achieve $R_W + C_{tr} \geq 50$. Where walls are not marked as an SEC category, there is no acoustic performance requirement.

Recommended constructions to achieve the sound insulation requirements are provided in Table 6.

Table 6 Recommended external wall constructions

SEC	$R_W + C_{tr}$	Sample Constructions
1	≥ 45	• Lysaght Longline 305 metal cladding on 25 mm furring channel • 2 x 16 mm fire rated plasterboard • 92 mm steel stud with a 25 mm top hat • 2 x 16 mm fire rated plasterboard • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs
		75 mm thick autoclaved aerated concrete panel (such as Hebel PowerPanel) with: • Two rows of 92 mm steel staggered studs in a 150 mm track • 75 mm thick glass wool insulation with a minimum density of 11 kg/m^3 positioned between the studs. • Two layers of 13 mm fire rated plasterboard fixed to the internal face.
2 to 4	≥ 50	• 150 mm thick concrete panel
		• Lysaght Longline 305 metal cladding on 25 mm top hat • 2 x 16 mm fire rated plasterboard • Two rows of 92 mm steel staggered studs in a 150 mm track • 2 x 16 mm fire rated plasterboard • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs
		75 mm thick autoclaved aerated concrete panel (such as Hebel PowerPanel) with: • A row of 92 mm steel studs at 600 mm centres, spaced at least 33 mm from the autoclaved aerated concrete wall panel • 75 mm thick glass wool insulation with a minimum density of 11 kg/m^3 positioned between the studs. • One layer of 10 mm moisture resistant plasterboard screw fixed to the autoclaved aerated concrete wall panel. • Two layers of 13 mm fire rated plasterboard fixed to the internal face.

4.2 Roof and ceilings

Rooves and ceilings within SECs 2 to 4 are required to achieve sound insulation ratings as shown in Table 4. Constructions for these areas are shown below in Table 7.

Table 7 Required roof and ceiling constructions

SEC	Room	R_W + C_{tr}	Areas	External and insulation requirements	Internal construction
2	Bedrooms	≥ 35	Apartment 2 & 4 – Western Bedrooms Apartment 14 – Western Bedroom	• Roof tiles or metal sheet roofing. • 165 mm thick glass wool or rock wool insulation with a minimum density of 7 kg/m^3 or 185 mm thick polyester insulation with a minimum density of 11 kg/m^3 installed above the plasterboard.	One layer of 10 mm plasterboard fixed to the underside of the joists or trusses.
3	Other Habitable Rooms	≥ 35	Apartment 13 & 14 – Living Areas		One layer of 10 mm plasterboard fixed to the underside of the joists or trusses.
3	Bedrooms	≥ 40	Apartment 13 & 14 – Eastern Bedrooms		One layer of 16 mm fire rated plasterboard fixed to the underside of the joists or trusses.
4	Bedrooms	≥ 45	Apartment 2 & 4 – Eastern Bedrooms		Two layers of 13 mm fire rated plasterboard fixed to furring channels to the underside of the joists or trusses.

4.3 External doors

The only non-glazed external door that falls within an SEC is the door for Apartment 1. As this falls within SEC 4, it is required to achieve R_W ≥ 30. Construction for this door (ED.1) should be as follows:

- 40 mm thick solid core timber door
- high quality rubber contact seals for the head and the jambs acoustically equivalent to Kilargo IS7095si or Raven RP24
- dropdown seal at the bottom acoustically equivalent to Kilargo IS8090si or Raven RP38.

Construction requirements for external glazed doors for the development are provided below in Table 8. Markups with required door types are attached.

Table 8 Required sliding door constructions

SEC	Door Code	$R_W + C_{tr}$	Construction
3	ED. 2	≥ 28	6.38 mm thick laminated sliding glass door, fitted with acoustically rated seals.
4	ED. 3	≥ 31	10.38 mm thick laminated sliding glass door, fitted with acoustically rated seals.
4	ED. 4	≥ 34	Acoustically rated proprietary door, tested to achieve R_W 34. A suitable product would be Capral 900 Series Sliding Door with 10.5 mm VLam Hush with a 300214 Glazing Channel, and fitted with: • QL48510 QLON Interlock seal • 301866 and 307393 Finseal • 300841 small bulb seal • 314416 F/P gasket

4.4 External windows

Construction requirements for external windows for the development are provided below in Table 9. Markups with required door types are attached.

Table 9 Required window constructions

Window Code	$R_W + C_{tr}$	Construction
WT.1	≥ 22	• Minimum 3 mm thick monolithic glass sliding window, fitted with acoustically rated seals.
WT.2	≥ 25	• Minimum 3 mm thick monolithic glass awning window fitted with acoustically rated seals, or • minimum 6 mm thick monolithic glass sliding window fitted with acoustically rated seals.
WT.3	≥ 28	• Minimum 6.38 mm thick laminated glass sliding window, fitted with acoustically rated seals, or • Minimum 6 mm thick monolithic glass awning window, fitted with acoustically rated seals.

Window Code	$R_W + C_{tr}$	Construction
WT.4	≥ 31	• Minimum 6.38 mm thick laminated glass awning window, fitted with acoustically rated seals, or • Proprietary sliding window system tested to achieve minimum $R_W + C_{tr}$ 31. A suitable product would be Capral Genesis Mk2 Sliding Window, with 10.38 mm thick laminated glass, 300039 glazing channel and the following seals: ○ 307393 Finseal ○ 301866 Woolpile ○ 300841 Bulb seal
WT.5	≥ 34	• Minimum 10.38 mm thick laminated glass awning window, fitted with acoustically rated seals, or • Proprietary window system tested to achieve minimum $R_W + C_{tr}$ 34. A suitable product would be AWS Magnum Series 601 Sliding window with 10.38 mm laminated glass.

The required constructions for windows on the eastern facade for apartments 1, 2 and 4 are based on a maximum glazed area of 20% of the bedroom floor area (e.g. based on a 1.7 m x 1.3 m window for an 11 m^2 bedroom). Should glazed areas be increased a higher level of acoustic performance will be required.

5 BCA Requirements

5.1 Walls

Our recommendations are based on floor plan for the development. The relevant proposed wall types and comment on compliance is detailed in Table 10.

Table 10 Proposed wall types and BCA compliance

Wall type	Proposed wall construction	Nominated area	Criteria	Compliance with BCA & additional requirements
WT01	• 150 mm precast concrete • 92 mm steel studs with a 25 mm steel top hat • 1x13 mm fire rated plasterboard • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs	Apartment to stairwell	$R_W \geq 50$	Compliant
WT02	• 150mm precast concrete • At least 33 mm gap • 92 mm steel studs • 1x13 mm fire rated plasterboard • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs	Apartment to lift core	$R_W \geq 50$ and Discontinuous construction	Compliant
WT03	• 2 x 16 mm fire rated plasterboard either side • Two rows of 92 mm steel staggered studs • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs	Between apartments	$R_W + C_{tr} \geq 50$	Compliant

Wall type	Proposed wall construction	Nominated area	Criteria	Compliance with BCA & additional requirements
WT04	• 2 x 16 mm fire rated plasterboard either side • Two rows of 62 mm steel studs with a minimum 20 mm gap between the studs • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs	Between apartments (where impact sound insulation is required)(1)	$R_W + C_{tr} \geq 50$ and Discontinuous construction	Compliant

Notes (1) The party wall for the bathroom of Apartment 11 requires impact sound insulation as it separates a bathroom from a habitable room in Apartment 12.

The proposed wall constructions will meet the requirements of the BCA if the walls are extended full height, past the ceiling to the underside of the slab or roof deck above.

5.2 Apartment doors

Apartment doors are to have a R_W 30 rating, with the following or equivalent construction:

- 40 mm thick solid core door
- high quality rubber contact seals for the head and the jambs acoustically equivalent to Kilargo IS7095si or Raven RP24
- dropdown seal at the bottom acoustically equivalent to Kilgaro IS8090si or Raven RP38.

5.3 Floors and ceilings

Separating floors between sole occupancy are required to comply with the BCA for both airborne and impact sound insulation. Where carpet is used, no acoustic underlay is required for impact noise control.

Floor airborne sound insulation

The minimum floor and ceiling system between sole occupancy units is:

- Minimum 200 mm concrete slab
- Minimum 300 mm ceiling cavity
- 13 mm plasterboard ceiling on a suspended light grid system

This construction satisfies the BCA airborne criterion for floors of $R_W + C_{tr} \geq 50$.

To improve the impact and airborne noise through this system, we recommend including 75 mm glasswool insulation in the ceiling cavity with a minimum density of 14 kg/m^3; a suitable product is 75 mm thick Pink Batts 'Silencer'.

The floor to the car park from apartments 5, 6 and 7 is 180 mm concrete with no ceiling. This complies with the $R_w + C_{tr} \geq 50$ requirement; however it does not meet the impact noise requirement. We believe that impact noise from the apartment to the car park is not critical as the car park is not a sensitive space. However, it is important to control noise from the car park into the apartments above. We therefore believe that compliance with the airborne noise criteria is sufficient to provide good acoustic amenity to the first floor apartments. The building surveyor may need to note this in their review.

Floor impact sound insulation

Impact noise transferred via timber floors, tiled kitchen and bathroom floors, and paved balcony areas has the potential to be heard in apartments below, including occupied spaces directly below and occupied spaces diagonally adjacent.

Floor impact noise can be controlled by:

- Proprietary underlays
- Concrete slab thickness
- Ceiling cavity depth and type of ceiling hanging system
- Acoustic insulation materials in the ceiling cavity
- A combination of the above methods.

Table 11 Floor and ceiling systems to control floor impact noise

Floor type	Control to meet BCA/NCC	Ceiling void upgrade
External balconies not located above internal area	None	Minimum 50 mm thick 14 kg/m^3 insulation in ceiling of habitable spaces diagonally below.
External balconies located above internal area	Regupol 4515 4.5 mm thick acoustic underlay incorporated into Rod and Paver system	Minimum 50 mm thick 14 kg/m^3 insulation in ceiling of habitable spaces under entire extent of balcony.
Timber floors	Regupol 4515 4.5 mm thick acoustic underlay incorporated into Rod and Paver system	Minimum 50 mm thick 14 kg/m^3 insulation in ceiling of habitable spaces under entire extent of timber floor.
Tiled floors directly or partially above habitable spaces	Regupol or equivalent acoustic underlay incorporated into tile system.	Minimum 50 mm thick 14 kg/m^3 insulation in ceiling of habitable spaces under entire extent of tiled floor.

5.4 Services

The following service systems are required to be acoustically treated under the BCA, if they serve or pass through more than one tenancy:

- mechanical services ducts

- soil pipes
- waste pipes
- water supply pipes.

In addition, all stormwater pipes passing through a sole occupancy unit must be acoustically treated.

The required acoustic treatments for services are presented in Table 12.

Table 12 Minimum treatments for services

Location of services	Criterion	Minimum construction requirements
In wall or service riser passing through a bathroom/ensuite area or over bathroom/ensuite ceiling OR Stormwater pipe adajcent bathroom/ensuite	$R_W + C_{tr} \geq 25$	• 10 or 13 mm plasterboard AND • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs; a suitable product is 75 mm Pink Batts 'Silencer'. The insulation is to extend a minimum of 1200 mm on either side of the pipe. OR • Alternatively, acoustically tested pipe systems such as Raupiano Plus may be used in lieu of insulation.
In wall or service riser passing through a kitchen/living or over kitchen/living ceiling OR Stormwater pipe adajcent kitchen/living	$R_w + C_{tr} \geq 40$(1)	• 10 or 13 mm plasterboard AND • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs; a suitable product is 75 mm Pink Batts 'Silencer'. The insulation is to extend a minimum of 1200 mm on either side of the pipe. • Pipe is to be lagged with Pyrotek '4525C', Bradford 'Acoustilag 45' or equivalent. OR • Alternatively, acoustically tested pipe systems such as Raupiano Plus may be used in lieu of lagging and insulation.(2)

(1) As the kitchen is open to the living area, the $R_w + C_{tr} \geq 40$ criterion is applicable rather than the $R_W + C_{tr} \geq 25$ criterion.

(2) Acoustic testing of the Raupiano system has demonstrated that there is no need for lagging or insulation in addition to a 10 mm plasterboard barrier to achieve equivalent $R_W + C_{tr}$ 40 rating (refer to report prepared by AECOM reference 60310081 A14E01LT-2 dated 23 May 2014).

Access doors and panels

Access doors or panels must be:

- firmly fixed so as to overlap the frame or rebate of the frame by not less that 10 mm, and
- fitted with a sealing gasket along all edges, and
- constructed from:
  - wood, particleboard or blockboard not less that 33 mm thick, or
  - compressed fibre reinforced cement sheeting (CFC) not less than 9 mm thick, or

- other suitable material with a mass per unit area not less than 24.4 kg/m^2.

Pipe supports

All pipes, including stormwater pipes, should be acoustically isolated at mounting points and penetrations. Pipe insulation (Bradflex), 6 mm thick neoprene, closed cell foam or 'unicushion' is required between all pipes and pipe clamps; alternatively provide neoprene element vibration isolation hangars to pipe supports or mounting points.

Also ensure there is no direct contact between waste pipes and surrounding elements. A 20 mm clearance to all other building elements is required.

Water supply pipes

Water supply pipes in walls are to be installed:

- In the cavity of a discontinuous wall cavity
- Have a clearance of at least 10 mm to the wall leaf of the adjacent sole-occupancy wall.

Electrical outlets

Electrical outlets must be offset from each other:

- in masonry walling, not less than 100 mm; and
- in timber or steel framed walling, not less than 300 mm.

DEVELOPMENT ACT 1993

REGULATION 83
STATEMENT OF COMPLIANCE

APPLICATION FOR CERTIFICATE OF OCCUPANCY

This statement relates to the building located at the following address / location :

Proposed Development : **168 Prospect Road Prospect**

Applicant :

Owner :

Classifcation : **New Class 2**

Rise in Storeys **4**

Type of Construction: **Type A**

Pursuant to Section 67 of the Development Act I apply for a Certificate Of Occupancy for the above mentioned works and pursuant to Section 67(3)(a) and Regulation 83.

- I declare that the building work has been carried out in accordance with the relevant approval in terms of the Development Act including any conditions attached thereto (disregarding any variation of a minor nature that has no adverse effect on the structural soundness or safety of the building or on the health of the occupants or any variation undertaken with the consent of the relevant authority).

- I declare that the service connections required to any public utilities listed in Regulation 83(2)(b) have been made in accordance with the requirements of the relevant supply authorities or utilities.

- I attach the completed certificate of compliance of the *Essential Safety Items* required under regulation 76(3a) (Refer Form 2 attached).

This part of the statement must be signed by a person authorized to sign on behalf of the Builder or if there is no such licensed Builder a person with the qualifications prescribed in Regulation 87(3) and 87(4) responsible for carrying out the relevant building work.

Please ensure that any conditions associated with the approval have been satisfied prior or in conjunction with forwarding this statement

A certificate of occupation does not constitute a certificate of compliance with the building rules.

Signed Dated

Name in Full : .....

Company / Position : .....

Address / Contact Phone No : .....

License Number : .....

APPENDIX D

PLANNING CONSENT

BCA CERTIFICATION

BUILDERS WRITTEN STATEMENT

APPLICATION CERTIFICATE OF OCCUPANCY

CERTIFICATE OF COMPLIANCE WITH ESSENTIAL SERVICES PROVISIONS

DEVELOPMENT ACT 1993

REGULATION 83(A,B)
SCHEDULE 19A – STATEMENT OF COMPLIANCE

BUILDERS WRITTEN STATEMENT

This statement relates to the building located at the following address / location :

- **Residential Building** **168 Prospect Road Prospect SA**

Description of building works to which this statement relates :

- **New apartments / Carparking**

Date of approval of building works to which this statement relates :

- **TBA**

Development Number : **TBA**

Our Ref No :

Client Name : **Studio Nine Architects**

Council :

This written statement must be accompanied by any certificates / reports or other documents previously specified and issued by the relevant authorities for the purposes of regulation 83(AB) of the Development Regulations 1993.

This part of the statement must be signed by the building work contractor responsible for carrying out the relevant building work, or if there is no such person, by a registered building work supervisor or a private certifier.

I certify the following :

- The building work described above (disregarding any variation of a minor nature that has no adverse effect on the structural soundness or safety of the building or on the health of the occupants or any variation undertaken with the consent of the relevant authority) has been performed in accordance with the documents and any conditions of approval.

- All service connections have been made in accordance with the requirements of the relevant supply authorities.

- All requirements under regulation 76(3) of the Development Regulations 1993 relating to *Essential Safety Provisions* have been satisfied.

- All notifications required under Section 59 of the Development Act 1993 have been given in accordance with the Act and the requirements of the Development Regulations 1993.

Signed Dated

Name in Full : .....

Company / Position : .....

Address / Contact Phone No : .....

License Number : .....

Renewing our Streets and Suburbs Stimulus Program - Certificate of consistency

I verify that I have examined carefully a copy of the exemption from the requirement to obtain development plan consent granted by the State Coordinator-General or nominated Assistant Coordinator-General (including any conditions and notes) described below, together with a copy of the plans approved and endorsed pursuant to Schedule 1A, Item 13 of the *Development Regulations 2008*.

The plans and supporting documentation submitted for building rules consent have been assessed for compliance with the Building Rules, while the plans endorsed by the Office of the State Coordinator-General have been reviewed to ensure that all buildings and structures included in the building rules assessment are consistent with the exemption from development plan consent requirements.

I hereby certify that the building rules consent issued on
……... *(date)* for
……
(description of project as described in the exemption from development plan consent requirements) at …… ……..
(location of proposed development) is consistent with the following development authorisation (including any conditions and notes) granting exemption from development plan consent requirements reference……*(application number)* issued on …… *(date)* by the Assistant State Coordinator-General or nominated Assistant Coordinator-General subject only to the variations specified below in the Table of Variations to meet Regulatory Requirements, attached for the purposes of section 93(2) of the *Development Act 1993*, which are necessary for compliance with the Building Rules or any other legislation specified therein.

Registered private certifier: ……...
Registration number: ……
Date: ……

Table of variations to meet regulatory requirements—pursuant to section 93(2) of the *Development Act 1993*

Item	Legislation / Regulation / Code	Reason for variation

Registered private certifier: ……...
Registration number: ……
Date: ……

MINUTE

Government of South Australia
Department of Planning, Transport and Infrastructure

MINUTES forming ENCLOSURE to

TO: MINUTE TO THE STATE COORDINATOR GENERAL

RE: ROSAS DEVELOPMENT APPLICATION – 168 PROSPECT ROAD, PROSPECT.

NATURE OF DEVELOPMENT

The proposed development – lodged in accordance with the Renewing Our Streets and Suburbs Stimulus Program (ROSASSP) – seeks exemption from the need to obtain Development Plan Consent for the demolition of two (2) existing dwellings and the construction of a four (4) storey residential flat building comprising a total of 16 dwellings (all of which are set to be marketed as 'affordable housing'). Ancillary car parking (accessible from the rear of the subject land) and land scaping also form part of the application.

The subject land is located at 168 Prospect Road PROSPECT and is legally identified in Certificate of Title Volume 5716 Folio 199 (Allotment 76 in File Plan 108763).

BACKGROUND

The proposal has been assessed against those qualitative and quantitative requirements of the Stream 2 assessment criteria – an assessment framework developed specifically for the assessment of Residential Flat Buildings comprising one dwelling located above another dwelling (i.e. 'apartments' or 'flats'). Two (2) pre-lodgement panel meetings and one (1) community consultation session was undertaken.

Pre-lodgement Panel (PLP)

Initial discussions commenced in September of 2016, with the first pre-lodgement panel meeting being held on 29 September 2016. Representatives from DPTI (Planning, Transport Services & ODASA), Renewal SA, the City of Prospect and Studio Nine were present, as well as Mr Michael Calabro (proponent/developer). Minutes from this PLP meeting can be found in the **ATTACHMENTS**.

The second PLP meeting was held on 21 November 2016. Minutes from this PLP meeting can be found in the **ATTACHMENTS**.

Community Consultation

Renewal SA conducted a drop-in session on 6 December 2016, allowing neighbouring residents to review the plans, ask questions and discuss their concerns with staff from both Council and Renewal SA. A total of 12 neighbouring properties were notified of the drop-in session, of which, four (4) individuals attended. Despite the restricted (intended)

audience, four (4) persons not in receipt of an invite attended the session out of general interest.

Three (3) participants expressed sincere dissatisfaction with the proposal and the potential for overlooking in to their backyard. Members of the project team met with the aggrieved neighbours on-site to discuss potential measures to address their concerns – resulting in modifications to the plans (most significantly, the upper storey rear set-back).

Copies of written submissions from neighbours have formed part of the application documents to DPTI.

Lodgement

The application for exemption was formally lodged by Renewal SA on 12 January 2017. Upon review of the plans, it was clear that some deficiencies were evident and a request for further information was sent (1 February 2017). Clarification and amendments to the provision of private open space, materiality of the building and screening of the waste storage room were requested, as well as provision of the land division proposal plans.

A revised set of land use plans were received on 8 February 2017 and the land division plans received on 17 February 2017.

Following consideration of the amended plans, a meeting was held with you at your offices on Friday 10 March 2017, where it was concluded that some further issues required attention prior to granting exemption from the requirement to obtain Development Plan Consent. The following issues were recommended to be investigated by the proponent team:

- Disability access from the car parking area.
- Location of air conditioning units.
- Bedroom windows with internal aspect (foyer / walk-way) may benefit from increased sill heights to provide occupants with additional privacy.
    - Provision of Section plans showing internal window and entrance locations.

Amended plans were officially received on 6 April and the following responses are noted:

- Disability access from the car park is not required in accordance with Part D3 SA – Table D3.1 & Table D3.2 pf the *Building Code of Australia* as the building comprises less than 20 sole-occupancy units.
- Location of air conditioning units have been revised and are now wall mounted. Units will have a minimum set-back from the southern and northern boundaries of 3.3m and 4.9m respectively.
- Sill heights to bedrooms with an internal aspect have been raised to 1.5m above FFL. Section plan SK13 provides a scaled demonstration of the location / height of these windows.

DISCUSSION

Based on the amended land use plans (received 6 April 2017) and land division plans (received 17 February 2017), the proposal is considered to broadly align with the provisions of the Stream 2 assessment criteria.

RECOMMENDATION

It is recommended that exemption be granted to the proposed development in accordance with Schedule 1A Clause 13 of the *Development Regulations 2008*.

Matthew Fielke
PLANNING OFFICER

6 April 2017

NOTED or **APPROVED** / **NOT APPROVED**

Jim Hallion
STATE COORDINATOR-GENERAL

6 April 2017

APPENDIX E

WATERPROOFING OF WET AREAS IN BUILDINGS

Minister's Specification SA F1.7 – Waterproofing of Wet Areas in Buildings

Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

SCOPE

This specification relates to the methods of construction and materials to be used for the waterproofing of certain rooms and facilities, as required by the Building Code of Australia (including South Australian variations and additions).

INTERPRETATION

Approved, for the purpose of this Minister's Specification, approved means approved by the relevant authority (Council, private certifier, or the Development Assessment Commission).

Floor Waste A grated inlet within a graded floor intended to drain the floor.

Shower area Where a fixed shower screen is installed, the shower area is deemed to be the floor, and the walls to a height of 1800 mm above the finished floor of the shower, within the area that is enclosed by the shower screen.

Where a fixed shower screen is not installed, the shower area must be considered to extend to the floor within a horizontal radius of 1500 mm from the shower outlet, and the walls within that radius, to a height of 1800 mm above the finished floor of the shower. (See Figure 1)

Note: For unenclosed showers, where a flexible/adjustable shower hose is used, the 1500 mm dimension applies from the furthest reach of the shower outlet.

Shower base A pre-formed, pre-finished vessel which is installed as the finished floor of a shower compartment and which is provided with a connection point to a *shower waste.*

Shower tray A waterproof liner which is installed in a shower compartment prior to the application of the floor and wall finishing system and which is drained into a drainage flange in the *shower waste,* and where applicable, the *floor waste.*

Shower Waste A *floor waste* in the floor of a shower.

1 Floors to be impervious

The floor surface in each bathroom, laundry, toilet, or room containing a shower or a sanitary fixture such as a hand basin, vanity bowl, urinal, bidet, cleaner's sink, slop sink, or pan sink, must be impervious. Clause 16 lists floor surfaces which are deemed to be impervious.

2 Floors to be graded and drained

The floor of each bathroom (including the floor under a free-standing bath), or room containing a shower or a sanitary fixture such as a hand basin, vanity bowl, urinal, bidet, cleaner's sink, slop sink, or pan sink, must be drained at a grade of not less than 1:80 to a *floor waste,* or to a shower set-down containing a *shower waste,* and must be finished such that water does not pond on the floor.

The floor of each shower must be drained to a *shower waste* at a grade of not less than 1:60, and must be finished such that water does not pond on the floor.

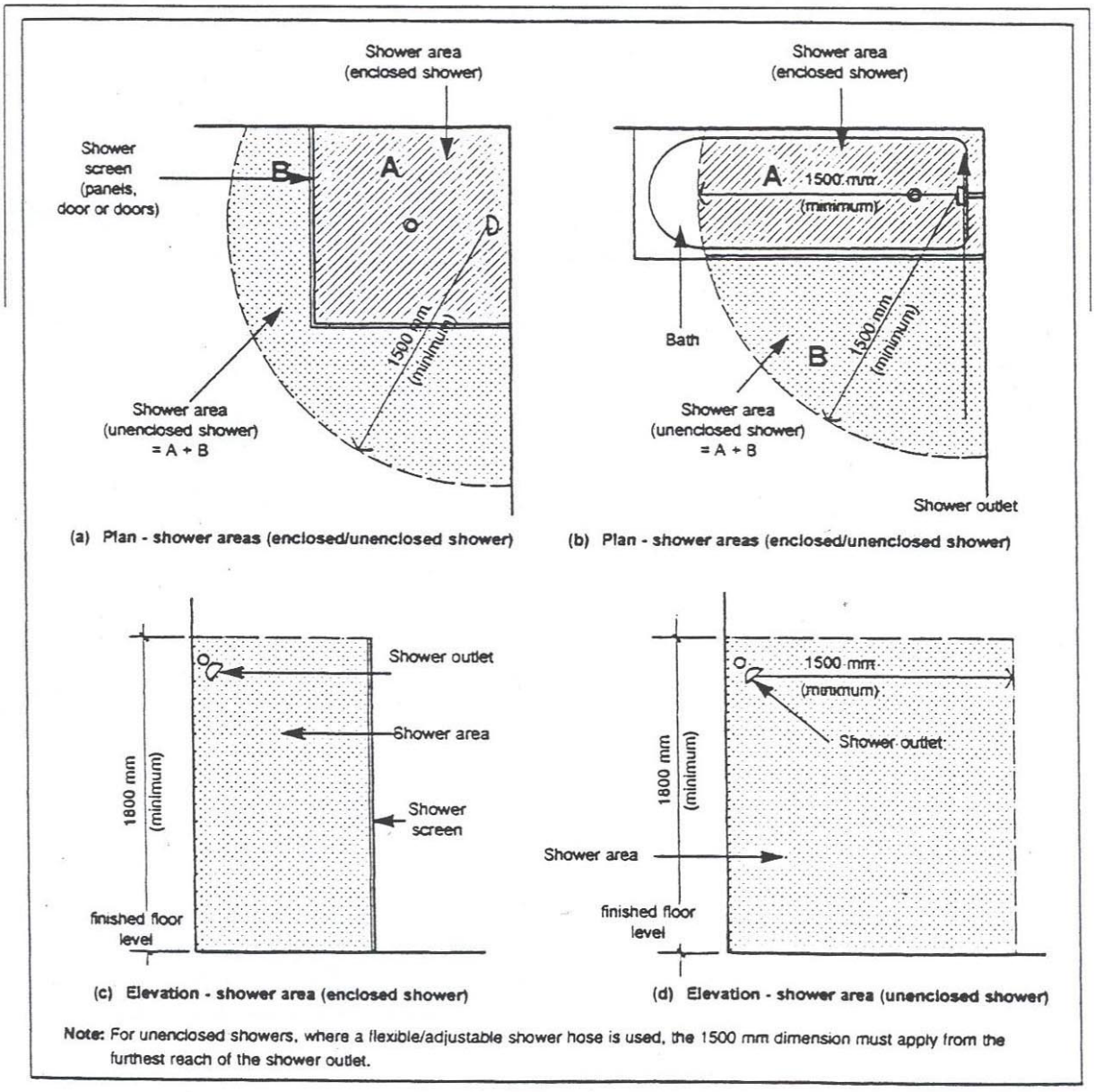
Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

3 Walls to be impervious

The wall surface of each bathroom, laundry, or room containing a shower or a sanitary fixture such as a hand basin, vanity bowl, urinal, bidet, cleaner's sink, slop sink, or pan sink, must be impervious to a minimum height of 100 mm above the finished floor level.

The wall surfaces in each *shower area* must be impervious.



(a) Plan - shower areas (enclosed/unenclosed shower)

(b) Plan - shower areas (enclosed/unenclosed shower)

(c) Elevation - shower area (enclosed shower)

(d) Elevation - shower area (unenclosed shower)

Note: For unenclosed showers, where a flexible/adjustable shower hose is used, the 1500 mm dimension must apply from the furthest reach of the shower outlet.

Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

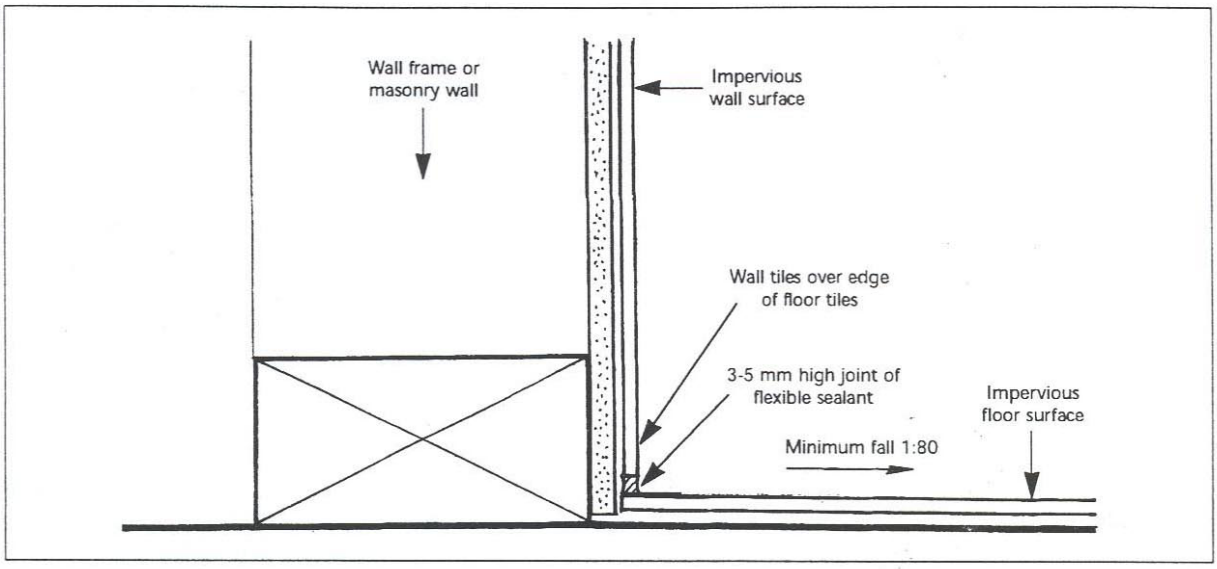


FIGURE 2 Impervious wall to floor junction

In a room containing only a single water closet, the wall surface must be impervious to a minimum height of 90 mm, and a sealed timber skirting may be used in lieu of another impervious surface. Clause 17 lists wall surfaces which are deemed to be impervious

4 Wall to floor junctions to be impervious

Where the wall and floor are required to be impervious, the wall to floor junction must be impervious. The materials and construction shown in Figure 2 are deemed to constitute an impervious wall to floor junction.

5 Bench tops and sanitary fixtures abutting walls

Where any bench top containing an inset sanitary fixture, or any sanitary fixture (including a kitchen sink), abuts a wall surface, the wall surface must be impervious for a minimum height of 150 mm immediately above the sanitary fixture, and for the full width and/or breadth of the sanitary fixture.

The junction between the sanitary fixture or bench top and the wall surface must be impervious (Figure 3).

Where a sanitary fixture does not abut, but is within 75 mm of a wall, such that water may be splashed between the fixture and the wall (eg. a free-standing bath), the adjacent impervious wall surface must extend from the floor to 150 mm (minimum) above the fixture.

6 Additional requirements for showers

In addition to requirements for an impervious surface, the floors of all *shower areas* must be waterproofed by the installation of either an *approved shower tray* or *shower base*, installed in accordance with the manufacturer's specifications. Where a fixed shower screen is installed, the waterproofing must extend:

Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

(a) up the inner face of the hob and across the top to the outer face of the hob (Figure 4(a)); or

(b) where there is a 25 mm minimum set down to the shower, 100 mm past the end of the set down (Figure 4(b)).

The fixings for the shower screen must not penetrate the waterproof membrane.

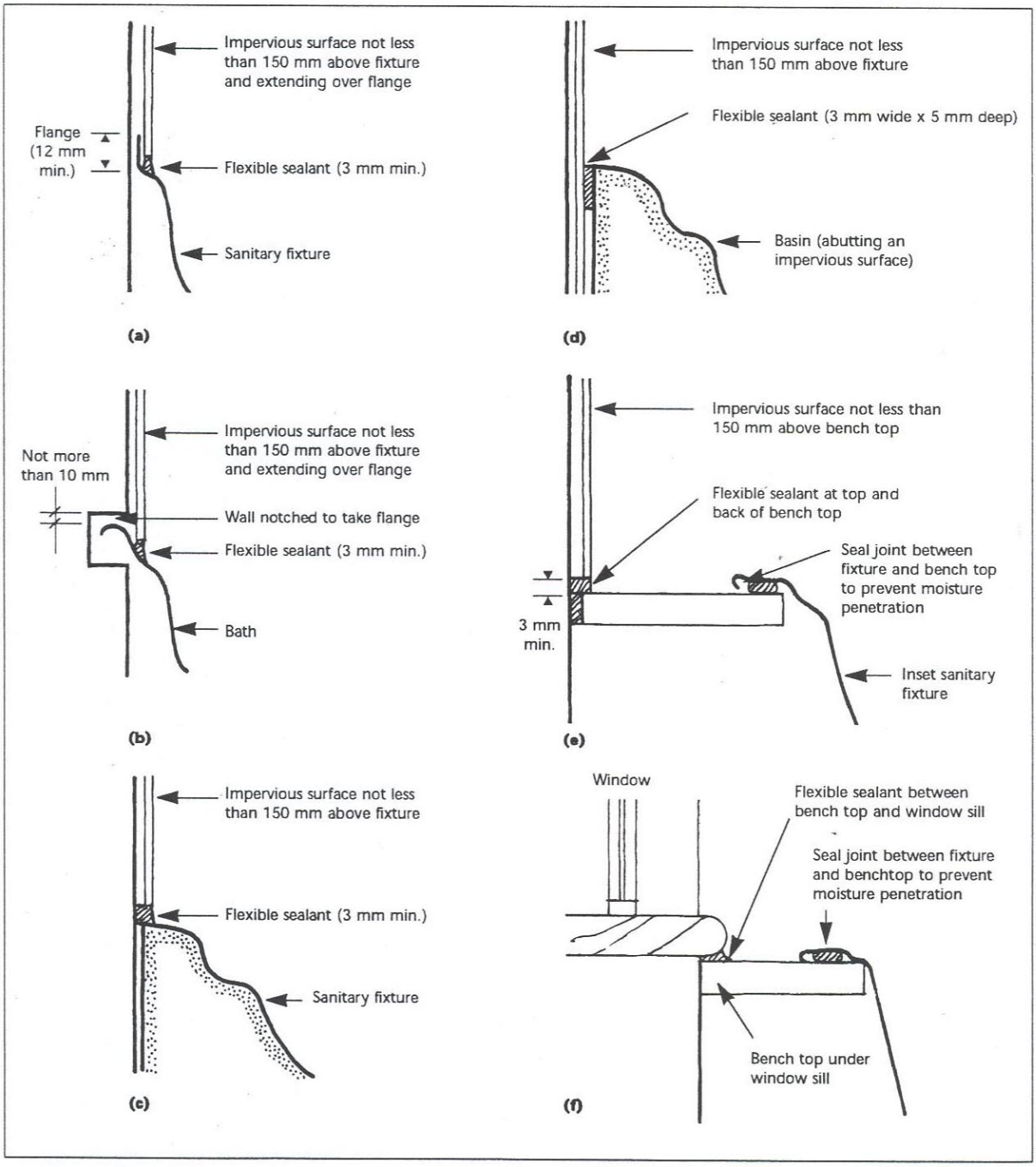


FIGURE 3 Bench tops and sanitary fixtures abutting walls

Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

The inside of face of a shower screen must be flush with the inside face of the hob or set-down (Figure 4).

Where a fixed shower screen is not installed, the waterproofing must be extended to the floor within the *shower area*.

The use of a hob is recommended for showers. Where a hob is not used, the highest point of the floor surface of the shower must be set-down 25 mm minimum from the remainder of the room, except where access for people with disabilities is required.

Where access for people with disabilities to the shower is required, and there is no hob or set-down, the waterproofing must be extended to the entire floor of the room.

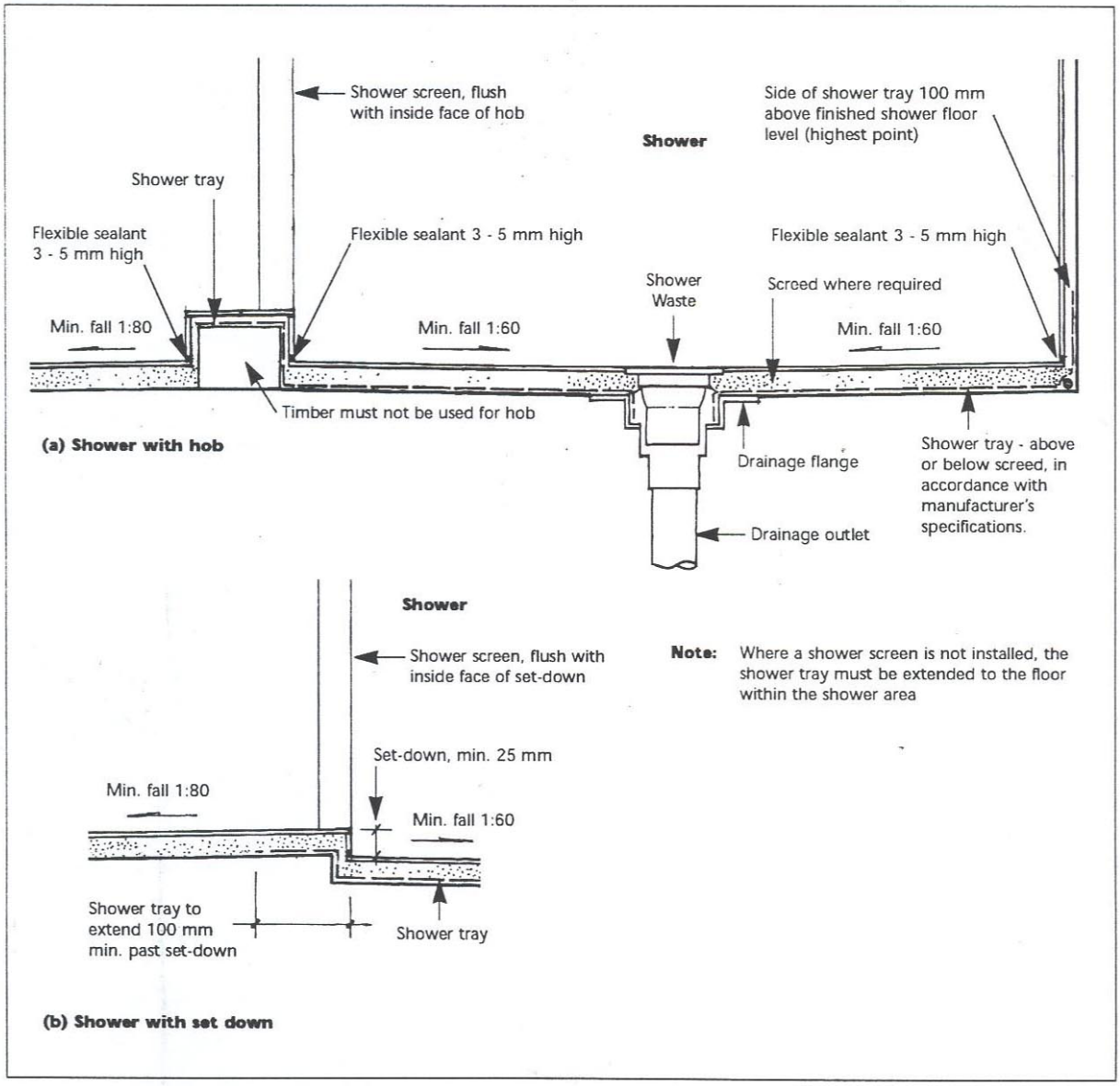
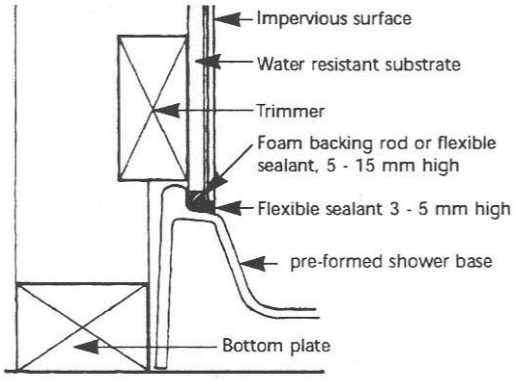


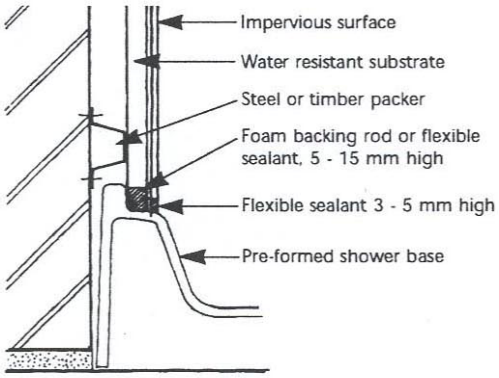
FIGURE 4 Waterproofing of shower area using shower tray

Minister's Specification SA F1.7

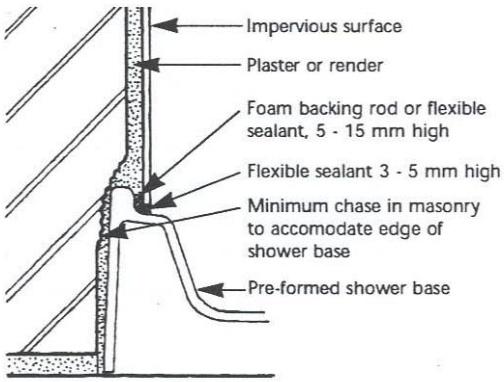
Waterproofing of wet areas in buildings



(a) Waterproofing of pre-formed shower base and wall junction (framed wall)



(b) Waterproofing of pre-formed shower base and masonry wall junction (offset wall lining)



(c) Waterproofing of pre-formed shower base and masonry wall junction

FIGURE 5 Waterproofing of shower floor using shower base

7 Shower trays

All *shower trays* must be drained into a drainage flange in the shower trap.

All *shower trays* must be installed in accordance with the manufacturer's specifications.

The height of the sides of the *shower tray* (at walls) must be at least 100 mm above the finished shower floor level (highest point).

8 Shower bases

Installation of preformed *shower bases* must comply with the requirements of the manufacturer's specifications. The junction of the *shower base* with the wall surface must be impervious. The materials and forms of construction shown in figure 5 are deemed to constitute impervious *shower base* to wall junctions.

9 Wall to wall junctions in shower area to be impervious

Wall to wall junctions in *shower areas* must impervious. The materials and forms of construction shown in Figure 6 are deemed to constitute impervious wall to wall junctions.

10 Penetrations through impervious wall surfaces

Penetrations for taps, shower nozzles and the like, through impervious wall surfaces in *shower areas*, must be sealed with a tap penetration flange installed in accordance with the manufacturer's specifications (Figure 7), or with a flexible sealant.

Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

11 Water-resistance of walls in a room containing a shower

All walls of masonry veneer or framed construction, in a room containing a shower, must be lined with water-resistant lining to a minimum height of 1 200 mm above floor level. (Walls in a *shower area* must be impervious up to 1 800 mm above floor level. Refer clause 3).

12 Water-resistance of wall around automatic washing machine outlets

In any room containing an automatic washing machine, where walls are of masonry veneer or framed construction, the wall must be lined with water-resistant lining from base of wall, to at least 75 mm above, and 75 mm each side of automatic washing machine outlets.

13 Group shower facilities

Group shower facilities must comply with the requirements of this Minister's Specification relevant to showers and *shower areas.*

In group shower facilities, the water from one shower facility must not flow over the floor of another shower facility.

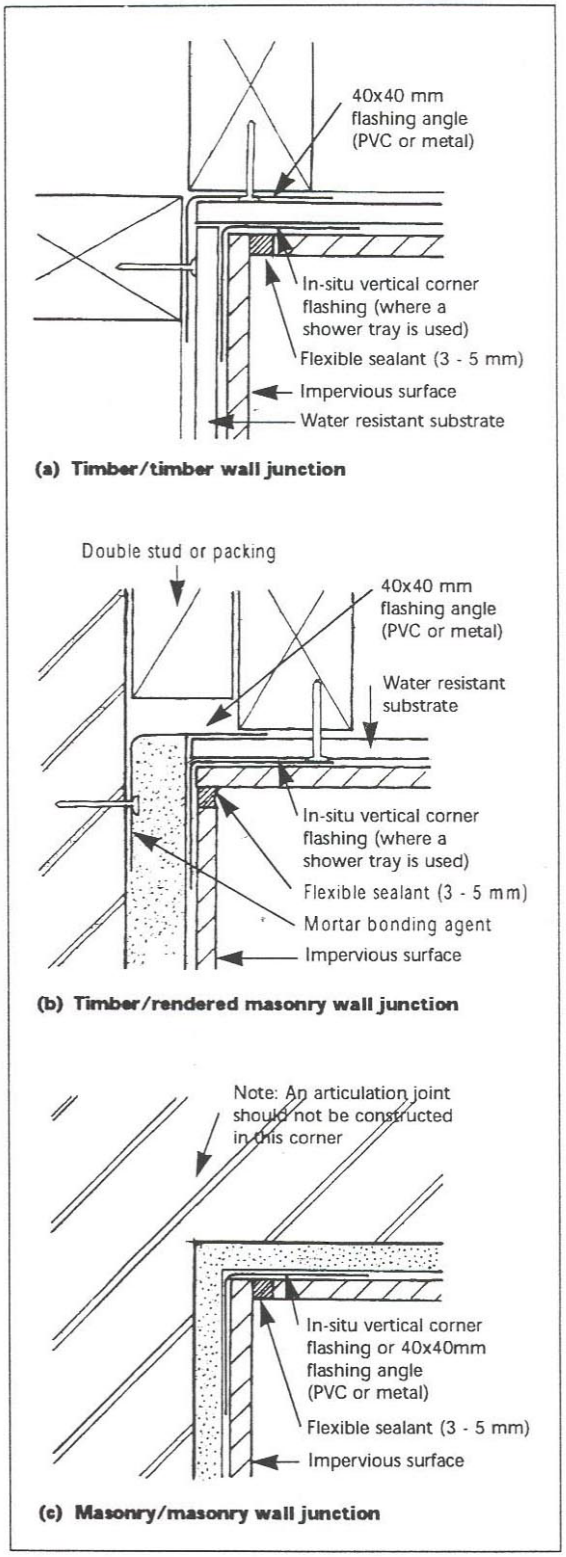
Where group shower facilities drain to a common drainage channel, the showers must have an impervious floor surface graded at not less than 1:60 to that outlet channel. The channel must be:

(a) not less than 100 mm wide;

(b) not less than 25 mm deep at the top of the outlet from the channel; and

(c) graded at not less than 1:80,

as illustrated in Figure 8.



Note: Bottom end of vertical flashing angle or corner flashing must finish on inside of shower tray or shower base.

FIGURE 6 Impervious wall to wall junctions (shower area)

Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

14 Urinals

The floor or step adjacent to every floor-type urinal must be impervious and must:

(a) be graded at not less than 1:60 to the urinal channel for a distance of not less than 400 mm in front of the urinal;

(b) be not less than 25 mm above the top of the urinal channel;

(c) overlap the urinal channel by not less than 25 mm; and in the case of a step,

(i) have a rise of not less than 100 mm and not more than 150 mm; and

(ii) have a tread not less than 400 mm wide,

as illustrated in Figure 9.

The wall surface behind wall-hung urinals must be impervious from floor level, up to a minimum height of 75 mm above the top of the fixtures.

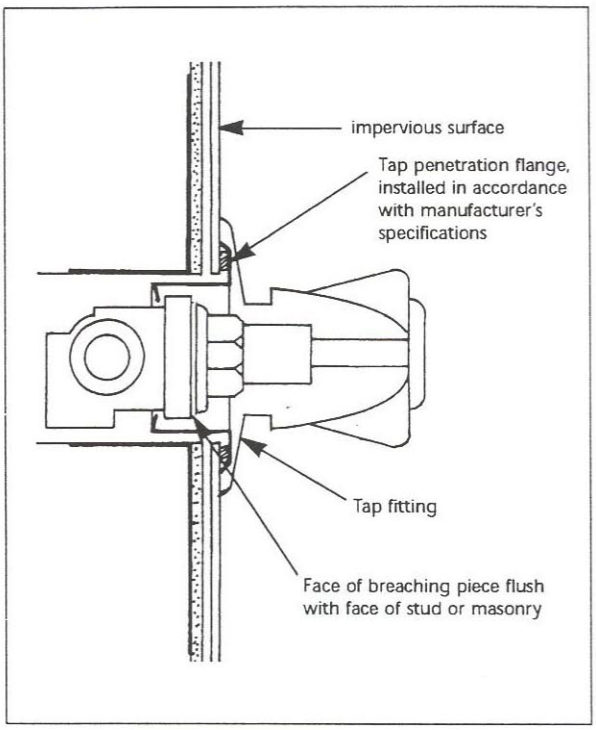


FIGURE 7 Penetrations through walls in shower areas

15 Built-in baths, spas and similar fixtures

Built-in baths, spas and similar fixtures must be installed in accordance with the manufacturer's specifications. The enclosed space under every cast iron of pressed metal built-in bath, spa or similar fixture must be ventilated by:

(a) two vent tiles; or

(b) an external wall cavity; or

(c) a ventilated under-floor space.

16 Impervious floor surfaces

The following finished floor surfaces are deemed to be impervious:

(a) Glazed tiles, grouted in accordance with the manufacturer's specifications.

(b) Smooth, steel float finish concrete.

(c) Terrazzo.

(d) Any other *approved* finish.

Minister's Specification SA F1.7

Waterproofing of wet areas in buildings

17 Impervious wall surfaces

The following finished wall surfaces are deemed to be impervious:

(a) Cement render, not less than 10 mm thick, with a hard, smooth finish.

(b) Glazed tiles, adhered to masonry or water-resistant lining, and grouted, in accordance with the manufacturer's specifications.

(c) Terrazzo.

(d) Any other *approved* finish.

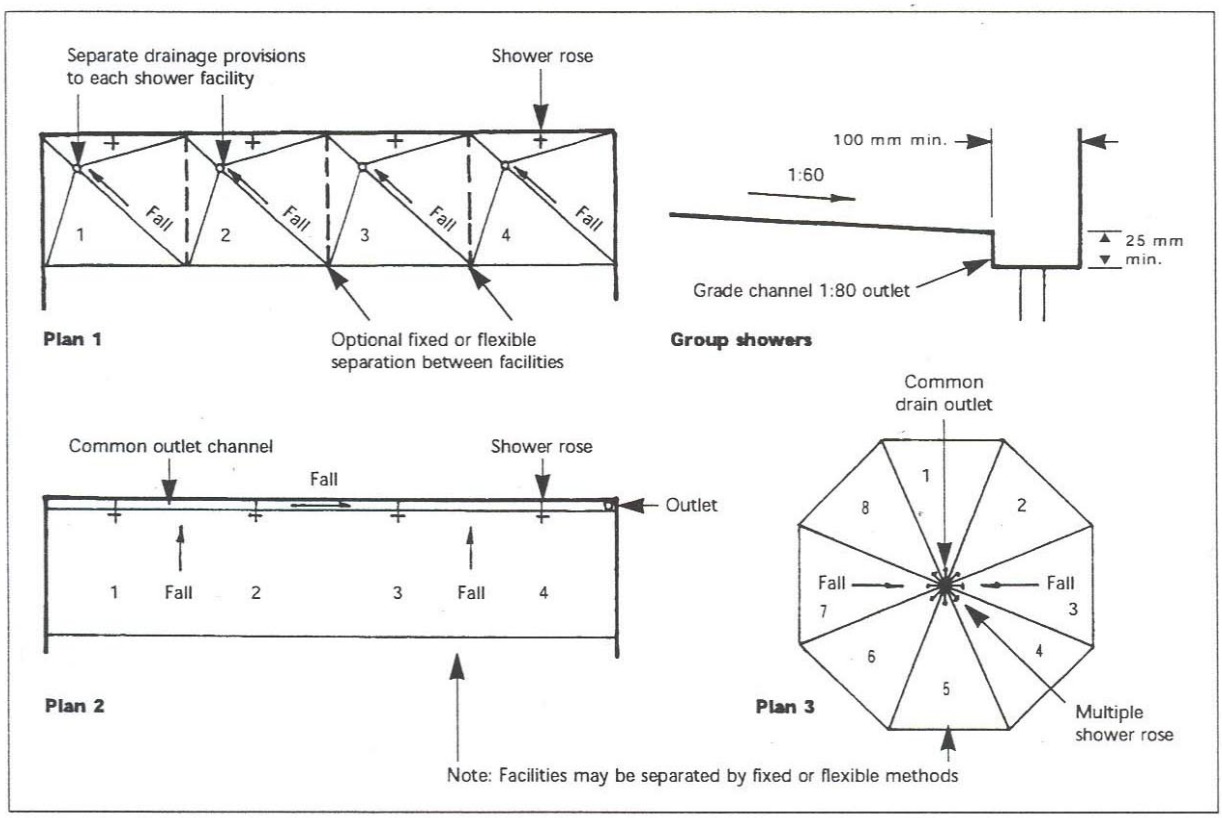


FIGURE 8 Group shower facilities

LUCID
CONSULTING AUSTRALIA

PROSPECT APARTMENTS

168 PROSPECT ROAD, PROSPECT

Project No: LCE12584

Electrical Services

Specification

Tender Issue

Revision T1

SPECIFICATION ISSUE REGISTER

REVISION	DESCRIPTION	DATE ISSUED	AUTHOR	REVIEWED
T1	Tender Issue	02.06.2017	MT	LP

PROJECT DIRECTORY

BUILDER	Bert Farina Constructions 11 Indama Street Regency Park SA 5010
ARCHITECT	Studio Nine Architects 9 King William Street Kent Town SA 5067
MECHANICAL, ELECTRICAL, HYDRAULIC AND FIRE PROTECTION SERVICES	Lucid Consulting Australia Level 3/169 Pirie Street Adelaide, SA 5000
STRUCTURAL AND CIVIL CONSULTING ENGINEERS	TMK Consulting Engineers Level 6/100 Pirie Street Adelaide, SA 5000

Contents

1 GENERAL 1
1.1 CROSS REFERENCES 1
1.2 PROJECT DETAILS 1
1.3 FIXED PRICE LUMP SUM CONTRACT 1
1.4 DEFINITION OF TERMS 2
1.5 DRAWINGS 2
1.6 SCOPE 2
1.7 ASSOCIATED WORKS 4
1.8 STANDARDS 6
2 CONTRACT SUBMISSIONS / REQUIREMENTS 9
2.1 HOLD POINTS 9
2.2 TENDER DRAWINGS 9
2.3 TENDER SUBMISSONS 10
2.4 PRE-CONSTRUCTION SUBMISSIONS 10
2.5 CONSTRUCTION SUBMISSIONS 12
2.6 POST-CONSTRUCTION SUBMISSIONS 15
3 MATERIALS & WORKMANSHIP 17
3.1 GENERAL 17
3.2 QUALITY ASSURANCE 17
3.3 EXISTING SITE CONDITIONS 17
3.4 COMPLETED SITE CONDITION 17
3.5 UNIFORMITY AND QUALITY 18
3.6 WARRANTIES 18
3.7 INSTALLATION COORDINATION 18
3.8 PENETRATIONS 20
3.9 CONCEALED SERVICES 21
3.10 TRENCH EXCAVATION, BACKFILLING AND COMPACTION 22
3.11 PAINTING 25
3.12 IDENTIFICATION 25
3.13 IDENTIFICATION OF MAIN SWITCHBOARD 27
3.14 ELECTRICAL INTERFERENCE 27
3.15 DISSIMILAR METALS 27
3.16 METALLIC SUPPORT SYSTEMS AND FIXINGS 28
3.17 EARTHQUAKE FIXINGS AND SUPPORTS 28
3.18 EARTHING SYSTEMS 30
3.19 WIRING TO AND CONNECTION OF EQUIPMENT 31
4 TESTING AND COMMISSIONING 32
4.1 TESTING 32
4.2 COMMISSIONING 32
5 ACCESSORIES & EQUIPMENT 35
5.1 LIGHT SWITCHES 35
5.2 ISOLATING SWITCHES 35
5.3 SWITCHED SOCKET OUTLETS (SSO) 36

5.4 ACCESS PANELS 36
5.5 MOVEMENT SENSORS 37
6 CABLES & ENCLOSURE 38
6.1 CABLE SELECTION 38
6.2 CABLE INSTALLATION 38
6.3 DOUBLE INSULATED WIRING 39
6.4 COPPER CONDUCTOR TERMINATIONS 39
6.5 CONDUITS GENERALLY 40
6.6 CONCEALED CONDUITS 40
6.7 NON-METALLIC CONDUITS AND FITTINGS 41
6.8 FLEXIBLE CONDUIT 41
6.9 OTHER WIRING ENCLOSURES 41
6.10 CABLE TRAYS AND LADDERS 42
6.11 CATENARIES 43
6.12 FIRE RATED CABLING AND SUPPORTS 44
7 SWITCHGEAR & CONTROLGEAR ASSEMBLIES (SCA) 45
7.1 SCOPE 45
7.2 DESIGN CRITERIA 45
7.3 EXTERNAL DESIGN 46
7.4 BUSBARS 48
7.5 NEUTRAL AND EARTH LINKS 49
7.6 FINISHES 50
7.7 SWITCHGEAR 50
7.8 ACCESSORIES, INSTRUMENTS, METERS 54
8 LUMINAIRES 55
8.1 SCOPE 55
8.2 PACKAGING 55
8.3 TESTING 55
8.4 PERFORMANCE STANDARDS 55
8.5 PHOTOMETRIC DATA 55
8.6 LAMP PERFORMANCE 55
8.7 GENERAL CONSTRUCTION 56
8.8 WIRING 56
8.9 ACCESSORIES AND CONTROL GEAR 57
8.10 LAMPS 59
8.11 RECESSED LUMINAIRES – wARNING sIGNS 59
8.12 EMERGENCY LIGHTING 60
8.13 SCHEDULE OF LUMINAIRES 61
9 NATIONAL BROADBAND NETWORK (NBN) CORPORATION CABLING SYSTEMS 63
9.1 SCOPE 63
9.2 STANDARDS AND PRACTICE 63
9.3 SYSTEM CERTIFICATION AND WARRANTY 64
9.4 WORKSHOP DRAWINGS 65
9.5 INSPECTIONS 65
9.6 GENERAL 65

9.7 CABLE SUPPORT SYSTEM 66
9.8 EXTERNAL WORKS 66
9.9 TESTING 66
10 STRUCTURED HORIZONTAL CABLING SYSTEMS (SHCS) 66
10.1 SCOPE 66
10.2 STANDARDS AND PRACTICE 67
10.3 PROTOCOLS AND STANDARDS 68
10.4 SYSTEM CERTIFICATION AND WARRANTY 68
10.5 INSPECTIONS 68
10.6 GENERAL 69
10.7 EXTERNAL WORKS 69
10.8 TESTING 69
10.9 COMMUNICATIONS OUTLETS 70
10.10 LABELLING - COMMUNICATIONS CABLING 70
10.11 OUTLETS 71
10.12 COPPER HORIZONTAL CABLING 71
11 COMBINED FIRE / ACCESS CONTROL SYSTEM 73
11.1 GENERAL 73
11.2 POWER SUPPLY 73
11.3 WIRING 74
11.4 PRE-CONSTRUCTION SUBSMISSIONS 74
11.5 TESTING 74
11.6 MAINTENANCE 75
11.7 MANUALS AND DRAWINGS 75
11.8 WARRANTY 75
11.9 SYSTEM CONTROL PANEL 75
11.10 ACCESS CONTROL 76
12 MATV SYSTEM 80
12.1 SCOPE 80
12.2 STANDARDS 80
12.3 SYSTEM DESIGN 80
12.4 PERFORMANCE 80
12.5 TESTING 80
12.6 CABLES 81
12.7 CABLE INSTALLATION 81
12.8 ANTENNA SYSTEM - MATV 81
12.9 ANTENNA INSTALLATION 81
12.10 ANTENNA AMPLIFIERS 82
12.11 PASSIVE ELEMENTS 82
12.12 OUTLET PLATES AND QUANTITIES 83
13 INTERCOM SYSTEM 84
13.1 SCOPE 84
13.2 ENTRANCE STATIONS 84
13.3 MONITORING STATIONS 85
13.4 WIRING, POWER AND EQUIPMENT 85

13.5 TESTING 85

APPENDIX A - SECTION COSTS & UNIT RATES - ELECTRICAL SERVICES 86

APPENDIX B - SCHEDULE - SUBCONTRACTORS AND PERSONNEL 87

APPENDIX C - SCHEDULE OF RATES - LUMINAIRES 89

APPENDIX D - SCHEDULE OF UNIT RATES 90

APPENDIX E - SCHEDULE OF TECHNICAL DETAILS - ELECTRICAL SERVICES 92

1 GENERAL

1.1 CROSS REFERENCES

All work covered within this specification shall be read in conjunction with the following trade packages and contracts. Should any discrepancy occur between the references the larger/greater shall be assumed and referred to the Engineer prior to proceeding with any works.

- Preliminaries and General Contract Conditions
- Architectural Drawings and Specification
- Mechanical Services Drawings and Specification for termination points
- Fire Services Drawings and Specification for termination points
- Hydraulic Services Drawing and Specification for termination points
- Structural Drawings for details of footings, piers, beams, columns or the like

1.2 PROJECT DETAILS

The works described within this specification pertain to the Electrical Services installation at 168 Prospect Road, Prospect.

1.3 FIXED PRICE LUMP SUM CONTRACT

The Electrical Contractor is to enter into a fixed price lump sum type contract. The following specification and accompanying drawings outline the general scope of works and have been prepared to enable specialist contractors to submit fixed sum tender prices for the electrical services installation. The drawings are intended to indicate the principles of design and should not be taken to define all offsets, bends etc which may be required to complete the installation and or be coordinated with other services.

The Electrical services constrictor will be responsible for final coordination with other trades and for final coordination with architectural drawings and building structure. The tender drawings are not to be used for architectural or structural work but are to be read in conjunction with architectural, structural and other relevant drawings.

Coordinate all cable runs, trays and installations with "MECHANICAL, HYDRAULIC AND FIRE SERVICES" trade to ensure non-clashing of services.

Deviation from the design principals shown will not be permitted without the written consent of the Superintendent. Any discrepancies which may affect the installations shall be brought to the superintendent's attention before the work proceeds.

Note apartment internal lighting, power, communications and fire alarm layouts and requirements have not been specifically defined by the specification and accompanying drawings. These layouts and drawings will need to be considered and defined as part of the electrical tender for review by the builder, consulting engineer and client.

1.4 DEFINITION OF TERMS

Consulting Engineers	-	Lucid Consulting Australia
Proprietor/Principal	-	Client or end user of the proposed building
Electrical Supply Authority	-	SA Power Networks – Frank Greco
Telecommunications Supply Authority	-	NBN Co. – Jim Kellet
Contractor	-	Installer undertaking the works.
Works	-	As described within this specification
Provide	-	Design, construct, supply, install, commission and place into service
Equal Approved	-	Alternative product/method of installation which is presented to the Consulting Engineer and written approval is received.

1.5 DRAWINGS

Tender Drawings

Drawings associated with and forming part of this specification are scheduled below:

Drawing No.	Drawing Title
LCE12584-E01	GROUND AND FIRST FLOOR POWER AND LIGHTING ARRANGEMENTS, DRAWING INDEX AND GENERAL NOTES.
LCE12584-E02	SECOND AND THIRD FLOOR POWER AND LUMINARIE ARRANGEMENT
LCE12584-E03	ROOF LEVEL POWER ARRANGEMENT AND SINGE LINE DIAGRAM
LCE12584-E04	LEGEND OF SYMBOLS AND STANDARD DETAILS

The arrangements and details indicated on the above drawings are approximate only. Check all dimensions and building details prior to commencement of the work.

A contractor walk through will be arranged for the contractor to raise queries and provide comment during the tender period.

1.6 SCOPE

Outline description: The work covered by this specification includes the following:

The provision of an electrical installation that satisfies all statutory, legislative and code requirements and conforms with the general details herein.

The planning, scheduling, procurement of components and their installation to meet the program. Completion of the works to meet the proposed and required staging, in coordination and liaison with other trade packages.

Full responsibility for the execution of the complete installation in accordance with the project specification and all drawings.

The installation, testing, commissioning, maintenance, service and warranty; and all sundry and material items whether mentioned in detail or not, required to complete the installation and put it into working order.

Description of the Installation

The following works generally describe the Electrical Services installation and shall be carried out under this specification:

- Provision of low voltage Electricity Supply Authority Service Supply.
- Payment of Electricity Supply Authority standard fees and connection charges.
- Provision of new underground consumers mains and site main switchboard including all switchgear, controlgear and auxiliary panels.
- Multiple submains and distribution boards throughout the installation, including cable trays, cable ladders, supports, conduits, switchgear and controlgear, auxiliary panels and enclosures and all ancillary equipment to complete the installation.
- Earthing systems to all accessories, outlets, equipment, luminaires, other services, building structure, switchboards and communications cabling systems including provision of equipotential earthing system to slab reinforcement in all wet areas in accordance with AS3000 and in co-ordination with the Builder.
- General power throughout including access provisions, supports, cabling and outlets.
- RCD protection of all socket outlet circuits, lighting circuits and other circuits and equipment as nominated.
- Power supplies to Mechanical, Hydraulic, Fire and specialised services including provision of supplies, outlets or isolators as nominated.
- Fire rated power supplies and communications connections to Lift Services and lift equipment including switchboard and control panels.
- Provision of general and specialised lighting throughout the complex including luminaires, lamps, motion sensors and specialist controls to suit BCA power density and energy efficiency requirements.
- Exit and emergency lighting throughout complying with the requirements of AS 2293.
- Access conduits and cable trays for communications systems including those for NBN Co, internal voice and data copper, and optical fibre cables, inclusive of pits and draw wires.
- Telecommunications facility cabling including support systems, accessories and terminations. Communications outlet to living room area adjacent MATV outlet for 'Smart TV' connection to NBN Co facilities.
- Provision of reticulated MATV system to all Apartments for digital FTA and Digital distribution including the ability for high definition digital TV distribution, including backbone cabling, outlet cabling, passive and active equipment, racking, aerial installation, head-end equipment auxiliary equipment and accessories to each apartment to complete the installation.
- Provision of combined fire / access control systems to car park and common areas including card readers, door hardware, proximity cards, door release buttons, emergency break glass door releases buttons, detectors, strobe sirens, TCP/IP interface between systems, interface to the intercom system, control equipment and programming.
- Audio intercom system to all apartments including audio equipment, audio building entrance stations, audio apartment monitoring stations, individual apartment door bells facility, bus control equipment, equipment enclosures, main entrance access controllers, main entrance push button release, cabling, supports, auxiliary equipment, interface to building access control system and all other accessories to complete the installation.

- Provision of all hoisting and access equipment required to install all systems.
- Provision of training of management and maintenance staff for all systems.
- Provision of smoke alarms with sounder bases and associated power supply cabling within apartments as shown on drawings.
- Make timely applications and liaise with electrical and telecommunication authorities and utilities for all infrastructure and connections associated with the project on behalf of the Proprietor/Principal to meet the construction program milestones.
- Testing and commissioning of the above systems.
- Maintenance and servicing, defects liability and warranty for 12 months from the date of practical completion.
- Bound volumes of Installation and Operating Manuals, and work-as-executed drawings.

Variations to the Scope

Instructions may be issued throughout the project which may alter the scope of works. Any aspects of any such works which are not specifically mentioned in any instruction are to comply with this specification.

Any claims for any additional costs or credits for any such variations must be submitted with a complete breakdown of costs including quantities and rates for all labour, materials and equipment. Variation Claims submitted without breakdowns will be rejected.

1.7 ASSOCIATED WORKS

Related Works

The following work related to the Electrical Services installation shall be carried out under control of the Head Contractor. Provide any additional work required for the completion and full operation of the Electrical Services Works including the provision of access panels for the proper maintenance of all equipment.

- Trimmed openings within plasterboard ceilings for luminaires.
- Saw-cutting of concrete and timber floors (including joints where applicable).
- Formed block-outs and penetrations through walls, slabs, footings, columns and beams as detailed on the architectural plans. If not indicated the Electrical contractor will be responsible for arranging directly with the associated trade to form the penetration and allow for the associated cost in their tender. Any required minor penetration through concrete beams or floors shall be sleeved by the Electrical contractor. Should a penetration be required to be cored after construction, the Electrical contractor shall arrange for and bear all associated costs.
- All trenching and reinstatement of surfaces.
- Provision of door signage and associated danger notices.
- Provision of equipment indicated by other trades including installation with exception of electrical connections.
- Provision of temporary power, lighting and emergency lighting during construction in accordance with the requirements of AS3012, including minimum emergency lighting levels of 20 lux.

- Provision of Hoisting of all equipment.
- Space for site shed and storage of equipment delivered to site.

Termination Points - sub-contractors

- Termination points with other sub-contractors are as follows:-

Mechanical Services Sub-Contractor:-

- Wiring and final connection from weatherproof roof mounted isolators for air conditioning condensing units shall be provided by the Mechanical Services Contractor. Electrical services contractor shall provide individual electrical supplies from local apartment distribution boards for each air conditioning condensing unit.
- Flex and plug and final connection from controlled socket outlets within ceiling space for toilet air and general exhaust fans shall be provided by the Mechanical Services Contractor. Electrical services contractor shall provide socket outlets within ceiling space supplied from local apartment power circuits and controlled from a combined light/fan switchplate within each location.
- Flex and plug and final connection from unswitched socket outlets within ceiling space for outside air fans shall be provided by the Mechanical Services Contractor. Electrical services contractor shall provide socket outlets within ceiling space supplied from local apartment power circuits. Controls for interlocking operation of outside air fan with local fan coil unit to be provided by the Mechanical Services contractor.
- Flex and plug and final connection from controlled socket outlet within ceiling space for common area toilet exhaust fan shall be provided by the Mechanical Services Contractor. Electrical services contractor shall provide socket outlets within ceiling space supplied from common area power circuits complete with adjustable run-on timer interlocked with local light circuit operation.
- For all roof mounted and indoor plant the Electrical Contractor shall provide isolators installed to pedestals located adjacent plant equipment, and labelled to reference plant equipment. No isolators shall be installed directly on plant equipment.

Hydraulics Sub-Contractor:-

- Provision of weatherproof single-phase double switched socket outlet for connection to of building central hot water plant shall be provided by the Electrical Services Contractor.
- Provision of weatherproof single-phase isolator adjacent to the building hot water circulating pump assembly control panel including wiring to and final connection to control panel shall be provided by the Electrical Services Contractor.
- Provision of single-phase switched socket outlet located adjacent to each dishwasher within cupboard space adjacent dishwasher recess, within each apartment shall be provided by the Electrical Services Contractor. Arrange with Joiner for cable and plug access via joinery divider.
- Provision of single-phase switched socket outlet located under gas hot plate within each apartment kitchen shall be provided by the Electrical Services Contractor.
- Provision of single-phase switched socket outlets adjacent communications cabinet in the car park for connection to Origin Energy's 'Gateway' data logger with 4G wireless access.
- Wiring and final connections from socket outlets and isolators to all Hydraulic Services Equipment to be provided by the Electrical Contractor under this contact.

- For all indoor and outdoor plant equipment the Electrical Contractor shall provide isolators installed to pedestals located adjacent plant equipment, and labelled to reference plant equipment. No isolators shall be installed directly on plant equipment.

Fire Services Sub-contractor:-

- Final termination of dedicated circuit hard wired connection to Diesel Fire Pump control panel in Fire Pump Room shall be provided by the Electrical Contractor under this contract.
- Flex and plug and final connection from dedicated circuit and weather proof SSO for jacking pumps shall be provided by the Electrical Contractor under this contract.

Lift Sub-contractor:-

- Final connections of all submains to Lift Services Switchboards shall be provided by the Electrical Contractor under this contract. Final locations to be co-ordinated with Lift Services Contractor.
- Telecommunications backbone cabling from dedicated building NBN NTU to FDPs within or adjacent Lift shall be provided by the Electrical Contractor under this contract. Final locations to be co-ordinated with Lift Contractor.

Termination Points/Associated Works - Authorities

- Termination points and associated works with utilities and authorities are as follows:

Electricity Supply Authority:

- Termination point for consumers mains cabling is the consumer terminals of the service fuse enclosure located on site at rear boundary and accessed from Williamson Lane.
- The Electrical Contractor shall co-ordinate with Electricity Supply Authority for the provision of a new supply to site.
- The Electrical Contractor shall co-ordinate with the Electricity Supply Authority for the removal and/or relocation of existing redundant services and equipment on site.
- The Electrical Contractor shall pay all associated fees with the above works, and lodge all necessary applications prior to completion of first fix.

NBN Co:

- The Electrical Contractor shall provide all access provisions in the form of conduits and cable supports for all NBN Co cabling in accordance with NBN Co requirements.
- The Electrical Contractor shall co-ordinate with NBN Co for the preparation and approval of Workshop Drawings, approval of cable pathways during construction, and handover of cable pathways to NBN No.
- The Electrical Contractor shall co-ordinate with NBN Co for the provision of a fibre optic lead-in and associated active equipment to site.

1.8 STANDARDS

Referenced documents: The following standards are referred by and/or form part of this Specification:

- AS/NZS 1170.4 SAA Loading Code - Earthquakes

- AS/NZS 1367	Multiple Outlet Television Systems
- AS/NZS 1345 ducts	Identification of the contents of piping, conduits and
- AS/NZS 1627 Set surfaces	Metal Finishing - Preparation and pretreatment of
- AS/NZS 1680 Set	Interior Lighting
- AS/NZS 1882	Earth and bonding clamps
- AS/NZS 1939 Set	Degrees of protection (IP Code)
- AS/NZS 2184	Low voltage switchgear and control gear
- AS/NZS 2293 Set	Emergency evacuation lighting in Buildings
- AS/NZS 2700	Colour standards for general purposes
- AS/NZS 3000	SAA Wiring Rules
- AS/NZS 3008	Electrical Installations – Selection of Cables
- AS/NZS 3012	Electrical Installations – Construction and Demolition Sites
- AS/NZS 3080	Telecommunications Installations
- AS/NZS 3084	Telecommunications Pathways and Spaces
- AS/NZS 3111	Approval and test specification for miniature overcurrent circuit-breakers
- AS/NZS 3135	Approval and test specification - Semi-enclosed fuses for a.c. circuits
- AS/NZS 3820	Essential Safety Requirements for Electrical Equipment
- AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
- AS/NZS 4792	Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialized process
- AS/NZS 5000 Set	Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1 kV
- AS/NZS 60598 Set	Luminaires
- AS/NZS 60921 Set	Ballasts for tubular fluorescent lamps - Performance requirements

- AS/NZS 60922 Set	Auxiliaries for lamps - Ballasts for discharge lamps - General and safety requirements
- AS/NZS 60923	Auxiliaries for lamps - Ballasts for discharge lamps - Performance requirements
- AS/NZS 60925	D.C. supplied electronic ballasts for tubular fluorescent lamps -Performance requirements
- AS/NZS 61048	Auxiliaries for lamps - Capacitors for use in tubular fluorescent and other discharge lamp circuits - General safety requirements Capacitors for use in discharge lamp circuits
- AS/ACIF S008	Requirements for customer cabling products
- AS/ACIF S009	Installation requirements for customer cabling (Wiring rules)
- AS/NZS CISPR Set	Electromagnetic Compatibility

Comply fully with all relevant Standards and Regulatory Codes published and in force at the time of construction, including the following:-

- The local and national Electricity Acts and Regulations
- Occupational Health Safety & Welfare Act and Regulations
- National Construction Code (NCC)
- Standards Australia
- Electricity Supply Authority Service Rules and Conditions of Supply
- ACMA Regulations
- NBN Corporation Technical Guidelines
- Federal, State and Local Government Building Acts and Regulations
- Foxtel Standards

2 CONTRACT SUBMISSIONS / REQUIREMENTS

2.1 HOLD POINTS

The following is a summary of Hold Points referenced for completion prior to progression:-

Clause Ref.	Submission Stage	Hold Point	Response Time
2.3	Tender	Tender Submission	5 Working Days
2.4	Pre-Construction	Technical Datasheets	10 Working Days
		Workshop Drawings	5 Working Days
		Calculations	5 Working Days
		Functional Controls Specification	5 Working Days
		Construction Approvals	5 Working Days
2.5	Construction	Inspections	2 Working Days
		Commissioning & Witnessing Plans	10 Working Days
		Testing and Commissioning Results	5 Working Days
		User Training	10 Working Days
		Prototype copies of Operation and Maintenance Manuals (including As-constructed Drawings)	5 Working Days
2.5	Post-Construction	Operation Maintenance	10 Working Days

2.2 TENDER DRAWINGS

The Tender Issue drawings accompanying this specification illustrate the design intent of the proposed works. It is the responsibility of the Electrical Contractor to design and construct the installation based on the Tender Issue drawings provided.

Where sizes, ratings, loads and the like have been identified on the Tender Issue drawings, they are to be considered as the minimum values. The Electrical Contractor is to confirm all sizes, ratings, loads and the like and provide an installation that meets or exceeds the values shown.

The Electrical Contractor shall accept all responsibility for the proposed works, and shall present any deviations or exclusions from the design intent identified in the Tender Issue drawings within their tender offer. Prior to submitting the tender offer the Electrical Contractor shall become fully acquainted with the nature and extent of the Contractor Works. If any doubt exists as to the meaning of any part of the tender documents, clarification must be obtained 7 days prior to the tender closing date.

2.3 TENDER SUBMISSONS

The submissions required at Tender shall incorporate, as a minimum, all information defined within the Appendices of this Specification. Any appendices not completely filled out will be rejected.

In addition to the Appendices the Manufacturer's selections data shall be provided incorporating the following:

- Electrical full load amps, voltage and phase data
- Performance data relevant to the equipment specification clause
- Acoustic data measured in Sound Power as per the equipment specification clause
- Size and weight information including maintenance clearance

Conduct of the Tender Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.4 PRE-CONSTRUCTION SUBMISSIONS

2.4.1 TECHNICAL DATASHEETS

Requirement: Submit technical datasheets for approval and permission. All subsequent materials and workmanship are to match the approved technical datasheets.

Conduct of the Technical Datasheet Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

Delay: Bear total responsibility for the consequences of delay resulting from failure to allow adequate time for assessment and approval of technical datasheets, including rejection of technical datasheets that are not approved for whatever reason.

Required technical datasheets: Submit technical datasheets of the following:

- Luminaires
- Motion Sensors
- Power Outlets
- Light Switches
- Smoke Detectors
- Strobe Sirens
- MATV Outlets

2.4.2 WORKSHOP DRAWINGS

Diagrammatic layouts: Tender Drawings forming part of this Specification are diagrammatic for tender only and shall not be used for installation purposes. Before commencing work, determine the exact positions of all electrical equipment in conjunction with and to the approval of the Consulting Engineer having regard to interior design, building features, other services, and the requirements of regulatory authorities and standards indicated above.

Construction Workshop Drawings for Review:

Requirement: Supply construction workshop drawings coordinated fully with other trades and the main contractor detailing the following items:-

- Main Switchboards and all Distribution Boards including:-
  - General plans, elevations and sections, construction and weights.
  - Circuit diagrams, busbar and cable sizes
  - Current carrying capacity, current and fault ratings
  - Equipment types and models, labelling and finishes.
  - Additionally provide documentary evidence of fault withstand type tests relevant to the applicable enclosure(s).
- Co-ordinate final lighting, power and communications layouts (and all other provisions detailed herein) with other services and to suit final furniture locations including wardrobes. Provide shop drawings showing fully co-ordinated floor and ceiling plans complete with dimensions.
- Cable supports and pathways for NBN Co cabling as described in the NBN Co technical guidelines.
- Combined fire/access control system showing the location and mounting details of system equipment and all associated power supplies (SSOs) including functional description for operation of the system.
- Cable tray proposed routes in full coordination with Mechanical Services workshop drawings detailing submain quantities, locations, penetrations and support details.
- MATV schematic drawings showing locations of all active and passive equipment (including SSOs) and all outlets, and estimated signal strength at each outlet.
- Termination points with all other trades.
- Details of all proposed labelling and engraving.
- Earthing layouts and bonding connection locations and details.

Conduct of the Workshop Drawings Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

Number of copies: 3 off print copies or 1 off electronic copy.

Preparation: Prepare all drawings to AS 1100, AS 1102, AS 1103 and AS 3702 to the same scales and on the same size standard sheets as the Contract Drawings (Size A1 sheets).

Work-as-executed drawings - Electrical Services

Requirement: Before the Date of Practical Completion and as a pre-condition to Practical Completion supply work-as-executed drawings based on the Contract Drawings.

Include the following minimum information:-

- Actual locations of installed equipment
- Interface points with other trades
- Circuit numbers and phase for all final sub-circuits
- Actual cable tray and communication cable routes
- NBN Co cable pathways and supports.

- Location depths of all underground conduits and pits dimensioned from permanent landmarks

Include these drawings once approved in the Electrical Services Installation Manuals.

Provide a laminated copy of the main switchboard single line diagram to the approval of the Principal and Consulting Engineer; mount adjacent the Main Switchboard.

Provide a laminated copy of the voice and data cabling schematic diagram and mount within the Communications Room. Provide a bound set of communications floor plans indicating labelling and wiring routes and locate within the Communications Room.

Bluebeam PDF format of the tender drawings are available from Lucid Consulting. (One single coordinated electronic transfer will be issued).

Work-as-executed drawings are to be provided by the Electrical Sub-contractor in both electronic on CD-Rom and hard copies within each Installation Manual.

2.4.3 AUTHORITIES, PERMITS, FEES, CERTIFICATES AND APPROVALS

Tariffs and installation of meters

Make applications for the timely works of all relevant authorities and utilities. Pay all associated fees and costs.

Complete all forms and applications and arrange for signing by the Proprietor as appropriate.

Provide documents evidencing approval of regulatory authorities, before and as a pre-condition to Practical Completion or other specified dates, including the State Fire Service.

Provide Certificates of Compliance indicating self-certification of all aspects of the project as required by the Electricity Act.

Allow to obtain approvals or connections from authorities and utilities in a staged manner to suit the program, construction and occupation of the project.

Upon request, submit for approval any item related to the installation, including data sheets on materials and equipment and licence certificates.

Conduct of the Construction Approvals Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5 CONSTRUCTION SUBMISSIONS

2.5.1 INSPECTIONS

Notice: Give sufficient notice so that inspection may be made at the following minimum stages:

- Trenching: Approval of routes, common trench arrangements (where proposed) and depths;
- Cabling: Commencement of cabling installation (including that of any sub-contractor);
- Connection: Connection of cabling and wiring;

- Earthing: Installation and connection of earthing system;
- Acceptance: Installation ready for acceptance;
- Testing of systems
- Commissioning of systems

2.5.2 COMMISSIONING & WITNESSING PLANS

The contractor shall submit for approval a detailed commissioning plan indicating step by step testing strategy for all equipment. The commissioning plan shall be developed in conjunction with other trades and shall be required to be submitted to the head contractor and Consulting Engineer for review prior to any commencement of commissioning. The electrical services contractor shall be responsible for providing commissioning duration period to head contractor for inclusion in the construction programme.

Any witnessing of commissioning required by the Consulting Engineer, prior to practical completion, shall be allowed for within the commissioning plan.

Conduct of the Commissioning & Witnessing Plans Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.3 TESTING AND COMMISSIONING RESULTS

Provide testing and commissioning results in accordance with the Testing and Commissioning section of this specification as a pre-condition of Practical Completion.

Submission of satisfactory testing and commissioning results shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.4 USER TRAINING

Carry out training on systems as nominated within this specification with user groups and other parties as nominated by the Superintendent. Provide a program for user training for approval by the Superintendent and Building Services Consulting Engineer.

Completion of user training shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.5 INSTALLATION MANUALS

Requirement: Before commencement of operational maintenance and prior to Practical Completion, provide the specified number of copies of a combined operating and maintenance manual, written in clear concise English, containing a title page listing suppliers' names, addresses and telephone numbers, a table of contents, and the following sections:

- Front cover including Project Name, Location, Builder and Electrical Contractor
- Index
- Contractor's Name, Address, Telephone number and emergency telephone numbers
- General description of the installation, written as briefly as possible, consistent with providing a general understanding of its features and operation.
- Schedule of Technical Data

- List of Equipment Suppliers' and Manufacturers' catalogues and descriptive matter to provide a complete source of information. (All manufacturers' literature shall be original copies.)
- A copy of "Work-As-Executed Drawings" showing all circuiting, circuit numbers, phase annotation and communications outlets designations. All underground cable routes shall be dimensioned from permanent landmarks. Photographic and video records of concealed works.
- A copy of switchboard workshop drawings and all other construction drawings.
- A copy of all final distribution board legend cards.
- Maintenance Instructions
  - Routine
  - Preventative
- Test results taken during acceptable tests and Authority Certificates including:-
  - RCD Test results
  - Exit and Emergency lighting discharge results
  - Communications cabling including calibration certificate for testing equipment
  - Electrical COCs
  - TCA1 form
- List of guarantees and warrantees of Equipment Suppliers.

Form: A4 size, printed or typed on durable printing paper, with each page consecutively numbered, and neatly bound in durable vinyl or similar hard covers with embossed covers. Provide multiple volumes as required.

Number of copies: 3

Installation manuals are to be provided by the Electrical Sub-contractor in both hard copies and electronic form (CD-Rom/DVD-Rom or USB drive within each Installation Manual).

Prototype copy: Provide a prototype copy for approval before proceeding with final copies. Co-ordinate the manuals with all other trades.

Final approval copies are to be received before and as a pre-condition to Practical Completion.

Submission of prototype copies of Operation and Maintenance Manuals shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.5.6 MAINTENANCE AND TESTING OF SAFETY INSTALLATION MANUAL INSERTS

Requirement: Prior to Practical Completion provide the specified number of copies of inserts into Maintenance and Testing of Safety Installation Manual as provided by the Fire Services Contractor, written in clear, concise English. Co-ordinate with the Head Contractor and all other trades for submission of the inserts.

Include the following inserts:

- Signage including exit and emergency lighting details, including locations and testing requirements.
- General description of the exit and emergency lighting system.

- Maintenance and testing of NBN Co NTU's servicing essential communications systems including fire and lift lines.

The manual shall comply with AS 1851 - Maintenance of Fire Protection Equipment.

Form: A4 size, type written-on durable printing paper, with consecutively numbered pages, neatly bound in red vinyl hard-covers with embossed covers.

Number of Copies: 3.

Submission of prototype copies of Maintenance and Testing of Safety Installation Manual inserts shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

2.6 POST-CONSTRUCTION SUBMISSIONS

2.6.1 OPERATIONAL MAINTENANCE

Maintenance period: 12 months from the date of Practical Completion.

Requirement: Provide 24 hour emergency call-out services and arrive on site to rectify defective items within 2 hours of notification of a defective item. During the maintenance period:

- Carry out monthly inspections and perform maintenance work at the frequencies and following the procedures recommended by the manufacturers of the supplied equipment;
- Check all terminations and connections within switchboards, identify and correct any overheating.
- Promptly rectify faults. Replace faulty materials and equipment, including all luminaire lamps, and accessories.
- Check the operation of evacuation lights and exit signs at three monthly intervals. Provide logbook and log all tests.
- Clean off dust and corrosion build-up to all plant and equipment.

Provide maintenance check sheets and arrange for signing of these by the nominated site representation. Provide a copy of the check sheets to the Consulting Engineer on a monthly basis.

Certification: At the end of the maintenance period make a final service visit and, upon satisfactory completion of the above procedures, certify in writing that the installation is operating correctly.

Approval for the release of retention monies will not be granted until 12 consecutive monthly check sheets have been received by both the Proprietor and the Consulting Engineer.

Conduct of the Operational Maintenance Submissions shall constitute a HOLD POINT. The Principal is responsible for release of this hold point.

Operational instruction: Coinciding with Commissioning and routine inspection visits, at times to be agreed with the Superintendent, instruct the Principal's operational maintenance staff in the recommended methods of operation and maintenance of the systems.

In addition provide a time allowance of 16 hours for the initial instruction in the operation of all systems.

3 MATERIALS & WORKMANSHIP

3.1 GENERAL

The following clauses set out the general requirements for the works. These requirements are not intended to cover all aspects of the installation and must be read in conjunction with all other sections of the Specification and the drawings.

Workmanship shall be of a high standard and each section of the work shall be properly and neatly executed to the best trade practice.

The tender drawings indicate the sizes of cables and the approved cable routes throughout the building. They do not, however, purport to show all minor cable offsets, hangers, method of fixing and clearances, all of which must be coordinated with other trades, measured on site and in accordance with AS 3000. All cable arrangements shall be coordinated with architectural, structural and other services on site prior to commencement of installation.

3.2 QUALITY ASSURANCE

Implement a Quality Assurance System for the works in accordance with the following Australian Standards:

- AS 3900
- AS 3901

The Quality Assurance System shall cover the following minimum aspects:

- Detailed plan setting out supervision, quality control and checking (witness point) procedures.
- Details of the Electrical Contractor's Quality Assurance Plan shall be submitted to the Superintendent upon request.

3.3 EXISTING SITE CONDITIONS

The contractor shall visit the site to familiarise himself with the extent of work. No extras shall be considered from neglect of this provision.

Minimum notice required for all required inspections; 10 working days

The Electrical Contractor shall check with all relevant authorities as to possible locations of any underground services on site and in adjacent footpaths/roadways and locate before commencing excavation.

The Electrical Contractor shall allow to terminate all redundant services as necessary to allow demolition to commence.

3.4 COMPLETED SITE CONDITION

Thoroughly clean all fixtures and fittings and leave the installation in a first class working condition.

Untidy work whether exposed to view or concealed will not be accepted and rectified at nil cost.

3.5 UNIFORMITY AND QUALITY

Obtain approval for and maintain uniformity of the manufacturer and type of all materials and equipment. Use only new, current manufacture, first quality materials and equipment.

Comply with the manufacturer's recommendations in respect to installation techniques and the requirements for associated materials, access clearances, equipment, components and devices.

Ensure compatibility of materials and equipment with the installed environment in respect of ambient temperatures, utilities supplies and vibration.

Support all Electrical services equipment including cabling and the like, independently of other services and/or non-structural building elements.

3.6 WARRANTIES

Warranties shall extend for a minimum of 12 months.

All equipment and workmanship to be provided with a warranty.

Warranty to commence at date of practical completion.

Details for all products with extended manufacturers warranties shall be provided within final Operating and Maintenance manuals.

3.7 INSTALLATION COORDINATION

Check on site at regular intervals the building working dimensions, tolerances and the setting out of the associated works. Immediately report any discrepancy.

Requirements

The positions of outlets, switches, luminaires and equipment shown on Drawings accompanying the Specification are for Tender purposes and are diagrammatic only. Check on site for positions and obtain approval and verification of all locations with the Principal and mounting heights prior to first fixing. When any relocating is required to conform to the above, undertake such relocation without additional costs to the Principal. Allow relocation of accessories and equipment a distance of 3m before and during first fix without variation to the contract.

Verify locations of all outlets, switches and equipment to ensure:-

- Co-ordination with final furniture arrangements and interior design;
- Co-ordination with other trades construction workshop drawings;
- The work of any other trade does not interfere with the electrical installation;
- They are not shrouded by door swings and tracks, furniture or equipment;
- Conformity with any pattern formed by ceilings, panels, tiles beams and the like;
- Full compliance with AS 3000 and Electricity Act requirements.

Anomalies

Promptly report any anomalies, for consideration and instructions. Work proceeding without obtaining approval, and subsequently rejected by the Superintendent shall be made good at nil additional expense to the Principal.

Co-ordination

Provide sizes and depths of recessed equipment including SCA cubicles and luminaires to other trades in writing for coordination before placing orders and before commencement of the relevant trade's construction workshop drawings.

Segregation

Physically mechanically segregate and separate circuits or services at common coverplates using approved isolating barriers.

Physically segregate the Electrical Wiring Systems from all other wiring and sub-wiring systems and equipment using physical isolation or approved isolating barriers.

Cable routes: The routes shown on the Drawings accompanying the specification are diagrammatic only and will require onsite coordination. Determine the final routes to suit the building structure, site conditions and penetration locations.

Approval: Obtain approval for the final routes prior to installing consumers mains, major sub mains and submains.

Concealment: Unless otherwise specified, conceal and protect cables and conduits.

Arrangement: Arrange cables and conduits parallel with walls, ceilings, floors and other building elements.

Separate conduits: Run circuits originating at different distribution boards in separate conduits or enclosures.

Derating: Unless otherwise stated, all cables shown on drawings or specified are based on nominal derating factors. Where the cable installation method chosen involves a derating factor of less than unity upgrade the cables so that the current carrying capacity of the new cable, multiplied by the derating factor, is at least equal to the current carrying capacity of the minimum specified cable.

Cutting and making good: Unless included as associated works, cut all openings and penetrations, and install all sleeves required for the electrical installation. Maintain fire ratings in all instances.

Segregation: Maintain physical barrier segregation and separation between the electrical system and all other wiring systems and services. Liaise with all other services and trades where required to maintain this segregation.

3.8 PENETRATIONS

Generally

Provide treatment to the penetrations as follows. Refer to architectural drawings for indication of all fire walls, floors ceilings, and the like, for allowance required to fire rated penetrations throughout:-

Fire walls, ceilings and structural members: Do not penetrate without approval. Restore the fire rating of all fireproof building members at barriers where penetrated by electrical services once cable installation is complete using an approved method. Provide approved proprietary fire-rated wall-boxes for accessories to be installed on fire rated walls. Seal to approval of Consulting Engineer and Authority.

Acoustic walls and ceilings: Do not penetrate without approval. Restore the acoustic rating of barriers where penetrated by electrical services once cable installation is complete using an approved method. Provide approved proprietary acoustic-rated wall-boxes for accessories to be installed on acoustically rated walls. Seal to approval of Consulting Engineer and acoustic engineer.

Damp courses: Do not penetrate.

Floor slab: Run conduits entering a building at ground level under the waterproof membrane and vertically penetrate the membrane and the floor slab.

Existing structures: Obtain approval from a Structural Engineer for any penetrations through existing structures. Pay all associated costs for structural engineering advice.

Penetration size: Provide penetrations of diameter 10 mm greater than the pipe or sleeve diameter for pipes and sleeves penetrating existing external walls, ground slab, or ground floor beams.

Sealing: Seal penetrations around conduits and sleeves with a weak sand/cement mix, or similar sealing compound. Seal the space between cables within sleeves with a pliable waterproof compound or intumescent fire rating material as required.

Fire Stopping Penetrations

Where services penetrate fire walls, floors or other fire rated barrier, sealant for those penetrations shall be sealed to the approval of the relevant Authorities.

Tenderers shall note the specific requirements to fire stop all cable penetrations through each floor and fire rated wall.

Submit details of proposed fire resistant sealants for approval prior to installations.

Fire Proofing: Fire proof each penetration through fire proof building members, irrespective of size, upon completion of installation of cables. Ensure fireproofing complies with all Building Code, Local Authority and Supply Authority requirements, utilising fire barrier pillows and mastic.

Sleeves

Fit a UPVC sleeve for each penetration through floor slabs, ground floor beams and external walls for cables not enclosed in conduit. In addition, for MIMS cables fit a sleeve for each masonry penetration.

Final location shall be accurately determined and installed to the approval of the Structural Engineer during construction. Provide shop drawings indicating location and size of all service penetrations for approval by the Structural Engineer.

Major External Penetrations (greater than 250mm)

Install weatherproof overflashings to upstand and complete with appropriate silicone sealant to prevent water ingress through penetration. Provide trimmer beams or other reinforcement necessary to support equipment, conduits and cabling passing through the penetration.

The over flashing shall be of the same material as the conduit passing through the roof and shall be securely fixed to it.

On completion the contractor shall test all penetrations for leaks to the satisfaction of the Architect.

Minor External Penetrations (Less than 250mm)

Utilise "Dektite" or "Rooftite" seal or equal approved and silicon sealant. Utilise a single seal for each conduit where not concealed under flashings. Utilise a multiple seal where seal is protected under sheetmetal flashing, not exceeding three (3) services through the Seal. Appropriately size all seals, silicone around the top of each seal and install clamps.

Exposed Penetrations

In addition to the above, flash penetrations where exposed to view with sheet metal escutcheon plates. Paint sheet metal to the architects approved colour

3.9 CONCEALED SERVICES

Conceal all services in areas other than plant or utility areas. Install services as follows:

Cavity walls, hollow block and dry walls – install services concealed within cavity.

Single leaf brickwork, concrete – surface mounted conduit or "mini-duct" and seek approval prior to installation.

Do not chase walls.

Consumers Mains/Submains protection: Provide HDPE conduit protection to all consumers mains, submains and other non-RCD protected cabling reticulating within close proximity to the surface of walls, floors, ceilings and roofs.

Cable protection: Provide non-metallic conduit protection to TPS cables installed in poured concrete members, concrete blockwork, partitions and the like. Size such conduits to accommodate the TPS cables with sheath intact.

Load Centre Protection: Provide 3mm thick steel plate behind load centres when installed within cavity walls.

Installation methods

Wall construction:	Installation and cabling facilities:
Rendered partition:	Flush wall box - Heavy duty conduit chased into wall.
Face partition:	Flush wall box - Heavy duty conduit concealed in cut or cored brick-work.
Face brick /block external cavity wall:	Flush wall box - Unless otherwise specified, cable run in cavity and tied against inner leaf of brickwork.
Stud partition:	Fixed clip - cable run in cavity. Provide shrouds as required to preserve segregation requirements.

3.10 TRENCH EXCAVATION, BACKFILLING AND COMPACTION

General: Underground submains cabling and communications access provisions shall be carried out by the Electrical Sub-contractor including the supervision of all associated trenching and backfilling and coordination with other trades for provision of common trenches where proposed or required.

Underground power conduits shall be of the heavy duty (orange) type. Underground conduits for Communications services shall be class B (white) type as approved by ACMA and NBN Co. All conduits shall be complete with suitable expansion couplers and suitable care shall be taken where conduits enter buildings to allow for earth/building movements.

Conduits shall be installed with suitable falls to allow for drainage and installed to the following minimum depths:-

- Electrical Conduits (LV) - 600 mm minimum
- Communications Conduits - 600 mm minimum

Conduit segregation distances shall exceed the requirements of ACMA and NBN Co Regulations.

After installation of cables all conduits shall be sealed to prevent ingress of dirt and moisture. Spare conduits shall be capped for future use.

Marker strips & location markers: Proprietary marker strips and location markers shall be installed above all runs of new underground cabling and conduits.

Marker Strips shall be polymeric batts and shall:

- Be formed from polythene sheet, not less than 200mm wide.
- Have black block letters 150mm high on an orange background printed "DANGER - ELECTRICAL CABLE' or "DANGER - COMMUNICATIONS" indicating the service buried beneath.
- Be of proprietary manufacture and incorporate an insulated tracer wire within.
- Be laid continuously 230mm below the surface of the ground and above each conduit.

- Be laid continuously at 50% of depth of cover for each electrical conduit and at least 150mm above each communications conduit.

Location markers shall:

- Consist of 200mm square or round flush aluminium warning plate complete with direction arrows and service designation set into concrete.
- Be of proprietary manufacture.
- Be located every 30m in straight runs and at junctions or changes of direction for all underground conduits.
- Be located wherever services enter a building.

Trenching, Backfilling and Reinstatement: Include the supervision of all trenching, backfilling and reinstatement. Mark out for approval all proposed routes before commencement of any excavation. Obtain Council approval for all trenching outside the extent of the site and pay all associated fees.

Maintain a digital photographic record of all trenching. Include records within the Installation Manuals.

Make due consideration for prevailing weather conditions and allow for de-watering of trenches as required.

Locations and the extent of existing and new underground or underconcrete routes as shown on the drawings accompanying the specification are indicative only. Obtain from all relevant authorities and the Superintendent all known details of underground services in the vicinity of proposed trenches.

Trace and mark and allow for all costs for relevant authorities to trace and mark the locations of existing underground services where in the vicinity of proposed trenching as follows:

- Power - trace cables electronically using detector or tracer and mark.
- Telecommunications and audio-visual - as above.
- Water - as above (metallic pipes).
- Sewer - provide internal metallic tracer for detection.
- Stormwater - provide internal metallic tracer for detection.
- Gas - as for power above.

Allow within the tender submission to hand dig new trenches within the vicinity of existing underground services and modify conduit installation as required and as directed on site.

Where solid rock is encountered, obtain approval for conduit invert levels and sand/slab as required in accordance with AS 3000 without variation to the work. Shale rock shall be removed without variation to the work.

Select trenching routes so as to avoid tree roots. Where tree roots are encountered, allow to remove as part of the work. For larger root systems install conduits beneath. Avoid trenching near large tree specimens.

Bear total responsibility and cost for the repair of underground services damaged in all cases without variation to the work.

Provide barriers to all trenching routes left open and temporary night lighting where this is deemed a requirement by the Superintendent and in all cases where trenching is left open after hours. The barriers shall not be removed until completion of all work.

Trenches must be kept clear of water at all times and timbered where necessary to prevent collapse. They shall be excavated only sufficiently in advance of laying to allow that work to proceed without delay.

Where necessary and/or required by the Authorities for safe and efficient completion of the work, supply, erect shoring, timbering, planking, etc. of sufficient strength and quality to prevent earth and other materials entering the excavations, tunnels, etc.

Work shall be carried out in accordance with Work SA requirements.

Remove all shoring and timbering in an approved manner on completion of the work and after the inspections have taken place.

Ensure trenches are excavated to a depth 150mm lower than that required for final installation and provide a bed of clean, washed sand. Install new services within trenches and arrange for inspection before backfill.

Excess excavation below the required level shall be backfilled at the Contractor's expense with sand, gravel or other material as directed by the Superintendent, and thoroughly compacted. Any soft or yielding material shall be removed and replaced with sound material and compacted to the satisfaction of the Superintendent.

Ensure trenches are backfilled using quarry sand under pavements and excavated material in landscaped areas after removal of all sharp stones and vegetation. Place the backfill in maximum of 150mm layers and consolidate to 95% modified maximum dry density in paved areas and 85% modified maximum dry density in landscaped areas. Bear responsibility for future subsidence.

After completion of backfilling remove excess material from the site immediately. All cartage costs and tipping fees shall be paid by the Contractor.

Reinstate all surfaces to match existing. Saw-cut and remove 100mm to either side of trenches through bitumen. Provide fine crushed rock pavement material to match existing depth and compact to 95% of the modified maximum dry density. Provide a minimum of 30mm of 10mm Hotmix Surface Course. Ensure no high or low areas are produced.

Reinstate concrete surfaces to match existing using concrete of strength 20 Mpa or greater. Provide reinforcement to match existing where applicable and dowel into existing. Match existing concrete finishes in all respects.

Reinstate unit-paved or other paved surfaces to match existing after preparing the surface as above, with the addition of 50mm sand bed. Replace any damaged pavers with a type to match that damaged.

Reinstate existing lawn and garden surfaces to match those prior to trenching in terms of planning, compaction and levels.

Replace damaged plant specimens with approved plant types.

Reseed all damaged grassed areas.

3.11 PAINTING

All concealed pipe work and metal surfaces, excepting galvanised surfaces, shall be supplied with one coat of red zinc chromate primer applied. The paint shall be undiluted and in accordance with the appropriate SAA Code. All surfaces to be painted shall be thoroughly dry, cleaned down, free from weld splatter, burrs, dust, rust, cement and grease and the like.

Include painting of all equipment supplied including the applicable supports and fixings.

Do not paint surfaces pre-prepared by the respective manufacturer or equipment not recommended by the manufacturer to be painted.

Paint system: Unless otherwise specified paint all equipment as follows:

- Indoor locations: A system not inferior to full gloss - solvent borne.
- Outdoor locations: A system not inferior to full gloss - solvent borne.

Provide protection to all painted surfaces and make good any damage prior to practical completion. If damage is extensive totally repaint damaged equipment surfaces.

All switchboards, control panels and the like shall be cleaned down and polished with automotive polish prior to practical completion.

Paint colours are to be approved by the Consulting Engineer in each case.

Exposed conduits, wiring ducts, cable trays, brackets, frames, covers, etc. shall be painted with at least two coats of best quality oil paint of a colour nominated by the consulting engineer.

Galvanised surfaces shall be etch primed before painting.

Metal surfaces shall be painted, where scheduled, with one prep coat and two finishing gloss coats to selected colours. Carry out any other treatment (e.g. etch priming for galvanised surfaces, degreasing) to ensure a satisfactory result.

Damaged or unsatisfactory painting shall be made good.

3.12 IDENTIFICATION

Switchboards: Number all circuit breakers within each switchboard and on the appropriate escutcheon; Number every hole on earth and neutral bars; Note these numbers on the switchboard circuit schedule. Label main switches. Identify all circuits with exit and emergency lighting.

All lift supplies to have an engraved Traffolyte label adjacent isolator reading “LIFT SUPPLY - DO NOT SWITCH OFF”.

Outlets: Where applicable, identify all isolators, outlets, lighting control switches and power outlets with 2 IPA studs indicating the number and phase of the circuit and distribution board to which it is connected. Locate IPA studs in accordance with the manufacturer’s recommendation. For socket outlets with ID windows use the ID tags in lieu of IPA studs.

Provide engraved Traffolyte labelling for all isolators, outlets, lighting switches and equipment indicating:-

- Distribution board supply
- Circuit reference

Use engraved and filled stainless steel labels for external areas. Brother labelling (or the like) will not be accepted.

Indicators: Where the circuit number has two numerals, provide an indicator with two numerals on the stud.

Additional marking: Provide marking as follows in addition to that required by AS 3000:

- Each Switchboard component.
- Each circuit breaker on the switchboard escutcheon, and with escutcheon removed.
- Complete circuit schedule (machine printed) at each switchboard
- Each fuse - fuse rating - visible without deadening circuit.
- Circuit number and switchboard on each light switch, power outlet and isolating switch.
- Each Main Switch

Label types: Unless otherwise specified, provide the following label types:

- For interior use: Engraved two-colour laminated plastic.
- For exterior use: Engraved and filled stainless steel.
- For interior general purpose outlets and switches: Push-in I.P.A. type studs.

Label edges: Round or bevel the edges of labels exceeding 1.5 mm thickness.

Colours:

-	Warning notices:	White letters on a red background.
-	Essential & fire equipment circuits:	Red letters on a white background.
-	Other labels:	Black letters on white background

Fixing: Fix each label by not less than two chrome plated screws. Where adjacent to terminations, locate the label so that the installed wiring does not mask the label.

Generally not less than the following:

Isolating switches:	10 mm
Other equipment:	4 mm
Warning notices:	4 mm
Inside enclosures:	3 mm

3.13 IDENTIFICATION OF MAIN SWITCHBOARD

The electrical contractor shall provide signage in compliance with the AS/NZS 3000: 'Wiring Rules'.

- The main switchboard shall be legibly and permanently marked 'MAIN SWITCHBOARD'.
- The location of the main switchboard shall be legibly and permanently indicated by a conspicuous notice at each entry to the building that may be used by emergency services personnel.
- Notices indicating the location of the main switchboard shall be of permanent construction and shall incorporate 'MAIN SWITCHBOARD' in contrasting colours.
- The location of the main switchboard need not be marked where the location can be readily determined, e.g. where it is clearly visible from the main entry to the electrical installation.
- The location of the main switchboard need not be marked at the entry to a building where the location is clearly indicated at a Fire Indicator Panel.

The electrical contractor shall liaise with the builder to confirm final locations.

3.14 ELECTRICAL INTERFERENCE

Design and use electrical equipment which will not cause interference with electronic and electrical equipment in the vicinity. In the event that the inherent characteristics of equipment make interference possible, fit effective suppressors to eliminate the interference.

Maintain radio and television interference level within the limits set out in Australian/New Zealand Standard 1044 – Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.

Maintain electrical disturbances within the limits set out in Australian Standard 2279 – Disturbances in mains supply networks. Comply with Australian Standard 4252 – Electromagnetic compatibility – Generic immunity standard.

3.15 DISSIMILAR METALS

Where clips, brackets, and pipe supports are of dissimilar metal to the actual piping used, completely insulate the piping at all fixing points with at least four layers of 50mm wide black polyethylene tape wrapped around the pipe prior to fixing in position.

3.15.1 CONCRETE PLINTHS

Construction

General: Provide plinths under all equipment located on concrete floor slabs as follows:

For all floor mounted equipment. Hot dipped or galvanised.

Concrete: Grade N25

Finish: Steel float flush with the surround.

Reinforcement: Single layer of F72 fabric.

Surround: Provide galvanized steel surround at least 75 mm high and 1.6 mm thick. Fix to the floor with masonry anchors. Fill with concrete.

Minimum height: 100mm for main switchboard.

3.16 METALLIC SUPPORT SYSTEMS AND FIXINGS

Fabrication: Provide brackets, racks, hangers and other supports sized to adequately support the installed system and equipment, fabricated from structural steel sections or from other materials in sections of equivalent strength.

Minimum thickness of structural steel sections:

- Angles and bars: 6.5mm.
- Rods: 10mm diameter.

Fixing to building structure: Fix the supports by surface fixing to ceilings and walls, or suspension hangers from ceilings, or angle brackets or racks from walls, using the following methods, as appropriate:

- Masonry or concrete walls: Embedded Fixings
- Concrete slab ceilings: Embedded Fixings
- Structural steel: Bolts and nuts through clearance holes

Spacing: Space the supports at intervals of not more than 1 m and provide a support at each joint in the tray or ladder system.

Fixing of tray or ladder: Bolt the tray or ladder to the brackets, racks and other supports.

Galvanising: To AS 1650. Galvanise steel conduits and support systems exposed to the weather or installed in damp locations. Conduits and support systems where exposed to view shall be painted.

3.17 EARTHQUAKE FIXINGS AND SUPPORTS

All plant, equipment and conduits shall comply with the requirements of Australian Standard 1170.4 - SAA Loading Code – Earthquake, AS2670 – Vibration, AS2625 Mechanical Vibration, ISO1940:2003 – Mechanical Vibration.

Where greater incorporate the Design, Selection and Installation with requirements of ASHRAE Handbook 2011, Applications Chapter 48.

For further information regarding earthquake restraining, refer to following:-

- Gripple Seismic Installation Manual
- Tyco flow control, 2002,unistrut seismic bracing systems
- Fema e-74, January 2011, reducing the risks of non-structural earthquake damage - a practical guide.
- S.M.A.C.N.A seismic restraint manual, guidelines for mechanical systems, 1998, S.M.A.C.N.A, sheet metal and air conditioning contractors' national association.

Provide restraints and supports designed and certified by a structural engineer, to all plant, equipment, conduits and cable trays in accordance with Australian Standard 1170.4-2007 Section 8, incorporating the following:-

Criteria	Unit	Factor
Importance Level	I	2
Annual Probability of Exceedance	yr	500
Soil Classification		De
Hazard Factor	Z	0.1
Probability Factor	Kp	1
Structural Classification	EDC	2

All restraints and supports shall be issued to the structural engineer to review the adequacy of the structure to support the services loads, including seismic forces.

The following do not require seismic bracing:

- All electrical conduit less than 64mm internal diameter

Transverse bracing for cable trays to be at 6.00m maximum centres and at section ends.

Longitudinal bracing for cable trays to be at 12.00m maximum centres and at section ends.

Transverse bracing on adjacent runs may be considered the longitudinal bracing for the adjacent section.

Spacing of the bracing may need to be reduced for example:

- Brace both sides of conduit or cable trays at flexible connections
- Brace to avoid collision between conduit or cable trays and other non-structural components
- Brace within 600mm of changes in direction, whether it be horizontal or vertical changes
- Brace where components penetrate floors or ceilings
- Brace in both directions at the top of all risers where risers exceed 900mm

The spacing of bracing along a run of conduit or cable tray should not vary greatly in order to ensure uniform deflection and loading.

Each unit of equipment connected to a run of conduit or cable tray shall be individually and independently braced. Thermal expansion and contraction forces, where present, must be considered in the layout of transverse and longitudinal braces. Flexibility should be provided where conduits pass through seismic or expansion joints or connect to equipment with vibration isolators.

Services braced in accordance with AS 1170.1-2007 section 8 shall have a minimum of 50mm clearance from all ceiling hangers and the ceiling grid.

Do not core through, cut through or otherwise damage steel reinforcement in concrete slabs, beams or columns when installing seismic bracing.

3.18 EARTHING SYSTEMS

Earthing system: The following earthing system is to be provided for the supply in accordance with AS 3000.

- Type: MEN system (New)
- Maximum earth resistance: In accordance with AS 3000.
- Electrodes: Copper Clad Stainless Steel - 2.4m length.
- Pits: Proprietary earthing pit (300 mm x 300 mm).

Earth all metallic structure and equipment where this relates to the Electrical Services or Telecommunications installation.

The location of the earth stake shall be identified at the Main Switchboard.

Connections: For the connection of the main earthing conductor and interconnecting bonding use clamps to AS 1882.

Additional earthing and bonding: Provide additional bonding between the earthing system and all piped services within each building, at the closest practical point to where the piped services enter the building. Include all piped services, including Hot Water, Cold Water and the like, where applicable.

Earth all cable supports including by not limited to cable trays, ladders and catenaries.

Telecommunications Earthing: Provide a protective earthing system for the Communications cabling systems in accordance with ACMA regulations. Provide a dedicated 16 mm2 earth cable to each Communications Rack Enclosure, MDF or TPF. The earth cable shall be an uninterrupted link from the nearest Distribution Board. For Communications Racks the earth cable shall be terminated on an earth stud located on a face plate adjacent the enclosure between 900 and 1100 AFFL.

Do not allow the earthing conductor of any rack equipment frame or any earth connection between the communications raised floor and equipment earth. Insulate support equipment brackets to suit.

Showers and Bathrooms: Provide additional bonding to conductive reinforcement within a concrete floors and/or walls forming part of a shower or bathroom construction. The equipotential bonding conductor shall have a cross sectional area not less than 4mm2 and shall be bonded to the nearest adjacent earthing system of the electrical installation.

Provide additional earth stakes where required by the Supply Authority or to achieve the earth resistance stated in AS 3000.

Submains: Provide an earth wire with each group of submains sized to meet the minimum requirements outlined in AS/NZS 3000.

Final subcircuits: Provide a separate earth wire to each final subcircuit. Within each respective switchboard connect each earth wire to an earth bar. Ensure that earth bar numbers correspond with circuit breaker and neutral bar numbers.

3.19 WIRING TO AND CONNECTION OF EQUIPMENT

Equipment status: Unless indicated equipment will be supplied internally wired.

Connection: Wire to the equipment through an isolating switch mounted adjacent, unless a plug top is provided.

Three-phase wiring: Provide a neutral cable equal in size to active conductors with all three phase wiring unless nominated otherwise.

Final connection: Provide all final connections unless advised otherwise.

Within 600mm of wall: Enclose the final connection in flexible PVC conduit, with approved type flexible conduit terminators.

More than 600mm from wall: Wire through conduit cast into or secured to slab. Final connection using flexible PVC conduit with approved terminators.

Flexible conduit type: Use galvanised steel flexible conduit for equipment requiring heavy duty protection or within plant rooms.

4 TESTING AND COMMISSIONING

4.1 TESTING

General: All testing and commissioning shall be undertaken in accordance with regulatory requirements, manufacturers requirements, and the requirements listed below.

Notice: Give sufficient notice so that all Testing may be witnessed by the Building Services Consulting Engineer.

Inspection / Testing Schedule: Provide a comprehensive Inspection and Testing Schedule a minimum of 10 working weeks prior to first inspection/test.

Minimum notice required: Provide 10 working days notice for exact time and date of each test/inspection.

Testing certificates: Provide test certificates and Certificates of Compliance for approval. Include copies within Installation Manuals.

Approval for energising: Obtain approval before energising newly installed or reconnected wiring or equipment.

Faulty installation: During testing, replace fuses and all equipment damaged as a result of incorrect installation work.

Testing and Tagging: Undertake all testing in accordance with AS/NZS 3760 for all electrical equipment and accessories installed under this contract. Provide tags on the flex cable (if fixed) or on the chassis (if flex cable is removable).

Provide a schedule of equipment that has been tested and tagged under this contract in the Installation Manuals, and confirm whether or not the appliance has passed or failed, date of test, and schedule for next test.

4.2 COMMISSIONING

Notice: Give sufficient notice that commissioning of the electrical services is to commence.

Minimum notice required: 5 working days

Phase sequence: Test phase sequence prior to commencement of works and ensure the correct phase sequence is maintained throughout the installation.

Balancing of load: Balance the load as evenly as practicable at Practical Completion. Recheck and, where necessary, rebalance the load at completion of the Defects Liability Period. Arrange all circuits so that balance is obtained at maximum demand as well as normal operating conditions, in accordance with AS/NZS 3000.

Site commissioning: Include the following:

Reticulation, Switchboards and Accessories:-

- Test and provide Certificates of Compliance for the installation in accordance with the requirements of the Electricity Act.
- Insulation resistance measurements.

- Provide full functional and operational checks on energised control equipment and circuits, including adjustments for the correct operation of safety devices.
- Provide full functional and operational checks for all SSOs and RCDs. Log all RCD test results.
- Labelling of all switches and outlets.
- Earth resistance measurement: To AS 3000.
- Earthing: Confirmation of effective earthing of the exposed metal of electrical equipment.

Multi-Function:-

- Check and verify operation, calibration and correct output of all meters. Provide calibration certificate and test results.

Circuit Protection:-

- Confirm that circuit protective devices are sized altered and adjusted, wherever necessary, to protect the installed circuits.

Luminaires:-

- Clean luminaire reflectors, mirrors and diffusers. Replace faulty components including lamps. Check for correct switching and demonstrate.

Exit and Emergency Evacuation Lighting:-

- Discharge test in accordance with AS 2293 and the Building Code of Australia.

MATV:-

- Test the operation of each outlet as specified under the MATV Section of this specification.

Communications Cabling:-

- Provide TCA 1 form compliance for communication system.
- Refer Communications Cabling Section of this specification.

Movement Detection:-

- Test and commission each lighting movement sensor in accordance with the manufacturers requirements to ensure a fully operational system.
- Undertake a walkthrough of each control zone to ensure functionality is as specified.
- Engage the services of the manufacturer as required.

NBN Corporation Cable Pathways:-

- Refer to NBN Corporation technical guidelines and the NBN Corporation section of this specification.

Combined Fire / Access Control System:-

- Test and demonstrate the operation of each door lock, reed switch and card reader.
- Test and demonstrate the operation of each smoke detector, thermal detector and siren.
- Test and demonstrate the interface operation of car park roller door / motion detection with Car Park Supply Fan control panel.

- Programme time groups, schedules and key-tags in accordance with the requirements of the proprietor.

Intercom:-

- Test the operation of each station as specified under the Intercom Section of this specification.

Defects:-

- Rectify all defects upon notification. Provide written notice to the Project Manager of completion of defects. Retention monies will not be released until completion and rectification to the Proprietors approval of all defects.

5 ACCESSORIES & EQUIPMENT

5.1 LIGHT SWITCHES

Rating and Type: 240 V, 15 A. All mechanisms shall be of heavy duty type suitable for inductive loads, of manufacture 'Clipsal 30 USM' (or equal approved). Mount to accessory plates of 'Clipsal C2000' Series (or equal approved) high impact polycarbonate.

Where switches are nominated as weatherproof they shall be of "Clipsal 56" Series manufacture (or equal approved) with locking provisions. Switches shall be UV stabilised where installed in external areas.

Limit light switch and lighting circuit loadings to 75% of sub-circuit capacity maximum, irrespective of circuiting arrangements indicated. Provide interposing relays where the load of any equipment exceeds 75% of the switchgear or circuit protection manufacturer's recommendation.

Mechanism: On face plates secure the mechanism with retaining screws, so that it cannot be displaced during normal operation.

Mounting: Provide all switches and lighting control panels as flush mounting type, generally matching, in flush mounting standard pattern or proprietary wall-boxes. Mount all accessories in flush wall boxes except where mounted on duct or surface mounted to approval. Where switches are located on fire rated, inter-tenancy or acoustic walls they shall be provided with fire rated and acoustic wall boxes to maintain the integrity of the wall. Group switches together on one face plate where possible. Architrave switchplates will not be accepted unless approved. Do not install circuits from differing phases behind a single plate without provision of approved mechanical shrouds or barriers. Switches within disabled areas shall be mounted at a height to the approval of the Architect, but generally all switches are to be mounted between 900 to 1100 AFFL and no closer than 500mm to any internal corners. Leave 10mm free space between adjacent faceplates.

Colour: To architects approval

Location: Check the exact location of each water container, door swings and other services for adequate clearance in compliance with AS/NZS 3000 before locating switches and outlets.

5.2 ISOLATING SWITCHES

Minimum rating: 415V, 20A minimum, or to exceed the connected load. All isolators shall be of heavy duty type suitable for inductive loads. IP Rating shall 56 minimum, fully complying with AS 3000.

Where isolators are nominated as weatherproof they shall be of "Clipsal 56" Series (or equal approved) high impact polycarbonate with locking provisions. Clipsal "Weathershield WHB IP66" Series (or equal approved) is acceptable in general external areas except in plant rooms, roofs or for specialist requirements.

Enclose the isolating switches to suit their operating environment. Label each isolating switch with the item of plant served with Traffolyte labelling.

Carry out all final connections to all equipment fitted with isolating switches.

Mechanisms: Isolating switches are to be provided with a rotating toggle with external locking facilities both in the 'on' and 'off' position.

The mechanism is to be rated in excess of the connected equipment.

Provide upstands and associated flashings as required for isolators. Do not mount isolators directly to equipment.

Colour: To the Consulting Engineers approval.

Location: Check the location of the isolator in respect to the connected plant and locate as close as practicable and within 600 mm.

5.3 SWITCHED SOCKET OUTLETS (SSO)

Rating and Type: 240V, 10A rated. Mount the outlet with the earth pin at the 6 o'clock position. Mount to accessory plates of "Clipsal C2000" series (or equal approved) high impact polycarbonate.

Mounting: Where SSOs are located on fire rated, inter-tenancy or acoustic walls they shall be provided with fire rated and acoustic wall boxes to maintain the integrity of the wall. SSOs shall be typically mounted at 300 AFFL. In areas where occupants may be of limited mobility install the SSOs no closer than 500mm to any internal corner.

Auto switched socket outlets shall not be provided without prior approval from architect and consulting engineer.

Where SSOs are pendant mounted they shall be of approved type suspended by means of a multi strand plastic coated stainless steel strain cable secured to building fabric (not ceiling system). Pendant outlets shall have a ceiling rose that matches the colour of the flex cable.

Where SSO's are nominated as weatherproof they shall be of "Clipsal 56" Series (or equal approved) manufacture. Clipsal "Weathershield IP53" Series (or equal approved) is acceptable in general external areas except in plant rooms, roofs or where IP66 rating is a requirement.

Provide SSO's with LED indicators where indicated.

Provide 15 Amp or 20 Amp SSO's in locations nominated, being equal to other accessories.

Colour: To the Architects approval.

Location: Check the exact location of water containers, inspection points, shower heads, eye wash outlets, door swings and other equipment for compliance with AS 3000 before locating SSO's.

5.4 ACCESS PANELS

Provide access panels of quantities at least as shown on the drawings to provide a fully accessible wiring system. Access panel construction is to match floor outlet enclosure construction as above.

Access panels shall have heavy duty galvanised steel hinged lids. Refer to the architectural drawings for details relating to access panels.

5.5 MOVEMENT SENSORS

Provide ceiling mounted movement sensors equal to "Clipsal 751 or 753", for control of nominated lighting circuits as shown on the drawings accompanying this specification.

All sensors shall have the following minimum requirements:-

- White in colour
- LED status indicators
- Ceiling/soffit surface mounted
- Low temperature/humidity resistant in external and wet areas
- Dual pole to all areas
- PIR detection
- Daylight switching to areas nominated and set to switch lighting off at 600 lux at 0.75m AFFL.
- Default setting at 10 mins (adjustable from 0 – 30 minutes)

The Contractor shall liaise with the manufacturer during installation and commissioning as required ensure the system functions as scoped.

6 CABLES & ENCLOSURE

6.1 CABLE SELECTION

Standards: Select cables in accordance with AS/NZS 3000 and AS/NZS 3008.1.

Ratings: Use AS/NZS 3008.1 for the determination of current ratings, voltage drop and cable size.

Voltage Drop: The maximum voltage drop to each final sub-circuit is not to exceed 2.5% unless specified otherwise.

Conductors: Unless otherwise specified, use multi-stranded copper conductors. Aluminium cabling will not be accepted.

Minimum Sub-Circuit size: 2.5mm2 for power and lighting circuits.

Minimum Sub-Main and Consumers Mains size: As shown on the drawings accompanying this specification. In any case, they shall be sized to the maximum circuit protection device rating on the circuit, and shall not be sized any less to those shown on the drawings.

Sub-Circuit cable types: Unless otherwise specified use cabling with V-90 (PVC) insulation and PVC sheath, or R-HF-110 (Elastomer) insulation and HFS-110-TP (Elastomer) sheath for fire and life safety services.

Sub-Main/Consumers Mains cable types: Unless otherwise specified use X-90 (XLPE) insulation and PVC sheath, or R-HF-110 (Elastomer) insulation and HFS-110-TP (Elastomer) sheath for fire and life safety services.

Underground cables: Use X-90 (XLPE) insulation and PVC sheath cable in underground enclosures unless specified otherwise.

6.2 CABLE INSTALLATION

Standard: To AS 3000.

Manufacturers' recommendations: Unless otherwise specified, install, terminate and joint cables in accordance with manufacturers' recommendations.

Terminations: Terminate each circular multicore cable, and each single core TPS cable of greater cross section than 35mm2, using a nonferrous gland at each end of each cable. Provide non-ferrous gland plates for all single core cables.

Handling cables: Handle cables so as to avoid damage to insulation and serving or sheathing. Report all damage and replace or repair damaged cable as directed.

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables for their entire route length without intermediate straight-through joints. Locate and carry out approved joints as directed. Cable joints and junctions shall not be accepted unless approved by the Engineer prior to installation.

Installation: Install and adequately support fixed wiring as specified throughout the installation. For cabling routes not specified in detail, submit a proposed route layout and gain approval prior to ordering cables or support equipment. All multi-phase circuits with single

conductors shall be installed in trefoil configuration, strictly in accordance with the requirements of AS 3008.

Should cabling require to be painted for concealment, the cabling shall be installed within a suitably sized conduit, with only the conduit painted in the desired colour. Under no circumstances shall cabling be painted.

Conductors:

Identification: For fixed wiring colour the conductor insulation as follows:-

- Active conductors in single phase circuits: RED.
- Active conductors in polyphase circuits:
  - A PHASE - RED
  - B PHASE - WHITE
  - C PHASE - BLUE
- Neutral conductors - BLACK
- Earth conductors - GREEN with YELLOW stripe
- Switched active conductors to and between fittings: WHITE
- Other conductors: To AS 3000.
- Sheathing: White for single phase and orange for 3-phase.

Tagging: Identify multicore cables and trefoil groups at each end and at crowded intermediate points by means of stamped, non-ferrous tags, clipped around each cable, or trefoil group. Tagging shall identify circuit details, equipment serviced and cable specification.

6.3 DOUBLE INSULATED WIRING

Conceal all cabling, and utilise the loop-in, loop-out system with all joints being effected at outlets only. Obtain approval for the location of any junction boxes and joint cables in an approved manner and in an accessible location.

6.4 COPPER CONDUCTOR TERMINATIONS

Requirement: Unless otherwise approved, terminate copper conductors to equipment, other than small accessory and luminaire terminals, by means of compression-type lugs of the correct size for the conductor, compressed only by the correct tool.

Within switchboards and equipment: Install all conductors within slotted ducts. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Identification ferrules: Where core identification is required, fit to each core durable numbered ferrules permanently engraved with numbers and/or letters to suit the specified connection diagrams.

Spare cores: Terminate and identify any spare cores into spare terminals.

6.5 CONDUITS GENERALLY

Minimum sizes: Metallic and non-metallic conduits: 25mm.

Galvanised water pipe: Medium or heavy tube to AS 1074, 25mm nominal minimum bore.

Fixings: Utilise dual fixing conduit saddles. Single fixing conduit saddles are not acceptable. Maintain fire rating of all wall surfaces.

Do not use explosive-powered or similar fixing equipment unless approved.

To woodwork: Conduit matching saddles and round head plated steel wood screws.

To masonry: Galvanised saddles and round head plated steel screws screwed into approved metallic expansion devices. Wooden plugs, explosive powered fixings and adhesive fastenings are not permitted.

To steelwork: Plated steel metal-thread screws. Drill and tap the steelwork for each saddle.

Support: Unless otherwise specified, fix conduit saddles at a maximum of 1 m intervals in both horizontal and vertical runs. Ensure that installed conduits are fully supported during construction.

Lengths: Up to the commercially obtainable conduit lengths of run, install conduits without joints. Remove all rags, burrs, and sharp edges from each length before completing each conduit joint. Fit moulded plastic screwed bushes to the free ends of metallic conduit runs before installing the conductors.

Inspection fittings: Inspection fittings and the like shall be accessible.

Draw-in boxes: Provide draw-in boxes at suitable intervals not exceeding 30 m in straight runs, and at intervals not exceeding 25 m in other runs including directional changes.

Underground boxes: Fit draw-in boxes installed underground with gasketted covers and seal them against entry of moisture.

6.6 CONCEALED CONDUITS

Route of run: Provide conduits in all concealed in wall chases, embedded in floor slabs and installed in inaccessible locations, direct between points of termination with a minimum number of sets. Do not conceal conduit fittings. Install conduits so as to allow future rewiring of the cabling system.

Location: Locate conduits run in concrete slabs entirely within the structural slab. Do not run conduits in concrete toppings.

Steel conduit: Steel conduit shall be galvanised if run in concrete slabs.

Fixing: Fix conduits directly to the reinforcing where the conduits pass above a single layer of reinforcing, or fix midway between double layers of reinforcing. Route the conduits in slabs so as to avoid crossovers and to keep the number of conduits in any one location to a minimum. Space conduits 75 mm apart in slabs.

Attendance at pours: Ensure that conduits are not displaced, broken, or damaged during concrete pours.

6.7 NON-METALLIC CONDUITS AND FITTINGS

Type: Unless otherwise specified, use heavy duty conduits. Associated fittings shall be of the same material as specified for the conduit.

Joints: Use cemented joints. Adopt the manufacturer's recommended procedure for making joints.

Fittings: Use inspection-type fittings in accessible and exposed locations.

Conduit setting: At site, apply heat to form sets in UPVC conduit. Bends shall be of large radii and, after setting, shall maintain effective diameter and shape. Conduit sets distorted by kinks, wrinkles, flats or heating will be rejected.

Expansion joints: Install flexible couplings where structural expansion joints occur in buildings and in straight runs not embedded in wall chases or floor slabs. Install conduit saddles close to the flexible coupling in a manner which allows free movement for expansion and contraction.

Mechanical damage: In situations where the conduit is exposed to mechanical damage and external to buildings, provide mechanical protection to UPVC conduit for a height of not less than 3 m above ground or platform level.

6.8 FLEXIBLE CONDUIT

Type: Use PVC flexible heavy-duty conduit with protective outer sheath with associated fittings unless otherwise specified.

Use: In addition to its use on expansion joints, fit flexible conduit to equipment and plant subjected to vibration or where necessary for adjustment or ease of maintenance.

Length: The maximum length of a flexible conduit connection shall be 600 mm. Obtain approval for lengths greater than 600mm.

6.9 OTHER WIRING ENCLOSURES

Ducting:

Type: Powder coated Galvanised steel minimum 1.0mm thick with firmly fitting screw fixed cover.

Entries: Round off sharp edges and provide PVC bushes or the like for cable entries into metallic ducting.

Support: Rigidly support the duct in all locations (minimum 300mm intervals).

Surface Mounted PVC Ducting:

Type: White rectangular mini-duct with firmly fitting slide on cover type 'Clipsal' or equivalent. Provide end caps as required and ensure all cabling is completely concealed. Paint ducting to match surrounding surfaces and make good any visible surface penetrations.

Support: Rigidly support using double sided tape and screws with screw intervals no greater than 150mm apart.

6.10 CABLE TRAYS AND LADDERS

Support system: Bends, connectors, trays, ladders, brackets, and other supports necessary to make a complete cable or conduit support system shall be of the same manufacture, sized to adequately support the installed cabling.

General: All cables greater than 50mm2 cross sectional conductor area, shall be supported via cable tray. All cable runs that require greater than 2 catenaries in a single run shall be supported via cable tray.

Steel trays: Perforated pre-galvanised.

Minimum steel thickness:

- Trays up to 150mm wide: 1.0mm
- Trays from 150mm to 300mm wide: 1.2mm
- Trays over 300mm wide: 1.6mm

Folded edge: Minimum height 20 mm, radiused.

Slotting: Normal or reverse with no burrs or sharp edges on the side to which cables are attached.

Construction: Manufacture cable ladder trays and cable ladder from two folded steel or extruded structural grade aluminium side rails with cable support rungs between the two rails spaced at intervals of not more than 300mm (ladder) and 100mm (ladder trays).

Small cable: Do not run cables smaller than 13mm outside diameter on the cable ladder unless continuously supported.

Cable fixing: Slots or ladder rails shall be suitable for fixing cable ties, strapping or saddles. Communications cabling shall be fixed with Velcro cable ties.

Bend radius: Bends shall have a minimum inside radius of not less than twelve times the outside diameter of the largest diameter cable carried. Bends shall be manufactured by the supplier. The contractor shall not modify trays or ladders to provide bends.

Spare capacity: Provide sufficient space on the tray or ladder for not less than 20% more cables or conduits than specified, irrespective of sizes indicated on the drawings. The sizes and quantities nominated on the drawings are indicative, and are to be confirmed by the Electrical Contractor based on final cable quantities, sizes and locations.

Route: Cable tray routes shown on the drawings accompanying this specification are shown indicatively, and are to be confirmed by the Electrical with reference to conditions on site and the Structural Engineers drawings. In any case, cable trays shall be run parallel and perpendicular to the building structure.

Access: Position the support system to give adequate access for inspecting, replacing, or adding cable.

Support: Provide support brackets of the cantilever type (ie. one side of the bracket left open), cold galvanised after fabrication. Mount brackets to manufacturer's recommendations, with no appreciable sag between supports.

Cable strapping: Fix cable to the support system by proprietary nylon ties, straps or saddles, at 500 mm centres for vertical runs and 1000mm centres for horizontal runs. Use nylon ties for smaller cables (up to 15mm diameter single core cables, 25mm multicore cables), non-magnetic saddles or strapping for larger cables. All data cabling shall be fixed to cable trays with Velcro cable ties.

Cable protection: Provide a slightly curved support surface under cables leaving the tray or cable ladder to protect the cable sheath from impingement by the tray or ladder edge.

Clearance: Maintain at least 200 mm clearance from hot water pipes 500 mm clearance from boilers or furnaces, and 100 mm clearance (minimum) from all other services.

Segregation: Segregation from electrical, communications, security etc. cabling shall be maintained in accordance with the relevant standards. Cabling can be reticulated on the same cable trays, provided a fixed partition (barrier) is installed to the cable tray.

Earthing: Earth all cable trays, ladder trays and ladders in accordance with the requirements of AS/NZS 3000 and ACMA technical standards.

6.11 CATENARIES

Construction: Provide commercial manufactured catenaries as follows:-

Properly rated for the weight of the cabling to be installed.

Provide uniform support throughout cable length.

Be fixed at each end.

Capable of withstanding any mechanical stresses within the environment installed.

Consist of material equally resistant to corrosion and deterioration.

2.7mm minimum diameter.

1.5kN minimum break force.

Zinc coated.

Cables themselves shall not be used as catenaries.

Installation: Install catenaries as follows:-

Provide no more than 3 groups of 5 bundles cables to each catenary.

Provide hangers at 1000mm intervals.

Shall be supported off the Building structure, and not off other plant and/or equipment.

Installed so as to run parallel and/or perpendicular to building structure.

Cable fixing: Nylon cables ties shall be provided for fixing electric cabling, and Velcro cable ties shall be provided for communications cabling at 500mm intervals.

Clearance: Locate cabling 100mm from moving parts of any equipment operating at elevated temperature.

Earthing: Earth all catenaries in accordance with the requirements of AS/NZS 3000 and ACMA technical standards.

6.12 FIRE RATED CABLING AND SUPPORTS

Standard: To AS 3000 and AS/NZS 3013.

General: Provide supports for fire rated cabling as follows:-

Comply with the requirements outlined in AS/NZS 3000 Appendix A and Appendix H.

Shall be certified and tested in accordance with AS/NZS 3013.

Cables shall be installed in accordance with the requirements outlined in AS/NZS 3013 in order to ensure a fully certified cable support system is provided.

Cables shall be fixed at maximum 1200mm centres using certified steel clips. Nylon cable ties will not be accepted.

Arrange in single layer or trefoil groups for side entry or exit. Protect cables from damage at entries.

Avoid unnecessary cable crossovers and maintain minimum 30% spare support width.

7 SWITCHGEAR & CONTROLGEAR ASSEMBLIES (SCA)

7.1 SCOPE

Outline description: The work covered by this section of the specification includes the following:

Provision of new main switch board, distribution boards, load centres and auxiliary panels throughout the installation including enclosures and internal switching and control equipment.

7.2 DESIGN CRITERIA

Design SCA to comply with the following minimum criteria:-

Main Switch Board

Designation(s)	–	MSB
Maximum Dimensions	–	1600mm Wide x 400 mm Deep x 2100 mm High
Rating	–	200 Amps, 3 phase, 415 Volts
Degree of Protection	–	IP56 Non-combustible material in accordance with BCA requirements
Installation	–	Outdoor, Free-standing
Fault Rating	–	19kA for 1 second
Form Factor	–	Form 3 BIH
Chassis Size	–	As shown
Connection	–	Front connected
Incoming Cable Entry	–	Below via gland plate
Incoming Cable Reticulation	–	Underground Constructed to AS/NZS 3013 WS Classification – WS- 33
Outgoing Cable Exit	–	Above via gland plates
Outgoing Cable Reticulation	–	Underground via conduit.
Plinth	–	Painted galvanised 75mm steel channel
Accessories	–	Exit/Emergency Lighting push-button test facility
Paint Colour	–	To approval of Architect
Rating/ Nameplates	–	To front door of Main Switchboard(s)
Doors	–	Required, ensure 600mm clearance around door swing in accordance with AS3000 requirements, provide barn door arrangement as required.

Typical Apartment Load Centre(s)

Designation(s)	–	LC.XX
Maximum Dimensions	–	to suit available accommodation
Make	–	Clipsal '4FC' series or equal approved.
Rating	–	To match upstream circuit breaker unit rating and/or isolator (whichever the greater)
Degree of Protection	–	IP33 internally
Installation	–	Recessed with flushing frame. Provide 3mm thick steel plate behind enclosure.
Fault Rating	–	6 kA RMS Symmetrical (conditional)
Form of Segregation	–	Form 1
Connection	–	Front connected
Chassis Size	–	Sized to accommodate all circuits shown plus 30% spare space
Cable Entry / Exit	–	Above and below
Cable Reticulation	–	Cabling shall be reticulated within wall cavity with suitable mechanical protection. Constructed to AS/NZS 3013 WS Classification – WS-10
Colour	–	White
Doors	–	Required

7.3 EXTERNAL DESIGN

REQUIREMENT: Provide an enclosure comprising panels, doors and the like, giving the specified enclosure, segregation and degree of protection as specified.

- Design and Construction: To AS/NZS 3439.
- Degree of Protection: To AS/NZS 1939 & AS/NZS 60529

Supporting Structure: Fabricate supporting frames from rolled, cold formed or extruded metal sections, with joints fully welded and ground smooth. Provide concealed fixing or brackets located to allow the assembly to be mounted and fixed in the specified location without removal of equipment.

Panels: Machine fold sheet metal angles, corners and edges with a minimum return of 25mm around the edges of front and rear panels, and 13mm minimum return edge around doors. Provide stiffening to panels and doors where necessary to prevent distortion or drumming.

Equipment Fixing: Provide equipment mounting panels fixed to threaded metal inserts located inside the enclosure at the rear of the mounting panels.

Lifting Provisions: Provide fixings in the supporting structure, and removable attachments, for lifting switchboard assemblies where floor-mounted. Provide switchboards in sections as required to enable installation in their final location.

Floor-Mounting: Provide a galvanised steel plinth channel, not less than 75mm high, for mounting the complete switchboard assembly on site. Drill sufficient clearance holes for 12mm diameter bolts, in the switchboard and the plinth, to rigidly fix the switchboard assembly to the plinth and the plinth to the floor.

Wall-Mounting: For flush or semi-flush switchboards: Provide a facing flange, of the same material and finish as the enclosure, and of a section which incorporates a return allowing the outside edge to fit neatly against the wall. For switchboards located on external walls, provide angled top to prevent water from pooling.

Minimum flange width: 32mm

Cable Entries

Provide sufficient clear space within each enclosure, adjacent to the cable entries, to allow the incoming cables and wiring to be neatly run and terminated, without overcrowding.

For cable entry and internal distribution, provide cable entries of not less than 100mm depth by the full width of cubicle space which is unrestricted by equipment or internal wiring.

Provide to each entry a removable gland plate fitted with a gasket to maintain the specified degree of protection.

Cable bushes for all entering and exiting cables (bunches of cables) to provide a close fit around cabling in accordance with the requirements of AS/NZS 3000. Seal cable entries to provide a close fit in all instances and to maintain the switchboard protection rating.

Doors

Maximum Width: To suit accommodation or as specified

Maintain 600mm clearance around distribution boards with equipment racked out and doors open. Provide barn door arrangement and/or bi-folding doors to enclosures as required to achieve this requirement. Alternative door construction shall not compromise the fit and finish or degree of protection of the switchboard.

Minimum Door Swing: Through 135° minimum or 180° where located in corridors.

Hang doors on heavy-duty chromium-plated block hinges which allow easy removal of the door when in the open position.

Ensure all doors operate smoothly and without sticking or creaking and close/latch with nominal clearances.

Provide a chromium plated lever-type handle to each door, operating a latching system with latching bar and guides. Key to 604 code.

Provide roller rods to all boards incorporating a 3-point locking system.

Number of keys required: 3 with engraved identification labels

Smoke Seals: Provide a resilient strip seal, of foamed neoprene or the like, around each door, housed in a suitable channel or housing and fixed with an approved industrial adhesive.

Seal contact: Positive contact with a flat surface of the enclosure at least as wide as the seal strip.

Provide door stiffeners to each door with diagonal length greater than 900mm.

Escutcheon Plates

Requirement: Provide hinged removable escutcheon plates with the front of the circuit breakers protruding through neat cutouts. Provide cutouts for all spare space allowances. Fit insulated clip-in infill panels to each spare pole space. This escutcheon plate shall provide a flush surface between the edges of the distribution board case. Fit chromium plated lifting handles to each escutcheon plate.

Rigidity: The escutcheon panel shall be not less than 1.6mm thick and must be rigid. Stiffen or brace the panel as necessary to achieve this rigidity.

Frame: Provide a continuous 12 mm wide support frame for the fixing of each escutcheon plate, including additional support where necessary to prevent panel distortion.

Fixing: Fix each plate to the frame with metal fixings held captive in the plate and spaced uniformly.

Maximum Height: To suit accommodation or as specified.

Hanging: Hang escutcheon plates on hinges which allow opening through a minimum of 120° and permit the removal of the escutcheon when in the open position.

Cable Duct

Requirement: Provide internal cable ducting sufficient to house cables for maximum board capacity without restricting closure to duct cover.

Minimum size: Cable duct to be a minimum of 70mm wide for all boards and minimum of 100mm for boards with a total capacity greater than 60 poles.

7.4 BUSBARS

Requirement: Provide a three (3) phase busbar assembly with high conductivity electro tinned copper busbars designed for a maximum current density of 1.5 A/sq.mm from the termination of the incoming unit to the line side of the protective equipment for outgoing circuits.

Provide each distribution switchboard segment with a busbar assembly suitable for a minimum 100A take-off at any point.

Future Extensions: Pre-drill the main busbar assembly for future extension and extend busbar droppers to spare locations. Drill each dropper to suit connection of future equipment of the same type as that specified.

Cross Section: Radius edges and corners to prevent damage to insulation.

Support: Provide support sufficient to withstand without damage the maximum prospective fault currents. Do not support busbars from circuit breaker terminals.

Jointing: Make busbar joints with high tensile bolts and nuts, locked in position with lock nuts or locking tabs. Tighten bolts to the manufacturer's recommendation with a tension wrench. Do not use tapped holes and studs or the like for jointing current-carrying sections.

Insulation: Insulate busbars as follows:

Active and neutral busbars: Fully insulate the busbars with suitable plastic insulation of appropriate colours to designate phases. Busbar assemblies shall be red, white, blue phases from left to right when viewed from the front of the switchboard. Maintain phase colours (and rotation) throughout the installation.

Joints: Insulate either by taping or plastic coating, as follows:

Taped joints: Apply a non-adhesive stop-off type tape, coloured to match the specified colour coding, half lapped to achieve a thickness of not less than that of the solid insulation.

Plastic-coated joints: Apply, in accordance with the manufacturer's recommendations, and to a minimum thickness equal to that of the solid insulation, an air-drying plastic coating material which achieves a tensile strength in excess of 17MPa, and a minimum elongation of 300%.

Colour Coding: Colour the insulation as follows:

Active busbars: Red, white or blue.

Neutral busbars: Black where applicable.

Earth busbar: Green and yellow where applicable.

Neutral Busbar: Extend the neutral busbar into each switchboard compartment containing outgoing circuits with neutral connections. Provide terminals or drill the busbar for neutral connections.

Identification: Clearly mark and number terminal connections.

7.5 NEUTRAL AND EARTH LINKS

Location: Locate neutral and earth links within 600mm of each cable entry unless written approval of greater spacing is obtained.

Connections: Provide stud connections for cables of cross section 16mm2 or larger.

Identification: Clearly mark and number terminals. Numbers on circuit breakers, neutral link and earth link for each circuit shall correspond.

Terminals: Provide a separate dual screw neutral terminal and earth terminal for each circuit breaker pole or fuse on each switchboard section. Provide additional terminals for future circuits.

Clearances: Provide 100mm (minimum) wiring channel between neutral and earth links and switchboard sheetmetal enclosure. Provide adequate clearance or insulating barrier between links and all live conductors.

7.6 FINISHES

Surface Preparation: Where metal surfaces are to be painted, prepare them appropriately to avoid corrosion, and to withstand the relevant environmental conditions.

Paint Systems: For indoor locations use system not inferior to FULL GLOSS, SOLVENT-BORNE: INTERIOR - PAINTING. Colours are to be provided to AS 2700, to the approval of the Architect.

PAINT COLOURS: To AS 2700, to be approved.

7.7 SWITCHGEAR

Requirement: Provide mains switching, outgoing circuit switching, motor and equipment controls and starters, protection, setting and auxiliary equipment as shown on the Drawings.

7.7.1 MOULDED CASE CIRCUIT BREAKERS (MCCBS)

General

Moulded Case Circuit Breakers shall comply with AS3947-2 and IEC947-2. The breaking capacity performance certificates shall be available for category B to the above mentioned standard where applicable. The test shall be carried out under the breaking performance during operation (Ics) and under the admissible short time withstand.

The ultimate breaking capacity of the circuit breakers shall be at least equal to the prospective fault level at the point of the distribution system where the breakers are installed, unless the limitation capacity of an upstream breaker allows cascading.

The rated service breaking capacity (Ics) shall be a minimum of 50% of the ultimate breaking capacity (Icu). The rated withstand of the breaker shall be equal to the rated service capacity.

For MCCBs up to 630Amps, the service breaking capacity (Ics) shall be 100% of the ultimate breaking capacity (Icu).

All Moulded Case Circuit Breakers shall be designed for horizontal or vertical mounting without any adverse effect on electrical performance.

It shall be possible to reverse feed the breaker without reduction performance.

Moulded Case Circuit Breakers shall be fixed, plug-in or withdrawable models and in 3 pole or 4 pole versions as nominated.

The breakers shall have a rated operational voltage of 690V AC (50/60Hz) and rated insulation voltage of the circuit breakers shall be 750V AC (50/60Hz).

The Moulded Case Circuit Breakers shall provide Class II insulation (to IEC 664) between the front and internal power circuits.

Setting

All adjustable circuit breakers are to be set at the values shown on the drawings accompanying this specification. The Electrical contractor is responsible for setting of MCCB on site to specified values as shown on the accompanying drawings.

Cascading and Discrimination

All protection devices shall be selected to enhance discrimination and avoid cascading between upstream and downstream devices. It shall be arranged so that only the protection device immediately upstream of the fault shall operate to clear the fault.

Construction

Operating mechanism shall be of the quick make, quick break type, with the speed of operation independent of the operator, and mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short circuit and overload conditions. The operating mechanism shall be constructed to operate all poles in a multi pole breaker simultaneously during opening, closing and tripped conditions.

The breakers shall be operated by a toggle or handle which shall clearly indicate the three fundamental positions ON, OFF and TRIPPED.

If required, rotary handles shall be fitted to the breaker.

Moulded Case Circuit Breakers shall be available in normal, high and limiting ranges.

Moulded Case Circuit Breakers of the same range shall have a common depth.

The standard operating mechanism shall provide positive break indication ie: -

- The operating mechanism shall be designed such that the toggle or handle can only be in OFF position if the power contacts are all actually separated.
- Isolation shall be provided by a double break on the main circuit.

The breakers shall provide double insulation from the front face allowing field installable auxiliaries without isolating the unit.

It shall be possible to lock the circuit breaker in the "isolated" position only with the use of a locking device and padlocks.

Protection units

All MCCBs shall be fitted with RMS sensing electronic trip units.

The trip units of MCCBs shall be easily interchanged with standard tools.

All electronic components shall withstand temperatures up to 125oC.

All settings on trip units shall have provision for sealing. Where circuit breakers as nominated to be sealed, the adjustable controls shall be concealed behind an escutcheon sealed with authority tags or otherwise.

Universal electronic trip units shall provide:

- Long time protection with adjustable time delay
- Short time protection with adjustable time delay
- Instantaneous protection
- All with adjustable thresholds

All universal trip units will incorporate a load monitoring function.

It shall be possible to install the following options without increasing the circuit breaker volume:

- high threshold earth-fault protection
- load monitoring with adjustable threshold
- LEDs to indicate the cause of tripping
- data transmission via a BUS

Characteristics

The solid state protection unit shall have as required: -

- Long time protection adjustable from 0.4 to 1 times sensor rating (In).
- Short time protection adjustable from 3 to 6 times the setting made on the long time protection: time delay (when required) adjustable for discrimination with downstream MCCBs.
- Instantaneous threshold set at 35kA.
- Earth fault protection (when required) adjustable from 0.2 to 0.5 times the long time protection setting; adjustable time delay from instantaneous to 0.3s.

The circuit breaker shall provide positive break indication.

When required, motor operated mechanism with or without fault lockout, shunt trip, undervoltage release, auxiliary switches (up to four changeover contacts) and a tripped signal contact shall be provided. Each of these units shall incorporate a pre-wired terminal strip which is accessible from the front of the breaker without removing the cover.

Operation

All circuit breakers shall be provided with the facility for padlocking or keylocking in the open position.

It shall be capable of being used in conjunction with a visible break isolation switch to become one integral unit.

Electronic Trip MCCBs shall be possible to field test the trip units utilizing a secondary injection test kit.

Circuit breakers shall have clearly accessible from the front face:

- Markings of rating
- Marked as suitable for isolation
- "Push to trip" test button to test operation of poles.
- Contact position indication

Auxiliaries and Accessories

All accessories and electrical auxiliaries shall be manufactured in such a way that they can be easily field fitted without adjustment.

The breakers will have a double insulation of the front face allowing field installable auxiliaries without isolating the unit.

All electrical auxiliaries shall be equipped with built-in control terminals. All internal electrical auxiliaries shall be of snap-in type.

It shall be possible to fit the Moulded Case Circuit Breaker with a motor mechanism without affecting the circuit breaker characteristics.

All electrical auxiliaries shall be separated from power circuits and their addition shall not increase the volume of the circuit breaker.

It shall be possible to retrofit a residual current device (RCD) directly to the existing circuit breaker enclosure.

It shall be possible to equip the circuit breakers with devices indicating faults without tripping the circuit breaker.

Miniature Circuit Breakers

Standards: To AS 2184 for fault capacities of 10 kA or more. To AS/NZS 3111 for miniature overcurrent circuit breakers up to 1000 A current rating and less than 10 kA fault capacity.

Type: Provide circuit breakers which are true DIN rail mounted of "Merlin Gerin" manufacture (or equal approved).

Provide non-standard curve type circuit breakers for all mechanical or refrigerative plant. Alternatively increase the size of circuit breakers and sub-circuit cabling to allow starting currents in accordance with AS/NZS 3000. Provide combined MACB/RCD circuit breakers where nominated, having a tripping current imbalance of 30mA within 300ms complying with AS/NZS 3190. MACB/RCD circuit breakers shall utilise a single pole space (alternatively increase pole spaces within distribution boards to suit).

7.7.2 CONTROL, TEST SWITCHES AND EQUIPMENT - SCA

Standard: To AS 60947

Rated operational current: Not less than 6 A at 240 V a.c. at utilisation category AC-11.

Degree of protection: Not less than the degree of protection specified for the switchboard.

7.7.3 CONTACTORS

Standard: To AS 60947

Type: Block type, air break, DIN rail mounted and labelled.

Rated operational current: Not less than the full load current of the load controlled.

Rated duty: Uninterrupted (continuous).

Minimum size: 20 A at 415 V a.c.

Utilisation category: Not less than AC-3 or DC-3 as applicable.

Mounting: Mount the contactor with sufficient clearance to other equipment and to its enclosure to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Interconnection: Do not connect contactors in series or parallel to achieve the specified ratings.

7.7.4 FUSES WITH ENCLOSED FUSE LINKS

Standard: To AS 6029

Manufacture: Provide fuse-holders and fuse-links or equal to GEC Red Spot manufacture.

Fuse-holder: Mount the fuse-holders so that the fuse carrier may be withdrawn directly towards the operator and away from live parts, and provide fixed insulation which shrouds all live metal when the fuse carrier is withdrawn.

Fuse-links: Enclosed, high rupturing capacity (HRC) type mounted in a fuse carrier. Provide a 'fuse blown' indication which is visible when the link is fitted to its carrier. Where necessary for safe removal and insertion of the fuse carrier, provide extraction handles and mount them on clips within the spares cabinet.

Spares: Provide a minimum of 3 spare fuse-links for each size of fuse-link on each switchboard. Mount the spares on clips within the relevant switchboard.

7.8 ACCESSORIES, INSTRUMENTS, METERS

Electricity Metering Equipment

Standards: To AS 62053.22

Test links: Provide test links for the connection of calibration instruments and meters and for the shorting of current transformer secondaries. Energy meters, maximum demand meters and ammeters, where specified, shall each be provided with a set of links comprising screw-clamped slide links and an earth link.

Current transformers

Standards: AS 60044.1

Accuracy classification and class: To be provided as follows:

- Energy measurements: 0.5M.
- Indicating and recording instruments: 2M.
- With 5A Secondary.

Rated short-time current: Not less than the short-time current equivalent of the potential fault capacity of the circuit in which the current transformer is installed.

8 LUMINAIRES

8.1 SCOPE

Outline description: The work covered by this section includes the following:

Provision of luminaires satisfying all statutory, legislative and code requirements and conforming to the general details indicated herein.

The planning, scheduling and procurement of luminaire components and construction of luminaires to meet the agreed programme.

Full responsibility for packaging, delivery, and unloading on site, storage, maintenance, service and warranty; and all other items whether mentioned in detail or not to complete the luminaires supply and warranty in accordance with this specification.

8.2 PACKAGING

Pack luminaires and components in robust and sealed packages suitable for withstanding conditions between dispatch and installation. Store luminaires within original packaging until installation. Take all steps as necessary for the adequate protection of luminaires.

8.3 TESTING

Standard: To AS/NZS 4847, AS/NZS 4934, AS/NZS 60598.1, AS/NZS CISPR Set

Certification: All luminaire manufacturers shall be members and/or endorsed by the Lighting Council of Australia, and shall be tested at a NATA approved laboratory.

All test results shall be available on request for approval.

8.4 PERFORMANCE STANDARDS

Thermal characteristics: To AS/NZS 60598.1

Glare control: To AS/NZS 1680

8.5 PHOTOMETRIC DATA

Standard: To AS 1680.3

Requirement: Where requested, provide and obtain approval, full photometric data before delivering a standard product, or commencing to manufacture a non-standard product.

8.6 LAMP PERFORMANCE

Requirement: Ensure starter switches and igniters (where applicable), control gear and lampholders are suitable for use with the lamps supplied and when installed in the luminaire body to be supplied will allow the lamps to achieve the performance given in the lamp manufacturer's published data sheets when operating on the power supply provided for the project.

8.7 GENERAL CONSTRUCTION

Stiffness: The materials, body shape, and method of manufacture shall result in a luminaire of adequate stiffness to prevent warping or sagging when installed in position.

Body shape: Rectangular and square luminaires shall have straight parallel edges and square corners.

Surface mounting: For fixing of surface-mounted luminaires to ceilings or walls provide symmetrically placed fixing holes as follows:

- In square and rectangular luminaires: Not less than four holes.
- In circular luminaires: Not less than three holes.

Recessed mounting in suspended ceilings: To AS 2946.

Provide all recessed luminaires with 1.5m 3-core flex and plug type connection.

Ceiling trim: Where ceiling trim is specified attach it to the luminaires with concealed fixings.

Degree of Protection: Construct each luminaire to provide the protection appropriate to its final installed location.

Condensation: Where required provide a facility for draining condensation.

Metal bodies: Preparation: (Except for aluminium bodies which have been etched and anodised): Degrease to AS 1627 Part 1.

Finish: An approved factory applied finish.

Minimum paint thickness: 0.025 mm for each surface and edge.

Diffusers and Visors

Provide diffusers and visors manufactured from UV stabilised acrylic, polycarbonate or other approved material which achieves the specified glare control.

Position: Locate diffusers and visors so that the diffuser or visor temperature does not exceed 75°C.

Colour matching: Colour match diffusers and exposed metal painted surfaces of the same type.

8.8 WIRING

Standard: To AS/NZS 60598.1

Fluorescent and LED luminaires:

Cable: V105 250 V PVC insulated cable copper conductor, minimum size 24/0.2 mm (stranded), or 1/0.80 mm (solid).

Loom wiring: Neatly loom the wiring and install clear of ballasts. Fix the looms with soft metal, polythene or similar approved clips fastened to the luminaire body.

Internal Termination: Wiring within the fixture shall be terminated on suitable rated terminal blocks.

External Termination: Provide external terminations as follows:-

- Luminaire installed within a suspended ceiling – flex and plug terminations are considered suitable
- Luminaire installed in exposed ceiling areas, and external areas – provide a junction box mounted on the top or side or within the luminaire body. Mount a fixed terminal block inside the junction box. Flex and plug connections will not be accepted.

Terminal blocks: Fix each terminal block to the body adjacent to the cable entry. Unless otherwise specified, provide suitably sized terminal blocks to accommodate the required cabling, equal to rapid earth terminal blocks.

Earthing: Provide an earthing connection point comprising an earth bolt or screw of not less than 5 mm diameter x 12 mm length located adjacent to the terminal block with solderless connection lug. Fix the bolt or screw to the luminaire metallic body or junction box by welding or double lock-nuts on to serrated washers.

8.9 ACCESSORIES AND CONTROL GEAR

Electronic Ballasts

Requirement: Electronic controlgear shall be provided for all luminaires and shall be equal to "Tridonic Atco, Philips or Osram" manufacture and include the following features as a minimum:

Constant Light Output

- Output to be independent of fluctuating supply voltage
- Smart heating (fluorescent and HID luminaires)
- Cathode heating reduction after pre-heat time
- Defined lamp warm start within 0.5s (fluorescent) and 15s (HID)

Voltage Guard

- Overvoltage indication starting at input voltage 267-306 V AC
- Overvoltage protection 320 V AC, 1 h
- Undervoltage protection (shutdown) below 150 V AC/176 V DC
- AC voltage range 220-240 V
- DC voltage range 175-280 V

Other Features

- Power factor > 0.97
- Operating frequency ≥ 40 kHz
- Operating frequency ≥ 140Hz for discharge luminaires.
- Earth leakage current ≤ 0.5mA.
- Suitable for automatic and manual wiring with insulation displacement connector (IDC)

- Wide operating temperature range from -25°C to +50°C
- Service life of 50,000 hrs under reference conditions with failure probability of less than 0.2% for every 1000 hrs of operation
- Safe switch off of defective lamps
- Automatic re-start after lamp change
- For luminaries with or an in accordance with EN 60598
- Suitable for luminaries with protection class SK I and SK II
- Ingress protection IP 20
- Thermal protection according to AS/NZS 61347.1
- EMC compliance according AS/NZS CISPR Set
- Integral 2 Amp fuse.

Ballasts shall have ENEC and CE identification and certified to:

- EN 55015
- EN 55022
- EN 61347
- EN 60925
- EN 60929

Ballasts must meet harmonic requirements outlined in AS/NZS 61000.3.2.

Energy class CELMA A-2 Energy Efficiency Index (EEI) and A-1 for dimmable.

Ballasts shall be thermally protected and in compliance with IEC specifications 928 and 929 for safety and performance.

Mounting of Accessories

Location: Positively locate accessories, including ballasts, capacitors, connection blocks, lampholders and the like.

Fixings: Fix accessories to the luminaire body (or to separate enclosures where applicable) with plated metal-thread screws and nuts. Screws shall remain fixed in position when accessories and fixing nuts are removed.

Bayonet cap and Edison screw accessories: Lampholder and socket mountings: Fix lampholder to prevent rotation.

Fluorescent accessories

Lampholder mountings: Mount each lampholder on a rigid bracket, to the dimensions and tolerances specified in AS 1201.2. Space lampholders laterally at not less than 70 mm centres.

Starter switch mounting: Unless otherwise specified, mount each starter switch so that it is not less than 20 mm from other components in the gear tray, and is accessible without removing the gear tray cover.

Ballasts: Position ballasts to obtain maximum heat dissipation. Unless secured to the luminaire chassis, ballasts shall be supported via hangers or catenaries within the ceiling space. Ballasts shall not rest on the ceiling.

Spacing: Where two or more ballasts are installed in the one location provide separation between ballasts to allow adequate ventilation in accordance with manufacturers recommendations. Maintain 50mm spacing from capacitors.

8.10 LAMPS

Requirement: Supply luminaires complete with lamps.

Single manufacturer: Lamps of the one type shall be of the same manufacture.

Lamp identification: Provide a legible label in each luminaire, fixed in a position convenient for reading at the luminaire installed position, which clearly identifies the lamp type to be installed in the luminaire.

Linear Fluorescent Lamps

Standard: AS/NZS 4782 and AS/NZS 4783.

Requirement: Provide lamps with low resistance cathodes and standard bi-pin caps.

Lamp data: Provide fluorescent lamps of identical manufacture equal to "Philips TLD 840 New Generation" complying with the following, unless specifically indicated otherwise:-

- Colour Rendering Index (Ra) - Greater than 85
- Colour Temperature - 3000 K

Provide compact fluorescent lamps complying with the requirements above. (Colour temperature to approval).

LED Lamps

Standard: IEC 62031 Ed 1.0

Lamp: Provide LED lamps of CREE, Philips, Osram, Luxeon, Rebel or Bridgelux manufacture, complying with the following, unless specifically indicated otherwise:-

- Colour Rendering Index (Ra) - Greater than 85
- Colour Temperature - 3000 K

Certification: Only LED lamps that have been tested in accordance with IESNA LM-70, IESNA TM-21 and IEC 62031 shall be accepted.

8.11 RECESSED LUMINAIRES – WARNING SIGNS

Standard: AS/NZ 3000

Requirement: Provide warning signage where recessed downlights are installed within an accessible roof space.

'WARNING: recessed lights have been installed in this roof space. To reduce the risk of fire DO NOT COVER the light fittings with thermal insulation or any other material unless in accordance with instructions provided by the lighting manufacturer,'

8.12 EMERGENCY LIGHTING

Standard: AS/NZS 2293 and Building Code of Australia (BCA)

Outline description: The work covered by this section of the specification:-

The installation of an emergency and evacuation lighting and exit sign system that satisfies all statutory, legislative and code requirements and conforms to the general details indicated herein.

The provision of discharge testing facilities for all emergency and exit luminaries in accordance with AS/NZS 2293 at local area distribution boards classified by the distribution board zoning of the Building.

Emergency and exit lighting shall generally be installed in accordance with AS/NZS 2293 and as shown on the accompanying drawings. However, when installed above doorways exit fittings shall be installed directly above on the transom.

The planning, scheduling and procurement of components, installation to meet the programme, coordination and liaison with other trade packages.

Full responsibility for the execution of the complete installation in accordance with the specification and drawings.

Installation, testing, commissioning, maintenance, service and warranty all building act tests up to the end of the defects liability period; and all other items whether mentioned in detail or not to complete the installation and put it into working order in accordance with this specification.

TESTING

Manufacturers' tests:

Classification testing: To AS/NZS 2293.3 Appendix C.

Type testing: To AS/NZS 2293.3 Appendix D.

Certification: For each size and type of emergency lighting luminaire and exit sign supply copies of a certificate of tests stating the testing authority, manufacturer and details of parameters and results for each test.

Number of copies: Insert one copy of each certificate in each copy of "Operating and Maintenance Manual"

LABELLING

Requirement: To AS 2293.1.

For each distribution board device that will cause emergency or exit lighting to discharge provide the following label: -

'WARNING: INTRERRUPTING SUPPLY WILL DISCHARGE EMERGENCY LIGHTING BATTERIES'

The label shall be fixed securely immediately adjacent the device which will operate the discharge facility. Note adhesive labelling will not be accepted.

Provide labelling adjacent each individual circuit that supplies exit and emergency lighting.

MAINTENANCE RECORDS - EMERGENCY LIGHTING

Requirement: To AS 2293.2 and the Building Code of Australia.

Log book: A4 size, printed or typed on durable printing paper and neatly bound in durable vinyl or similar covers, coloured distinctly different from the colour of the operating and maintenance manual covers. Include the log book within the Maintenance and Testing of Safety Equipment Manuals.

SINGLE-POINT SYSTEMS

Battery: Indelibly stamp each battery with its date of manufacture. Provide the manufacturer's warranty on the battery life with the luminaire operating under normal conditions at an ambient temperature of 25oC. Batteries shall be of the high temperature Nickel-Metal Hydride (NiMH) type.

Battery charger: Two-rate, constant current, constant voltage, temperature compensated type with automatically selected boost and float charging rates.

Local Testing facilities: Provide a local test switch on each luminaire. Provide self-testing facilities for each luminaire.

Distribution Board Testing facilities: Provide test facility within each local distribution board that supplies exit and emergency lighting circuits. The test facility shall be constructed as described on the drawings accompanying this specification.

Inverter system: Protect the inverter system against damage whilst in operation in the event of failure, removal or replacement of a lamp.

Installation: To AS 2293.1 Section 2.

Circuiting: Unless shown otherwise all exit and emergency lighting shall be circuited from the un-switched active of the nearest adjacent general lighting circuit. Where essential circuits are available, circuit from the nearest essential general lighting circuit.

8.13 SCHEDULE OF LUMINAIRES

The schedule defining the type of luminaires with designations can be found on the drawings accompanying the specification.

Each luminaire has been selected in accordance with the following criteria:-

- Compliance with relevant Australian and International Standards.
- Energy efficiency with respect to ongoing energy consumption.
- Appearance based on the requirements outlined by the End User and/or Architect.

- Known reliability of the proposed luminaire with respect to longevity, ongoing maintenance and the intended use.
- Relevant trade price of the luminaire.
- Quality of the fixture, including componentry.
- Recognition by the Lighting Council of Australia. Only manufacturers who are members or are endorsed by the Lighting Council of Australia will be accepted.
- Testing undertaken by NATA (National Association of Testing Authorities).
- Testing undertaken in accordance with relevant Australian Standards.
- Photometric data provided for computer lighting simulations.

Where alternative luminaires, lamps, controlgear and the like have been proposed by the Contractor, evidence shall be provided to ensure they are fully compliant with the above requirements. The Contractor shall then engage the services of Lucid Consulting Engineers on an hourly rate basis to undertake all necessary photometric calculations required to ensure the proposed alternatives will provide sufficient light levels within the nominated areas. On submission of the tender offer the Contractor acknowledges by default their acceptance of this requirement.

9 NATIONAL BROADBAND NETWORK (NBN) CORPORATION CABLING SYSTEMS

9.1 SCOPE

Outline Description: The work covered by this section includes the following:

- Access provisions for NBN Co cabling to site.
- Access provisions for NBN Co Network Termination Units (NTU), Power Supply Units (PSU) and Fibre Wall Outlets (FWO).
- Provision of cable supports and pathways in accordance with NBN Co requirements.
- Coordination and arrangement of inspections with NBN Co via the NBN Co Project Officer.
- Coordination with NBN Co for transfer of ownership of all NBN Co cable pathways.
- Testing and commissioning of all systems installed and connected.
- Labelling of systems.
- Other items, whether mentioned in detail or not to complete the installation and put it into working order.

9.2 STANDARDS AND PRACTICE

Conformity to Standards

All materials and practice shall comply with the following standards unless otherwise specified:

AS/ACIF S008

- Requirements for Authorised Cabling Products

AS/ACIF S009

- Installation Requirements for Customer Cabling (Wiring Rules)

AS/NZS 1477

- PVC Pipes and Fittings for Pressure Applications

AS/NZS 2032

- Installation of PVC Pipe Systems

AS/NZS 3000

- SAA Electrical Wiring Rules

AS/NZS 3080 – Class C

- Integrated Telecommunications Cabling for Commercial Purposes

AS/NZS 3084

- Commercial Building Standards for Telecommunications Pathways and Spaces

AS/NZS 3085.1

- Administration of Communications Cabling Systems – Basic Requirements

AS/NZS 3086

- Telecommunications Cabling Systems for Small Office/Home Office Premises

AS/NZS 3087

- Testing of Balanced Communications Cabling

AS 3996

- Access Covers and Grates

AS/NZS 4117

- Surge Protection Devices for Telecommunications Cabling

AS/NZS 4129

- Fittings for Polyethylene Pipes and Pressure Applications

AS/NZS 4130

- Polyethylene Pipes for Pressure Applications

AS/NZS 4586

- Slip Resistance Classification of New Pedestrian Surface Materials

ACIF C524

- External Telecommunications Cable Networks

G591

- Telecommunications in Road Reserves – Operational Guidelines for Installations

SAA HB29

- Communications cabling manual

NBN Corporation Technical Guidelines

In addition the entire works shall be carried out by ACMA Open Cabling Registration cabling installers. All materials and equipment supplied shall hold relevant ACMA approvals.

The system shall generally be installed in accordance with the above standards; however reference shall also be made to the manufacturers' requirements. Where there is a discrepancy, the standard which exceeds the requirements of the other shall be adhered too.

9.3 SYSTEM CERTIFICATION AND WARRANTY

Requirement

It is the Electrical Contractor's responsibility to supply, install, design and construct the cable support mechanisms for all NBN Co cabling based on the drawings accompanying this Specification. The cable support system and pit and pipe installation shall be fully certified by NBN Co prior to handover. Any NBN Co cable supports shown on the accompanying drawings are shown indicatively and are to be amended by the Electrical Contractor in consultation with the Electrical Engineer and NBN Co to suit the specific site requirements.

Submission

The Electrical Contractor shall submit all information necessary, including final design documentation for review and approval, to NBN Co as required, to ensure a fully certified system is provided.

It is the Electrical Contractor's responsibility to ensure NBN Co sign-off and acceptance of the installation.

9.4 WORKSHOP DRAWINGS

Diagrammatic layouts: Tender Drawings forming part of this Specification are diagrammatic for tender only and shall not be used for installation purposes. Before commencing work, determine the exact positions of all equipment in conjunction with and to the approval of the Architect, Consulting Engineer and NBN Corporation having regard to interior design, building features, other services, and the requirements of regulatory authorities and standards indicated above.

Requirement: The Electrical Contractor shall submit Workshop Drawings in accordance with NBN Co guidelines to NBN Co for review and sign-off prior to commencement of work on site.

It is the Electrical Contractor's responsibility to ensure NBN Co approval and sign-off of the drawings.

9.5 INSPECTIONS

Arrange for, and give sufficient notice for inspection to the NBN Co Project Officer as follows:-

- Installation of all underground works including conduits and pits.
- Installation of internal cabling cable supports before closing of ceilings.
- Completion of installation prior to handover to NBN Co.

Minimum notice required: 10 Working days

Coordinate with the NBN Co Project Officer to arrange for all necessary inspections required by the Authority. It shall be the Electrical Contractors responsibility to rectify all defects indicated by NBN Co, which shall be rectified without any addition to the construction programme, and at no additional cost to the project.

9.6 GENERAL

Supply and install all trays, ducts, pits, hangers, brackets and the like to suit.

All metallic cable support mechanisms shall be connected to the building protective earth as specified for each case in AS/ACIF S009 or local equivalent, whichever is greater. It shall be the Electrical Contractors responsibility to ensure earth continuity is maintained for the full extent of all cable support mechanisms.

All conduits shall be installed in accordance with NBN Co Pit and Pipe requirements. The system shall be capable of supporting NBN Co cabling, and certified in accordance with NBN Co requirements.

9.7 CABLE SUPPORT SYSTEM

Supports generally:

Shall comply with AS/NZS 3084, manufacturers requirements and NBN Co requirements.

Segregation:

Segregation shall be provided in accordance with NBN Co requirements. However the following shall be incorporated within the installation:-

- Cable pathways are to be generally run parallel and/or perpendicular to the Building structure.
- Cable pathways shall generally be installed below other services to allow ease of access by NBN Co during cabling installation.
- Conduits shall be labelled in accordance with NBN Co requirements.
- Draw wires shall be labelled with tags at both ends to identify

9.8 EXTERNAL WORKS

Provide NBN Co approved P100mm (unless shown otherwise) communications conduits and pits as shown on the drawings, accompanying the Specification. Conduit runs shall generally be straight, however where bends exist they shall not exceed the bend radius requirements outlined in the NBN Co Technical Guidelines.

Refer to the drawings accompanying the specification for approximate locations of pits. Final locations are to be approved on site.

Provide 10mm nylon draw cords within all conduits, with ID tags provided to both ends.

Underground works shall be carried out in accordance with the "Cables & Enclosure" section of this specification, and NBN Co guidelines.

All conduits shall be installed in accordance with NBN Co Pit and Pipe requirements. The system shall be capable of reticulating NBN Co cabling, and certified in accordance with NBN Co requirements.

9.9 TESTING

Undertake all testing as required in the NBN Co technical guidelines.

Results:

Results are to be presented to NBN Co as required to achieve sign-off.

10 STRUCTURED HORIZONTAL CABLING SYSTEMS (SHCS)

10.1 SCOPE

Outline Description: The work covered by this section includes the following:

- Provision of Category 6/Class E compliant Structured Cabling System (SHCS) incorporating horizontal cabling and all cable terminations.

- Provision of cable-trays, vertical ducts and equipment.
- Testing and commissioning of all systems installed and connected.
- Labelling of systems.
- Other items, whether mentioned in detail or not to complete the installation and put it into working order.

10.2 STANDARDS AND PRACTICE

- Conformity to Standards

All materials and practice shall comply with the following standards unless otherwise specified:

AS/ACIF S008

- Requirements for Authorised Cabling Products

AS/ACIF S009

- Installation Requirements for Customer Cabling (Wiring Rules)

AS/NZS 3000

- SAA Electrical Wiring Rules

AS/NZS 3080 – Class E

- Integrated Telecommunications Cabling for Commercial Purposes

AS/NZS 3084

- Commercial Building Standards for Telecommunications Pathways and Spaces

AS/NZS 3085.1

- Administration of Communications Cabling Systems – Basic Requirements

AS/NZS 3086

- Telecommunications Cabling Systems for Small Office/Home Office Premises

AS/NZS 3087

- Testing of Balanced Communications Cabling

AS/NZS 4117

- Surge Protection Devices for Telecommunications Cabling

SAA HB29

- Telecommunications Cabling Handbook

ISO/IEC 11801

- Information Technology – Generic cabling for customer premises

In addition the entire works shall be carried out by ACMA Open Cabling Registration cabling installers. All materials and equipment supplied shall hold relevant ACMA approvals.

The system shall generally be installed in accordance with the above standards; however reference shall also be made to the manufacturers requirements. Where there is a discrepancy the standard which exceeds the requirements of the other shall be adhered too.

Refer to 'Earthing' Section detailing earthing requirements.

10.3 PROTOCOLS AND STANDARDS

The SCS shall be capable of supporting the following minimum protocols and standards:-

- Ethernet Standards:-
  - 10 Base T, 100 Base TX, 1000 Base TX, 10G Base T
  - ATM25
  - ISDN
  - PSTN
- Voice Communications
  - Analogue and digital PABX systems
  - Analogue and digital video applications
  - Video conferencing
  - Broadband video
  - Broadcast television
  - Voice over IP (VoIP).
- Power Over Ethernet
  - PoE in accordance with IEEE 802.3af PoE
  - PoE+ in accordance with IEEE 802.3at PoE

10.4 SYSTEM CERTIFICATION AND WARRANTY

Requirement

The cabling installation shall be provided as an impedance matched end to end solution. The end to end system shall be from one of the following preferred manufacturers TE Connectivity, Siemon, CommScope Systimax, Clipsal Actassi, Molex SCS and Panduit systems. All products shall exceed requirements for Category 6/Class E channel and components.

The installation shall be capable of meeting or exceeding AS/NZS 3080 certification and warranty requirements. The warranty is to comprise of an Applications Assurance and Extended Product/Labour Warranty that will have a valid minimum warranty of 5 years and is to be a fully manufacturer certified system.

The tendering contractor shall be an approved installer of the SCS system.

Submission

Provide with the tender a clear statement of the Applications Assurance and extended product warranty offered on the communications installation.

10.5 INSPECTIONS

Arrange for, and give sufficient notice for inspection of the installation as follows:

- Installation of all underground works including conduits and pits.

- Installation of cabling.
- Installation of internal cabling before closing of ceilings.
- Completion of installation ready for termination.
- Minimum notice required: 10 Working days

10.6 GENERAL

Supply and install all trays, cables, ducts, pits, and mounting blocks/brackets to suit. All data plates to match other accessories.

All distribution frames, cabinets, cable trays and catenary wires shall be connected to the building protective earth as, specified for each case in AS/ACIF S009 or local equivalent, whichever is greater.

Underground works shall be carried out in accordance with the "Cables & Enclosure" section of this specification.

10.7 EXTERNAL WORKS

Provide ACMA and NBN Co approved P50mm and/or P100mm communications conduits and pits as shown on the drawings, accompanying the Specification. Conduit runs shall generally be straight, however where bends exist they shall not exceed the bend radius requirements of the cabling to be installed within. Plan and gain approval for all routes before excavation.

Refer to the drawings accompanying the specification for approximate locations of pits. Final locations are to be approved on site.

Provide 10mm nylon draw cords within all conduits.

Underground works shall be carried out in accordance with the "Cables & Enclosure" section of this specification.

10.8 TESTING

Copper

All cables shall be tested and approved for Category 6/Class E compliance utilising certified test equipment as provided by the Sub-Contractor. Provide certifying evidence of the calibration accuracy of all test equipment.

The following shall be the minimum testing requirements for copper cabling:

- 100% testing of all runs for continuity and polarity.
- 100% testing of all cabling with compliance to Category 6/Class E requirements.
- A written test report for every test (1 per page) and a soft copy on CDROM shall be submitted and included with the as-built documentation. Alternatively, if requested in the Scope of Work, test results to be submitted in .FLW and .PDF format, to allow generation of summary test information in lieu of individual test pages.
- Testing shall be carried out with a minimum of a Level III tester. The contractor prior to performing any testing must seek approval from Principal if any other cable tester is to be used.

The following parameters shall be tested according to AS 3080:-

- Near-End Crosstalk (NEXT) (Both directions)
- Power sum Near-End Crosstalk (PSNEXT) (Both directions)
- Far-End Crosstalk (FEXT) (Both directions)
- Power sum Far-End Crosstalk (PSFEXT) (Both directions)
- Power sum Equal Level Far-End Crosstalk (PS ELFEXT) (Both directions)
- Attenuation
- Return Loss (Both directions)
- Delay Skew
- Continuity
- Wire Map
- Length
- DC Loop resistance
- Attenuation to Crosstalk Ratio (ACR)
- ACR @ remote
- Power sum ACR
- Propagation Delay (Both directions)

General

A complete set of test results shall be provided as part of the Installation Manuals. Inspection and testing of these parameters does not relieve the Contractor of their responsibility to provide and maintain an operational system. Replace any cables not performing within the specified requirements.

Marginal passes will not be accepted.

Provide completed and signed TCA1 form for entire communications system installation.

Results: Provide copies of the test results and TCA1 form and include within Maintenance Manuals.

10.9 COMMUNICATIONS OUTLETS

Provide outlets to each location nominated on the drawings accompanying this specification, which shall generally be provided as follows:-

- Fitted with Category 6/Class E, 8 way RJ45 outlets. Make of RJ45 outlets shall match that of the cable.
- Mounted on face plates of identical manufacture to power outlets.

10.10 LABELLING - COMMUNICATIONS CABLING

All labelling will be in accordance with AS/NZS 3085.1.

Faceplates to match socket outlet Faceplates and are to be supplied and installed by the Contractor. RJ45 Category 6/Class E sockets shall mount into faceplate, which will be flush mounted.

In addition, provide labels for all cables consisting of wrap-around markers, behind face-plates and at communications enclosures. Hand written labelling directly on cables will not be accepted.

All labels, regardless of their location, shall provide for clear and concise ease of identification of its respective point. It is the Contractor's responsibility to provide and install these pre-printed labels sized appropriately to its location.

Labelling requirements shall be defined in conjunction with the Proprietor after submission of Communications Room workshop drawings.

10.11 OUTLETS

Each outlet shall be provided with:

- Faceplate with a socket mounting cut-out, of colour to match other accessories;
- Faceplate socket inserts consisting of Category 6/Class E RJ-45 connectors. This connector shall have the following characteristics:
  - A minimum contact coating of 50 microns (1.27 micro meters) of gold over 50+ microns Nickel
  - 8 pin cable connector of insulation displacement type compliant with the Category 6/Class E transmission performance.
- Cable termination, pin assignments, pair allocation, colour coding and performance shall conform to AS /NZS 3080, option T568A.
- Mount designated dual and triple outlets on a single plate matching other accessories where shown on the contract drawings.
- Approved labelling system utilising the engraved labelling adjacent each outlet, or alternatively utilising the outlets proprietary labelling system.
- Mount designated dual outlets on a single plate matching other accessories where shown on the contract drawings.

10.12 COPPER HORIZONTAL CABLING

Provide Category 6/Class E compliant solid core 4 pair UTP cabling.

Conductor:-

Provide solid bare copper sized accordingly. Stranded cabling will not be accepted.

Insulation and Jacket:-

Provide polyethylene insulation and PVC jacket or LSZH.

Terminations:-

Terminations shall be provided as follows:-

- Terminate all cable pairs and all cables.
- Terminate with connector pin assignment in accordance with AS/NZS 3080, option T568A.
- Maintain cable twists as far as possible up to the point of termination and no more than 8mm from the point of termination.
- Cut back cable sheaths neatly and support adequately.
- Provide adequate and positive strain relief.

Copper Horizontal Cabling:-

Copper backbone and horizontal cabling shall be provided as follows:-

- Cable length of UTP cables, including patch leads shall not to exceed 100 m, and be greater than 15m. Plan all routes so as to achieve this requirement
- Provide copper horizontal cables from the appropriate cable centre to information outlet locations as shown
- Terminate the copper cables at each outlet location and at the relevant NBN NTU unit as shown. Provide a 1m loop within the ceiling space at each end. (loop must be installed in figure eight design)

General:-

All cable installation shall observe the manufacturers recommendations regarding the installation methods and techniques, particularly bending radius.

All cables shall generally be laid at random within cable trays to avoid alien crosstalk.

Perform test on each cable in accordance to manufacturer's testing recommendations and in accordance with AS 3080. Replace any damaged or failed components.

11 COMBINED FIRE / ACCESS CONTROL SYSTEM

11.1 GENERAL

Standard: AS/NZS 2201 Set

Scope

Provide a combined fire / access control system comprising:

- Access control system including entry cards/keys as required
- Car park vehicle access control including RF controllers
- Smoke and thermal detection to common areas including sirens to apartments
- Power supply
- Wiring, conduit and all minor works associated with system.

Work

The work shall include:

- Detailed system design
- Manufacture, supply, installation and wiring
- Testing and commissioning
- Operation and maintenance manuals
- Maintenance during defects liability period
- Liaison with other contractors responsible for door hardware, roller doors, lifts, etc, as applicable

Alarm Operation

The system shall be self-contained. An alarm condition shall initiate local audible and visual external alarm device.

External Monitoring Interface: The system shall include provisions for an interface suitable for connection to a monitored security company.

System Structure

The system shall be a distributive system with electronic equipment connected via network communications links.

11.2 POWER SUPPLY

Requirements:

Provide 230 volt AC mains power supply to central supervisory system controller/control panel and other devices as required. Incorporate transient voltage protection in all devices.

The Contractor shall provide all necessary power supplies for all equipment and appliances that shall warrant a fully operational system.

Dedicated Circuit:

The supply shall; be provided by a dedicated circuit and the circuit breaker shall be labelled "ACCESS CONTROL SYSTEM – DO NOT SWITCH OFF".

Back-up Supply:

Provide 12 Volt DC battery back-up with minimum capacity in accordance with AS/NZS 2201 Set. The battery shall consist of maintenance free sealed led acid cells.

11.3 WIRING

General

Cabling shall be reticulated utilising any of the following methods:-

- Cast in situ concrete when installed on concrete walls and the like.
- Reticulated along cable trays in a segregated section using partitions. Cables are to be strapped to the cable trays using nylon cable ties.
- Installed within heavy duty conduit when installed in areas with exposed ceilings, including in areas with cable tray.

Communications Network

Twisted 2 pair screened cable or other as required in conduit linking all controllers. The network shall be supervised.

Cabling shall not exceed 1.5km in length.

11.4 PRE-CONSTRUCTION SUBSMISSIONS

The Electrical Contractor shall provide the following minimum information prior to commencing installation of the security system, for approval by the Engineer:-

- Layout drawings showing equipment locations, paths of reticulation and the like.
- Schedules identifying equipment type (make and model) corresponding to the layout drawings.
- Schematic diagrams for the access control system.
- Schedule of interfaces with all equipment and devices separate to the combined fire / access control system e.g. Intercom etc.
- Functional specification identifying the operation of the access control system, including description of each zone, and programming.

11.5 TESTING

Testing and commissioning shall be undertaken in accordance with the system manufacturers' requirements.

Testing and commissioning shall be coordinated with a representative of the manufacturer. Upon completion the security system shall be warranted and approved by the manufacturer.

11.6 MAINTENANCE

Requirement

Maintain system during Defects Liability Period in accordance to AS/NZS 2201 Set.

Site Visits:

Visit site and carry out maintenance procedures at not less than 3 month intervals and whenever advised of a fault.

11.7 MANUALS AND DRAWINGS

The Electrical Contractor shall provide all As-Installed information for inclusion within the Operating and Maintenance Manual as follows:-

- As-Installed drawings showing the following minimum items:-
  - Cable pathways and types.
  - Controllers, detectors, accessories, interfaces locations and the like
  - Control panel types and locations.
  - Schematics and diagrams
- Technical Specification identifying the operation of the system to the Proprietor.
- Handover and training records

11.8 WARRANTY

The system shall be warranted for a minimum 1 year period, which includes parts and installation.

11.9 SYSTEM CONTROL PANEL

Requirement

Provide a wall mounted control panel for monitoring and control of the system comprising a programmable access control processor and control switches, visual indicators, relays, etc. Provide an LCD display with English text to indicate any abnormal condition and to facilitate programming.

Enclosure

Control panel enclosure shall be of sheet steel with acrylic enamel paint finish, stainless steel or impact resistant plastic. Layout and labelling shall facilitate use by operator.

Provide vandal resistant screws on all enclosures.

Location

Enclosure(s) shall be installed between 1500 to 1800 AFFL, and shall be installed over the relevant power and communications outlets.

Locations shown on the drawings accompanying this specification are indicative, and are to be confirmed on site.

Capacity

The controller shall have provision for at least 8 independent alarm systems with up to 256 programmable inputs.

Programming

The controller shall permit system configuration and options to be programmed by an operator using selected access key/code.

Access Control

The control panel shall provide programming of all access control functions.

Time Clock

System shall incorporate a 365 day real time clock with battery backup.

Memory

System shall have a built in memory which allows recall and display of all transactions. Provide a printer to give English text record of all transactions.

Operation

Activation of alarm device when control panel is in secure mode shall:

- Initiate audible/visual alarm on panel
- Initiate external audible/visual alarm if required
- Illuminate appropriate sector indicator on control panel
- Transmit alarm to control station

Mute Button: Provide facility to silence audible alarm while retaining visual indication until alarm is cleared and device is reset.

Reset: Private Code activated facility.

Time Delay: Provide adjustable time delay (30 sec to 3 mins) on motion alarm signals in sectors between control panel and entry/exit doors.

Status

The status of each sector shall be displayed on the control panel.

11.10 ACCESS CONTROL

Make and Model

Access Control System shall be of "Inner Range Integriti" manufacture or equal approved.

Scope

The access control system shall control and monitor selected doors and the movement of lifts cars detailed on the drawings utilising access keys, key pads, key readers, door locks shall be provided.

System Features:

- Independent operation (2 card users/apartment plus 10 spare for building owner)
- Routine reporting to system controller via networking link
- Battery backup for 8 hours
- Communications via telephone line (PSTN) and Ethernet (IP).
- Monitoring and control by each local control unit of 2 doors each with an entry key reader, PIN reader and exit key reader as required.
- Interface to fire alarm system for automatic door release on fire alarm.
- Memory for audit trial.
- Anti-passback support.
- Card status indicator via red/green LED indicators on reader.
- Response time from presentation of a key to operation of the interface contacts shall be less than one second.

Visitor Entry

Entry to the building, outside normal working hours when the building is secured, shall only be available to persons who are holders of authorised access keys or via release signal from building intercom system.

Visitor Exit

Exit from the building be available at all times, including at controlled access points, by push-button control or by operation of internal door handles.

Vehicle Entry

Vehicle entry to the secure car park area shall only be available to persons who are holders of authorised remote transmitters, or via release signal from the building intercom system.

Vehicle Exit

Vehicle exit from the secure car park area shall only be available to persons who are holders of authorised remote transmitters, or by a proximity detection device installed as part of the roller door installation.

Authorisation

Entry via access controlled door shall be available to key holders only at entry points authorised to the particular keys. Entry points shall be individually assigned to keys.

Time

Access controlled doors shall remain unlocked for an adjustable period initially set at 30 seconds. On expiry of selected time, doors shall relock.

System Controller

System shall incorporate a programmable controller wired to local control units for central monitoring and control. Programming shall be available to operators with required access code/key.

Local Control Units

Access control devices (key readers, door locks, etc) shall be connected to distributed local micro-processor based control units located within equipment rooms, cupboards or within the ceiling space in approved locations.

Control System: Connect to Security System Controller via communications network.

Access Keys

Type: Keyring fob with RF pushbuttons for auto roller door control

Quantity: Provide 2 access card/keys per apartment plus 6 spare for building manager with initial system.

Card Readers

Type: Provide proximity card readers to locations as nominated on the accompanying drawings.

Card readers shall be compatible with all types of cards, fobs and the like specified as part of these works.

Readers shall have distinct LED indicators for "LOCKED" and "UNLOCKED".

Enclosures: Reader head enclosures shall be of minimum protection classifications:

External: IP 66D to AS 1939

Internal: IP 54 to AS 1939

Tamper Switches: Reader enclosures and wiring terminations enclosures shall be fitted with tamper switches. Operation of the tamper switch shall cause the system to ignore any further information from the reader and any associated request to exit buttons. Tamper shall be reported to the security system controller and must be reset manually.

RF Car Park Roller Door Reader

Type: 30070 MicroLatch REC-20 4 Channel Wiegand RF Receiver.

Indicators: On Keeloq™ Reception – Red LED, On Wiegand Transmission – Green LED

Current consumption @ 12VDC 10mA maximum

Physical Dimensions 85mm (L) x 65mm (W) x 32mm (H)

ABS plastic case material

4 Output Channels

Output Options: INT Shunt selectable, REMOVED 10K pull-ups to 5 volt DC, EXT Open collector +5 volt out terminal active for user selectable external pull-ups

433.92MHz RF Operating Frequency

Code Hopping (Keeloq™) AM ASK Superheterodyne for RF Signal Type

Conform to Wiegand standard

Electric Door Strikes

Type: Fail safe, power on to secure. Strike shall engage door latch.

Requirement: Provide electric door strikes for all access controlled doors.

Installation: Supply electric door strike too responsible door hardware trade for installation within door frames. Wire to and commission. Provide concealed conduits for all wiring.

Operation: Secure mode – controlled by access control system. Non-secure mode – access and egress shall be permitted. Provide interface with building fire system for automatic release of all controlled doors on receipt of a fire signal.

Fire Doors: Electric door latch release units fitted to fire rated door frames shall be designed and installed to avoid any loss of the fire rating.

Double Doors: Provide wiring hinge and wiring through fixed leaf door strike position.

Door Release

Provide door release push-button adjacent each nominated controlled door. Push-button is to be mounted on a face plate to match the surrounding power outlets, and labelled accordingly.

Break Glass Release

Provide Break Glass Release adjacent each nominated controlled door. Releases shall be sufficiently labelled, and shall generally be coloured green.

12 MATV SYSTEM

12.1 SCOPE

Outline Description: The system is to reticulate Digital Video Broadcasting – Terrestrial (DVB-T) services from within the metropolitan area to outlet locations nominated.

12.2 STANDARDS

Standards: AS/NZS 1367, AS 1417, IEC 60966 Set.

12.3 SYSTEM DESIGN

Distribution Technique: Radiating main trunk cable from the main antenna position. Outlets are to be supplied from distribution cable using splitters and/or tee units.

On-Site Measurements: Before completing the final design, measure the on-site signal levels of the nominated services, and note the existence and direction of any ghosting sources, and sources causing increased Bit Error Rates (BER). Establish the required aerial height and submit workshop drawings for approval, including mounting proposals.

Final Design: Before commencing the installation submit details of the proposed final design, including expected signal levels at all outlets, and showing the configuration of equipment required to meet the specified performance.

12.4 PERFORMANCE

Picture Quality: At each outlet, the picture received on a domestic TV receiver shall not be noticeably inferior to the picture received when the receiver is connected directly to the antenna, and shall be free from discernible cross-modulation, intermodulation, ringing, noise or other distortion.

Signal Levels:

At any outlet:

- Maximum: 10 mV - Minimum: 2 mV.

Differential signals: To AS 1367.

Sound Carrier Level: At least 9 db less than the vision carrier.

Maximum Voltage Level: 120db(uV) at any point on the distribution system.

12.5 TESTING

Requirement: Carry out tests to demonstrate compliance with the performance and other requirements of the Specification, in the presence of the Superintendent.

Equipment: Provide the equipment, apparatus and materials necessary to perform the tests, including field strength meter and portable TV receiver.

Rectification: Correct the system, and replace components without extra cost, as necessary to achieve compliance.

12.6 CABLES

Type: Single core coaxial cable with a nominal impedance of 75 ohms.

Screen: Copper tape and wire braid.

Dielectric: Polythene 5 cell extrusion.

12.7 CABLE INSTALLATION

Cable Routes: Install cable using the most direct route. Run cables in false ceiling spaces, wall cavities, conduits and ducts, keeping clear of other services. Do not embed in plaster, mortar, cement, or the like, nor run in cracks or joints in walls, ceilings, floor slabs and the like.

Surface Cables: Do not run cables on surfaces without approval.

Continuity: Run cables continuously from the originating point to the terminating point without intermediate joints or connections unless otherwise approved.

Fixing: Fix coaxial cable with plastic clips at 600mm maximum centres.

Bending Radius: Not less than the cable manufacturer's recommended minimum.

Sealing: Seal the ends of cables exposed during the installation with tape or caps to minimise moisture take-up.

Tails: Leave 150mm tails for cut-off before terminating.

Terminations: Prepare cable ends for termination using the 'hot wire' stripping technique. Do not use cutting tools.

12.8 ANTENNA SYSTEM - MATV

Requirement: Provide an antenna system which gives adequate gain, directional characteristics and polarisation for the nominated services.

Balun: Supply, and install in a weathertight enclosure, a balun matching each antenna to the 75 ohm co-axial lead-in cable.

Insertion loss: Less than 0.5 db.

Frequency response: 0.5 db over the channel or band.

12.9 ANTENNA INSTALLATION

Standard: AS 1417.

Locations: Locate antennae upon the roof plant platforms to obtain suitable signals. Obtain prior approval from the Superintendent for the proposed locations before commencement.

Orientation: Orient the antennae to minimise reception of reflected signals.

Lead-In-Cable: Run lead-in cable inside the mast.

Fixing: Attach the antenna to a pipe support, sealed at the top but open at the bottom, fixed to the building and flashed where required.

Weather Proofing: Spray signal receiving parts with silicone or an equivalent weather damage inhibiting spray.

12.10 ANTENNA AMPLIFIERS

Standard: To AS 1367.

Requirement: Install a pre-amplifier at the masthead if the signal level at the distribution amplifier is less than 46 db(uV).

Power Source: Provide low voltage a.c. power to the pre-amplifier via the co-axial feeder cable. Install the power source in an easily accessible location. Include associated costs for power supplies, and power to power supplies within the tender submission. (MATV amplifiers and SSO's for this equipment are not shown on the drawings accompanying the specification). Obtain prior approval to the proposed location.

Frequency Response: Flat to within 1 db across the desired band.

Impedance: Match input and output to provide RLR of at least 15 db for 75 ohm co-axial cable.

Gain: Sufficient to achieve minimum signal level of 46 db(uV) at the distribution amplifiers.

Rating: Continuous use.

12.11 PASSIVE ELEMENTS

Standard: To AS 1367.

Type: Taps, splitters, and the like, shall be of the transformer or directionally coupled type. Components shall be mounted on fibre-glass boards. All connections shall be permanently labelled on the outside of the enclosure to allow fast identification. Cable saddle clamps are to be correctly sized to suit the diameter of the cable.

Frequency Response: Flat to within 2 db over the range 45 MHz – 820 MHz.

Screening: Screen passive elements to minimise the effect of radiation and/or reception of interfering signals.

Plugs and Sockets:

Construction: To be 75 ohm co-axial push-on type, machined from either beryllium-copper, or brass with nickel or silver plating. Where crimp connections are used they shall be performed using the correct crimping tools. All crimping sleeves used shall exceed 5 mm in length. Plugs using the centre conductor of the coaxial cable as the centre pin are not permissible.

Termination Impedance: Install termination impedances on unused splitter and tap-off outlets and at the end of each line.

12.12 OUTLET PLATES AND QUANTITIES

Requirement: Install outlets where shown on the Drawings. Provide outlet plates to match other accessories.

Type: Co-axial cable sockets flush-mounted on high-impact plastic plate. Fix components on a printed board assembly fitted with a clamp and screw for the co-axial cable termination.

13 INTERCOM SYSTEM

13.1 SCOPE

Outline Description

The system shall provide audio communications and main building entry door(s) and control as detailed on the electrical services drawings and schematics to individual apartments.

The system shall be designed, constructed, supplied and installed by an installer certified by the manufacturer.

The install system shall be of commercial manufacture and of 'Bticino' or equal approved, and shall generally provide the following minimum facilities and operation:

- Audio intercom facilities from main building entry door(s) entrance station to individual monitoring stations in Apartments 02 to 16 to allow for controlled visitor entry to the building main entry door(s) and foyer area.
- Stand Alone intercom facility to Apartment 01 on ground floor to allow for controlled visitor entry to external gate to Apartment 01 front entry door on property boundary.
- Interface to building access control system to allow for release of the main entry door(s) locking mechanism(s) and or door controller(s).
- Doorbell facility to individual Apartments.

Work

The works shall include the following:

- Detail system design.
- Supply and installation.
- Programming of system.
- Testing and commissioning of system.
- Operation and maintenance manuals.
- Maintenance during the liability period.
- Liaison with other contractors including door hardware, etc as applicable.

13.2 ENTRANCE STATIONS

The entrance stations shall have the minimum features and provide:

- Audio communications to all Apartments.
- Digital apartment call panel including digital name scrolling facility.
- Door release via integrated RFID tag reader or tenants unique password.
- Interface with main entry door(s) release facilities.
- Vandal resistant and IP rated for external conditions.
- Options for hearing impaired persons.

Entrance stations shall be "Bticino" manufacture or equal approved.

13.3 MONITORING STATIONS

The monitoring station shall have the minimum features and provide:

- Audio communications to main building entrance station(s).
- Door release to building main entry door(s) including adjustable time delay facility.
- Additional function button for roller door operation and/or user programmed option.
- Doorbell facility to individual Apartments.
- Integrated help facility.
- Adjustable volume control.
- Integrated hearing aid setup.

Monitoring stations shall be "Bticino" manufacture or equal approved.

13.4 WIRING, POWER AND EQUIPMENT

Requirements

The intercom system shall be an IP based system utilising 2 wire cabling.

Provide all necessary power supplies as required to ensure a fully operational system.

Dedicated Circuit: the supply shall be provided by a dedicated circuit and the circuit breaker shall be labelled "INTERCOM SYSTEM – DO NOT SWITCH OFF" at the relevant area distribution boards throughout the building.

Audio and visual bus wiring types to suit the final system and manufacturers requirements.

Provide all wiring, equipment and accessories to complete the installation.

Provide all cable segregation requirements between power and communications bus cabling.

13.5 TESTING

After the installation is completed, tests to be carried out to demonstrate that the installation is in a satisfactory working order to all stations

Testing shall include the operation of each monitoring station communication to all entry stations and correct interface to access control and lighting control systems including door release and lift call functions.

Programming of system to suit the Proprietor's requirements.

Provide system details, testing and commissioning results within the Installation Manuals.

APPENDIX A - SECTION COSTS & UNIT RATES - ELECTRICAL SERVICES

This schedule is to be completed and submitted with Tender submissions. The amounts indicated in the total tender price including administration costs and profit for sections of the work are as follows:

ITEM	AMOUNT TENDERED
Access Conduits & Pits	$ .....
Main Switchboard & Distribution Boards	$ .....
Earthing and Bonding	$ .....
Consumers Mains and Submains	$ .....
Cable Trays & Support Systems	$ .....
Power Subcircuits	$ .....
Lighting Subcircuits	$ .....
Accessories & Outlets	$ .....
Luminaires	$ .....
Exit & Emergency Luminaires	$ .....
NBN Corporation Cable Pathways	$ .....
Structured Cabling System	$ .....
MATV System	$ .....
Combined Fire / Access Control System	$ .....
Intercom System	$ .....
Testing & Commissioning	$ .....
Maintenance & Servicing	$ .....
For Approval/Workshop Drawings	$ .....
As-Constructed Drawings	$ .....
Operating and Maintenance Manual	$ .....
User Training	$ .....
Other (specify)	$ .....
SUBTOTAL	**$ .....**
GST	$ .....
	$ .....
TOTAL	
COST OPTION A - Electric Hotplates	
Cost to wire electric hotplates including electrical supplies and isolation switches to all apartments in lieu of gas cooktops.	$ .....

Tenderer ..... **Date** .....

APPENDIX B - SCHEDULE - SUBCONTRACTORS AND PERSONNEL

Identify below Sub-Contractors included within the tender submission.

ITEM	SUB-CONTRACTOR
SCA	.....
Communications Cabling	.....
MATV	.....
Combined Fire / Access Control	.....
Intercom System	.....
Other	.....

Personnel	Name	Years Experience	Years with Company
Project Manager	.....	.....	.....
Foreman	.....	.....	.....

Tenderer ..... **Date** .....

SCHEDULE - HOURLY RATES

Identify below the following hourly rates that are applicable for the duration of this contract:

Occupation	Normal Time Rate $/hr	Overtime Rate $/hr	Double Time Rate $/hr
Foreman	.....	.....	.....
Electrical Mechanic	.....	.....	.....
Electrical Apprentice	.....	.....	.....
Communications Technician	.....	.....	.....
Fire/Access Control Technician	.....	.....	.....
Intercom Technician	.....	.....	.....

INDICATIVE PROJECT HOURS ALLOWANCE

Identify the indicative number of working hours included in the Tender submission:-

ITEM	Normal Time	After Hours	Total Hours
Project Manager	.....	.....	.....
Supervisor	.....	.....	.....
Electrical Mechanic	.....	.....	.....
Apprentice	.....	.....	.....
Total Hours	.....	.....	.....

Tenderer ..... **Date** .....

APPENDIX C - SCHEDULE OF RATES - LUMINAIRES

ITEM	ADDITION	DELETION	DELETION
Include labour and material, profit and overhead costs in each item.		(Prior to Approval)	(After Approval)
Luminaire Designations			
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....
....	$.....	$.....	$.....

Tenderer ..... **Date** .....

APPENDIX D - SCHEDULE OF UNIT RATES

Include labour and material, profit and overhead costs in each item.

ITEM	ADDITION	DELETION
General Power		
One single-phase double SSO on existing circuit (with 15 metres of cable)	$.....	$.....
One single-phase 15A SSO on new circuit (with 15 metres of cable and 16A RCD/MCB)	$.....	$.....
One 20A 1-phase Isolator with 30m of 2c 4mm2 cable & 20A circuit breaker	$.....	$.....
Installation of light switch and 10 metres of 2c 2.5mm2 switchwire	$.....	$.....
Price per metre 2.5mm2 2c+E installed anywhere in building	$.....	$.....
Price per metre 16mm2 2c+E installed anywhere in the Building	$.....	$.....
Price per metre 25mm2 2c+E installed anywhere in the Building	$.....	$.....
Price per metre 35mm2 2c+E installed anywhere in the Building	$.....	$.....
Price per metre 16mm2 4c+E Cu/X-HF-110/PVC	$.....	$.....
Price per metre 95mm2 4 x 1c+E Cu/XLPE/PVC installed to tray	$.....	$.....
Cable tray - 300 mm installed per metre	$.....	$.....
- 450 mm installed per metre	$.....	$.....
Price per metre installation of 100mm electrical conduit underground to a depth of 600mm cover, including all excavation works and reinstatement	$.....	$.....
Copper price at time of Tender	Price per tonne	$.....

Tenderer ..... **Date** .....

SCHEDULE OF UNIT RATES cont'd

ITEM	ADDITION	DELETION
Communications		
One RJ 45 communications outlet, 30 m Category 6 cable and associated terminations at communications enclosure	$.....	$.....
As above, but double outlet	$.....	$.....
Fire / Access Control		
Key tag (proximity fob c/w RF Push Button)	$.....	$.....
Key tag detector (proximity card reader)	$.....	$.....
Electric Strike	$.....	$.....
Release Switch	$.....	$.....
Smoke Detector	$.....	$.....
Thermal Detector	$.....	$.....
Siren	$.....	$.....
Access controlled single door within 50m of SCU	$.....	$.....

Tenderer ..... **Date** .....

APPENDIX E - SCHEDULE OF TECHNICAL DETAILS - ELECTRICAL SERVICES

DETAIL – LUMINAIRES

Complete this schedule of material items proposed and include with tender documents. These items must comply with the specification unless the tenderer nominates and includes details of the nonconformity.

Luminaire Designation	Manufacturer	Cat. No.	Lamp Type & Manufacturer	Delivery from Approval

Tenderer ..... **Date** .....

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

EQUIPMENT ACCOMMODATION

Itemise below any equipment offered that cannot be accommodated in the spaces shown on the drawings.

Tenderer ..... **Date** .....

DETAIL - POWER & ACCESSORIES

Complete this schedule of material items proposed and include with Tender. All items shall comply with the specification unless the Tender nominates and includes details of the nonconformity.

1 Cables

Manufacturer . . . . . .

Cat. No. . . . . .

2 Conduits

Manufacturer . . . . . .

Cat. No. . . . . .

3 SSOs

Manufacturer . . . . . .

Cat. No. . . . . .

5 Light Switches

Manufacturer . . . . . .

Cat. No. . . . . .

6 Isolators

Manufacturer . . . . . .

Cat. No. . . . . .

7 Cable Trays/Ladders

Manufacturer . . . . . .

Cat. No. . . . . .

8 Movement Sensors

Manufacturer . . . . . .

Cat. No. . . . . .

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

Tenderer ..... **Date** .....

DETAIL - SCA

Complete this section of material items proposed and include with the tender. These items must comply with the specification unless the Tender nominates and includes details of the nonconformity.

1 MAIN SWITCH BOARD

Manufacturer	. . . . .
Fault & Current rating	. . . . .
Segregation	. . . . .

Main Switch

Manufacturer	. . . . .
Type	. . . . .

Moulded Case Circuit Breakers

Manufacturer	. . . . .
Type	. . . . .

Power Monitoring Units

Manufacturer	. . . . .
Type	. . . . .

Dimensions

W x H x D	. . . . .
Mass (kg)	. . . . .

Tenderer ..... **Date** .....

2 APARTMENT LOAD CENTRE(S)

	Manufacturer	. . . . .
	Fault rating	. . . . .
Miniature Circuit Breakers		
	Manufacturer	. . . . .
	Type	. . . . .
Residual Current Devices		
	Manufacturer	. . . . .
	Type	. . . . .
Contactors		
	Manufacturer	. . . . .
	Type	. . . . .
Dimensions		
Typical Load Centre	W x H x D	. . . . .

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

EQUIPMENT ACCOMMODATION

Itemise below any equipment offered that cannot be accommodated in the spaces shown on the drawings.

Tenderer ..... **Date** .....

DETAIL - COMMUNICATIONS CABLING

Complete this schedule of material items proposed. These items must comply with the specification unless the Tender nominates and includes details of the nonconformity.

1 Cable

Manufacturer . . . . . .

Cat. No. . . . . .

2 Outlets

Manufacturer . . . . . .

Cat. No. . . . . .

3 Horizontal Cabling Terminations

Manufacturer . . . . . .

Cat. No. . . . . .

4 Conduits

Manufacturer . . . . . .

Cat. No. . . . . .

EQUIPMENT CONFORMITY

Itemise below all points where tendered items differ from the specification.

EQUIPMENT ACCOMMODATION

Itemise below any equipment offered that cannot be accommodated in the spaces shown on the drawings.

DETAILS OF PROPOSED MANUFACTURER'S WARRANTY

(Attach separate sheets as required)

Tenderer ..... **Date** .....

DETAIL – COMBINED FIRE / ACCESS CONTROL SYSTEM

1 SYSTEM PANEL

Manufacturer . . . . . .

Cat. No. . . . . .

Read Distance . . . . . .

2 PROXIMITY KEY-TAGS (Proximity Fob C/W RF Push Button)

Manufacturer . . . . . .

Cat. No. . . . . .

3 REED SWITCHES

Manufacturer . . . . . .

Cat. No. . . . . .

4 EMERGENCY BREAK GLASS

Manufacturer . . . . . .

Cat. No. . . . . .

5 ELECTRIC STRIKE

Manufacturer . . . . . .

Cat. No. . . . . .

Type . . . . . .

6 KEY-TAG READER (Card Reader)

Manufacturer . . . . . .

Cat. No. . . . . .

Diameter . . . . . .

7 SMOKE DETECTOR

Manufacturer . . . . . .

Cat. No. . . . . .

Type . . . . . .

8 THERMAL DETECTOR

Manufacturer . . . . . .

Cat. No. . . . . .

Type . . . . . .

9 SIREN

Manufacturer . . . . . .

Cat. No. . . . . .

Type . . . . . .

Tenderer ..... **Date** .....

DETAIL - INTERCOM SYSTEM

1 BUILDING ENTRANCE STATION

Manufacturer . . . . . .

Cat. No. . . . . .

2 MONITORING STATIONS

Manufacturer . . . . . .

Cat. No. . . . . .

3 AUDIO BUS EQUIPMENT

Manufacturer . . . . . .

Cat. No. . . . . .

4 CABLE

Manufacturer . . . . . .

Cat. No. . . . . .

LUCID
CONSULTING AUSTRALIA

PROSPECT APARTMENTS -168 PROSPECT ROAD, PROSPECT

Project No: LCE12584

Fire Services Specification

Tender Issue

Revision T1

SPECIFICATION ISSUE REGISTER

REVISION	DESCRIPTION	DATE ISSUED	AUTHOR	REVIEWED
T1	Tender Issue	02.06.2017	MF	TT

PROJECT DIRECTORY

BUILDER	Bert Farina Constructions 11 Indama Street Regency Park SA 5010
ARCHITECT	Studio Nine Architects 9 King William Street Kent Town SA 5067
BUILDING SERVICES	Lucid Consulting Australia Level 3/169 Pirie Street Adelaide, SA 5000
STRUCTURAL AND CIVIL CONSULTING ENGINEERS	TMK Consulting Engineers 100 Pirie Street Adelaide, SA 5000

CONTENTS

1 GENERAL 1
1.1 CROSS-REFERENCES 1
1.2 PROJECT DETAILS 1
1.3 DEFINITION OF TERMS 1
1.4 CONTRACT 2
1.5 DRAWINGS 2
1.6 LEGISLATIVE REQUIREMENTS 3
1.7 SCOPE OF WORKS 3
1.8 PERFORMANCE SOLUTIONS 7
2 CONTRACT SUBMISSIONS 9
2.1 TENDER SUBMISSIONS 9
2.2 PRE-CONSTRUCTION SUBMISSIONS 9
2.3 CONSTRUCTION SUBMISSIONS 10
2.4 POST-CONSTRUCTION SUBMISSIONS 11
3 QUALITY AND WORKMANSHIP 13
3.1 GENERAL 13
3.2 DESIGN REQUIREMENTS 13
3.3 UNIFORMITY 14
3.4 WARRANTIES 15
3.5 PAINTING 15
3.6 FIRE-STOPPING PENETRATIONS 15
3.7 FIRE SERVICES DURING CONSTRUCTION 15
4 SITE WATER SUPPLY 17
4.1 GENERAL 17
4.2 AUTHORITY APPLICATIONS 17
4.3 BACKFLOW PREVENTION 17
5 FIRE BRIGADE BOOSTER ASSEMBLY 18
5.1 GENERAL 18
5.2 DESIGN CRITERIA 18
5.3 ENCLOSURE 19
5.4 SIGNAGE 19
6 PUMPS 20
6.1 GENERAL 20
6.2 DESIGN CRITERIA 20
6.3 FIRE PROTECTION PUMPS – DIESEL TYPE 21
6.4 PRESSURE MAINTENANCE PUMPS 22
6.5 NOISE AND VIBRATION 23
6.6 CONTROLS 24
6.7 ALARMS AND INDICATION 25
6.8 TESTING FACILITIES 25
7 FIRE HYDRANT SYSTEM 26
7.1 GENERAL 26

7.2 DESIGN CRITERIA ... 26
7.3 FIRE HYDRANT VALVES ... 27
7.4 FIRE RESISTANCE ... 27
7.5 TESTING FACILITIES ... 27
8 FIRE HOSE REELS ... 29
8.1 GENERAL ... 29
8.2 DESIGN CRITERIA ... 29
8.3 MANUFACTURE ... 30
8.4 INSTALLATION ... 30
9 AUTOMATIC FIRE SPRINKLER SYSTEM ... 32
9.1 GENERAL ... 32
9.2 DESIGN CRITERIA ... 32
9.3 SPRINKLER CONTROL VALVE ASSEMBLIES ... 33
9.4 SPRINKLER HEADS ... 34
9.5 SPARE SPRINKLERS ... 36
9.6 TESTING FACILITIES ... 36
10 PIPEWORK AND VALVES ... 37
10.1 GENERAL ... 37
10.2 DESIGN CRITERIA ... 37
10.3 PIPEWORK MATERIALS ... 37
10.4 FITTINGS AND PIPE COUPLINGS ... 39
10.5 INSTALLATION OF PIPING ... 40
10.6 UNDERGROUND PIPEWORK ... 41
10.7 PIPE SUPPORTS ... 43
10.8 NOISE AND VIBRATION ... 44
10.9 VALVES ... 44
11 PORTABLE FIRE EXTINGUISHERS AND FIRE BLANKETS ... 46
11.1 GENERAL ... 46
11.2 DESIGN CRITERIA ... 46
11.3 PORTABLE FIRE EXTINGUISHERS ... 46
12 TESTING AND COMMISSIONING ... 47
12.1 GENERAL ... 47
12.2 TESTING ... 47
12.3 COMMISSIONING ... 48
13 SERVICE AND MAINTENANCE ... 49
13.1 SERVICE CONTRACT ... 49
13.2 MAINTENANCE WORKS ... 49
13.3 ONGOING TRAINING ... 49
13.4 CERTIFICATION ... 49
APPENDIX A TENDER PRICE BREAKDOWN ... 51
APPENDIX B SCHEDULE OF RATES ... 52
APPENDIX C SCHEDULE OF TECHNICAL DATA – SUPPRESSION SYSTEMS ... 53
APPENDIX D SCHEDULE OF SUBCONTRACTORS AND PERSONNEL ... 55

1 GENERAL

1.1 CROSS-REFERENCES

All work covered within this specification shall be read in conjunction with the following trade packages and contracts. Should any discrepancy occur between the references the larger/greater shall be assumed and referred to the Engineer prior to proceeding with any works.

- Preliminaries and General Conditions of Contract
- Architectural Documentation
- Mechanical Services Documentation
- Electrical Services Documentation
- Hydraulic Services Documentation
- Structural Drawings for details of footings, piers, beams, columns or the like
- Geotechnical soil reports
- Civil Services Documentation
- Fire Engineering Report

The above documents shall be made available upon request through the head contractor.

1.2 PROJECT DETAILS

The works described within this specification pertain to the Fire Services installation at 168 Prospect Road, Prospect.

The works shall involve the installation of a combined hydrant/sprinkler system, hose reel, fire extinguishers and fire detection system as documented within the fire services drawings and within this specification.

1.3 DEFINITION OF TERMS

Consulting Engineers	-	Lucid Consulting Engineers
Proprietor	-	Client or end user of the proposed building
Architect	-	Studio Nine Architects
Head Contractor	-	Building Contractor appointed to carry out the construction of the building. Fire Contractor shall enter contract to undertake the Fire Services installation with the successful Head Contractor.
Contractor	-	Installer undertaking the works, who shall be appropriately licensed and a member of the NFIA and/or the FPA
Works	-	As described within this specification

Provide	-	Supply, install, commission and place into service
Equal Approved	-	Alternative product/method of installation which is presented to the consulting engineer and written approval is received.

1.4 CONTRACT

Fixed Price Lump Sum Contract

The Fire Services Contractor is to enter into a fixed price lump sum type contract. The following specification and accompanying drawings outline the general scope of works and have been prepared to enable specialist Fire Contractors to submit fixed sum tender prices for the fire services installation. The drawings are intended to indicate the principles of design and should not be taken to define all offsets, bends etc which may be required to complete the installation and or be coordinated with other services. The Fire Services Contractor will be responsible for final coordination with other trades and for final coordination with Architectural Drawings and building structure.

The tender drawings are not to be used for architectural or structural work but are to be read in conjunction with architectural, structural and other relevant drawings.

Coordinate all pipe runs with "MECHANICAL, HYDRAULIC AND ELECTRICAL SERVICES" trade to ensure non-clashing of services.

Deviation from the design principals shown will not be permitted without the written consent of the Superintendent.

Any discrepancies which may affect the installations shall be brought to the Superintendents attention before the work proceeds.

The Contractor shall also familiarise himself with the location of existing pipe and cable runs. No variation will be issued for any damage caused to existing services.

1.5 DRAWINGS

Refer to the following drawings accompanying this specification:

Drawing No.	Title	Revision
LCE12584-F01	GROUND AND FIRST FLOOR FIRE SERVICES ARRANGEMENTS, DRAWING INDEX AND GENERAL NOTES.	T1
LCE12584-F02	SECOND AND THIRD FLOOR FIRE SERVICES ARRANGEMENTS.	T1
LCE12584-F03	LEGEND OF SYMBOLS AND DETAILS.	T1

The arrangements and details indicated on the above drawings are approximate only. Check all dimensions and building details prior to commencement of the work.

1.6 LEGISLATIVE REQUIREMENTS

Comply in all respects with the requirements of the current standards applicable to the works in respect to equipment, material, workmanship and installation techniques.

The works must comply with the rules and regulations:

Reference Name	Authority/Corporation	Document(s)
Local government	SA Government	Development Act 1993 Development Regulations 2008
	Australian Building Codes Board	National Construction Code 2016
Local water authority	SA Water Corporation	Conditions of Connection
Local power authority	SA Power Networks	Supply Regulations
Local fire authority	SA Metropolitan Fire Service	Conditions of Connection Policies and Guidelines
Work, Health and Safety authority	Safework SA	

Technical Codes and Standards applicable to each fire services system installation are listed within each section of this specification.

1.7 SCOPE OF WORKS

The work covered by this specification includes the following.

1.7.1 General Requirements

- The detailed design, supply, installation, testing, commissioning, maintenance, service and warranty and all sundry and material items, whether mentioned in detail or not, required to complete the installation and place into working order.
- The planning, scheduling, procurement of components and installation to meet the programme, coordination and liaison with the head contractor and other trade packages.
- Full responsibility for the execution of the complete installation in accordance with this specification and drawings.
- The provision of a Fire Services installation that satisfies all statutory legislative, local authority, code requirements and satisfies the general details herein.
- Compliance with all relevant Occupational Health, Safety and Welfare legislation and best practice including any site-specific requirements or regulations such as attendance at site inductions and adherence to the procedures covered in such inductions.

1.7.2 Description of the Installation

Site Infrastructure

- Application to the water authority for towns mains connection, for dedicated fire connection including payment of associated fee.
- Provision of backflow prevention of fire service at the property boundary in accordance with the requirements of the local water authority.
- Diesel fire pumpset to serve fire hydrant system including provision of lagged diesel exhaust and weatherproof discharge to atmosphere.
- 240V consumer mains powered automatically controlled jocking pump. 240V single phase power supply and terminations to jacking pump to be undertaken by electrical services trade.
- Combined fire sprinkler/hydrant suction and booster facility complying with the requirements of the local fire authority and AS2419.1-2005.
- Remote pump controls within the booster assembly.

Fire Hydrant System

- Provision of fire hydrant system including provision of associated trenching, backfilling and making good of surfaces.
- Provision of fire hydrant system including provision of isolation valves and fire hydrant valves.
- Annubar testing and fire authority commissioning as required.
- Provision of fire hydrants within fire isolated stairs.
- Fire hydrant system block plans.
- Application to fire authority or independent testing authority for booster testing of the combined sprinkler/hydrant system (upon completion of works) including payment of associated fees.

Fire Hose Reels

- Fire Hose Reels located as indicated on drawings including associated statutory signage and provision of testable double check valves where required to satisfy the local water authority's requirements.

Automatic Fire Sprinkler System

- Fire Sprinkler Control valves located within fire brigade booster facility complete with powder coated sheet metal enclosure and statutory signage.
- Fire sprinkler installation throughout all areas in accordance with AS 2118 including:

  - Exposed fast response sprinkler heads to Ordinary Hazard Group II classification within the car park areas.
  - Fast response window wetting sprinkler heads to second and third floor windows as indicated on the fire services drawings.

- Flow switches at the fire sprinkler control valve and interface to the Fire Detection Control and Indicating Equipment for fire authority notification and occupant warning system/sound and intercom system for emergency purposes.

- Remote test valves to simulate single fire sprinkler head operation and test flow/pressure switches.

- Annubar testing and fire authority commissioning as required.

- Provision of eight (8) additional fire sprinklers to account for coordination with architectural features, structure and other services. Should these sprinklers not be utilised during project works, allow to handover to the client at practical completion in original packaging.

Portable Fire Extinguishers

- Portable fire extinguishers of type and at locations as nominated on the drawings, including signage in accordance with AS 2444.

- Provisions of vandal and weather resistant enclosures as nominated.

General

- Testing, commissioning, service and warranty.

- Operating and Maintenance Manuals (three copies off) including all related approval documentation e.g. Electrical certificates of compliance, completed installer's statements.

- Preparation of work-as-executed drawings.

- Preparation of Fire Safety Log Books for all required fire safety systems.

- Provision of tactical fire plans.

- Application to the fire authority for testing of the entire system (upon completion of works) including wet system booster testing and payment of all associated fees and charges.

- Maintenance, warranty and defects liability extending for a period of 52 weeks from date of practical completion of the project. Maintenance procedures to be strictly in accordance with the requirements of the relevant legislation.

- Provision of completed maintenance certificate at the end of the 52 weeks defects and liability period. The maintenance certificate shall state that the systems operate in accordance with the requirements of the relevant legislation. The certificate shall take the format required within the relevant legislation.

- All associated building work unless specifically nominated below. This work shall include setting out and providing penetrations for all floor and wall penetrations for pipework and cabling, fire stopping penetrations, making good and painting.
- Painting, identification and labelling of all plant, equipment and piping systems.
- Seismic restraint of all plant, equipment and piping systems.
- All other items necessary to form a complete and approved system.
- All rubbish is to be disposed of in the designated waste disposal area as directed on site. All rubbish is to be disposed of in this manner the same day that it is generated.
- Works to be coordinated with management to ensure continuity of trade. Maintain clear communications with Building Owners representative at all times.
- Provision of all statutory signage as required by AS1670, AS2118, AS2419, AS2441 and AS2444 unless otherwise nominated as being the responsibility of other trades.
- Associated works as necessary to complete the installation and as set out below.

1.7.3 Variations to the Scope

Instructions may be issued throughout the project which may alter the scope of works. Any aspects of any such works which are not specifically mentioned in any instruction are to comply with this specification.

Any claims for any additional costs or credits for any such variations must be submitted with a complete breakdown of costs including quantities and rates for all labour, materials and equipment. Variation Claims submitted without breakdowns will be rejected.

1.7.4 Substitutions

Where a substitution to the specification is proposed, the contractor shall submit each substitution, incorporating technical details and a cost breakdown, to the head contractor. The substitution shall be reviewed by the consulting engineer and the client for consideration. Unless approved by the consulting engineer and the client, the substitution will not be acceptable as an equal or approved approach to the specification.

1.7.5 Associated Works

The following works related to the fire services installation shall be carried out by the Head Contractor's related trades. Provide any additional work required for the completion and full operation of the fire services works.

Electrical Services

- Provision and termination of 230V single phase power supply to diesel pump set control panel.
- Provision and termination of 230V 15A single phase power supply to automatic jocking pump.

- Provisions of terminal strips at the access control panel/security control panel for signal cabling to monitor gate valves within sprinkler/hydrant booster.

Hydraulic Services

- Provision of trapped tundish within sprinkler/hydrant booster enclosure for fire water test drains.
- Provisions of 300 x 300 x 300 floor sump within the fire pump room for collection of fire pump cooling water discharge.

Structural Steel

- Provision of formed openings within structural steel to allow for the passage of fire sprinkler pipework in areas as nominated on the fire services drawings.
- Provision of formed openings within structural steel to allow for the passage of fire hydrant pipework in areas as nominated on the fire services drawings.

Building Related Trades

- Provision of fire hydrant enclosure including powder coated sheet metal doors with budget locks.
- Provision of sleeved penetrations in concrete slabs for pipework/cable penetrations.
- Patching and fire rating around penetrations to retain fire-rated integrity.
- The building works trade shall provide a fire booster enclosure including powder coated sheet metal doors with budget locks and concrete plinth with weep holes falling a minimum of 40mm towards the front over the depth of the cabinet in accordance with AS2419.1-2005.
- The building works trade shall allow to construct a fire rated pump housing within the ground floor carpark area, complete with lift-off or swing type doors along the length of the enclosure to allow accessibility for maintenance. Building works trade shall allow to bund and fall the fire pump room to the floor drain to be provided by the hydraulics services trade.
- The building works trade shall provide formed penetrations external wall panels for the provision of window wetting fire sprinklers. Fire services trade shall allow for any escutcheons required to complete the fire sprinkler installation.
- The building works trade shall allow to bund and fall the fire pump room to the floor drain to be provided by the hydraulics services trade.

1.8 PERFORMANCE SOLUTIONS

The fire services design outlined within this specification incorporates deviations from the Deemed-to-Satisfy Provisions of the Building Code of Australia. These deviations have been justified and accepted as Performance Solutions through consultation and documentation with the project stakeholders.

Refer to the Fire Engineering Report for details of these Performance Solutions. The Fire Engineering Report can be made available through the Head Contractor.

The Performance Solutions pertaining to the fire services installation are summarised as follows:

- The protection of operable openings to the building within 3 metres of and perpendicular to the property boundary through the provision of 'Crimsafe' fire attenuation screens.
- The protection of operable openings to the building within 3 metres of and parallel to the property boundary through the provision of 'Crimsafe' fire attenuation screens and window wetting sprinklers to AS 2118.2 requirements.
- The protection of openings to the building within 3 metres of the boundary presented by the car park space, through the provision of fire sprinklers to AS 2118.1 OH II spacing requirements.
- To permit the provision of feed fire hydrant flows and pressures at the booster town's main outlet in lieu of attack hydrant flows and pressures at the two most disadvantaged hydrant outlets.

Provide a printed list of the above Performance Solutions on a laminated A4 sheet within the Fire Panel cabinet, and list also within the Operating and Maintenance Manual.

2 CONTRACT SUBMISSIONS

The contractor shall prepare and submit the items in each section identified below to the consulting engineer for approval.

2.1 TENDER SUBMISSIONS

The submissions required at tender shall incorporate, as a minimum, all information defined within the Appendices of this Specification. Any appendices not completed in entirety will be rejected.

2.2 PRE-CONSTRUCTION SUBMISSIONS

2.2.1 Samples

Submit the following sample equipment prior to commencing construction:

- Fire sprinkler heads
- Fire Pumps – brochure acceptable
- Diesel Fire Pump Muffler – brochure acceptable
- Signage

Do not commence work affected by the samples until approval for the sample has been obtained.

2.2.2 Workshop Drawings

The contractor must prepare workshop drawings from which the contract works shall be built.

Submit one copy of drawings (digital or print) for approval prior to commencing manufacture or installation.

Workshop drawings shall all be on the same size drawings sheets and shall be of a scale not less than 1:100 and larger where necessary.

Workshop drawings shall cover the following parts of the work:

- All wall, floor and ceiling penetrations.
- Pipework layouts including details of constructions, supports anchoring, expansion, fixing, dimensions, etc.
- Coordinated reflected ceiling plans indicating all sprinklers, fire detectors, occupant warning devices, air outlets and lights.
- Pipework and Detection schematics
- Fire booster, Fire pump room and Sprinkler Control Valve Cabinet details and set-out (minimum 1:20 scale).

- All signage locations on plans and elevations.

Examination of shop drawings shall not remove from the Contractor the responsibility for the correctness of the dimensions on such drawings nor compliance with Statutory Regulations or the requirements of this specification.

The Fire Services Trade Contractor shall coordinate with all other trades to ensure non-clashing of services.

Submit shop drawings with due account for the construction programme. Allow for 7 days for the return of such drawings. If requested submit a full document issue sheet detailing all shop drawing issue dates, return dates, re-submission dates and dates for outstanding drawings.

2.2.3 Calculations

The contractor shall allow undertaking of all relevant calculations for the works including the following:

- Hydraulic calculations using an approved proprietary program i.e. Hyena or approved equal

All calculations shall be submitted to the consulting engineer for review prior to the order of any equipment.

2.2.4 Factory Test Certification

Provide factory test certificates for the following:

- Fire Pumpsets including Jocking Pumps

2.3 CONSTRUCTION SUBMISSIONS

2.3.1 Authorities, Permits, Fees, Certificates and Approvals

All works shall be carried out in accordance with the requirements of the local authorities including but not limited to the local water authority, electricity authority, local fire authority, the building certifier and to the satisfaction of the Superintendent. Allow to pay all fees relevant to the fire services package.

All fire service installations shall be inspected by the local fire authority prior to practical completion on the project. The contractor shall allow for payment of all associated inspection and testing fees.

All in-ground pipework shall be tested to the requirements of the relevant water supply authority and hydrostatically tested as detailed in this specification. The contractor shall allow for payment of all associated inspection and testing fees (if applicable).

The contractor shall upon completion of testing and commissioning, certify that the works have been completed and in accordance with the National Construction Code and relevant Australian Standards. Any alternative solutions to the deemed to satisfy provisions of the Building Code of Australia shall also be included within this certification.

This certification shall take the format of an 'Installer's Statement' as specified in the relevant legislations. Where not required by the relevant legislation, provide certification as outlined within the Appendices of the relevant installation standards.

In addition to the installer's statement, the Contractor shall procure a certificate of practical completion indicating a satisfactory installation from all relevant authorities and lodge same with Superintendent on completion of the Contract.

The final certificate for payment will not be issued until this requirement has been fulfilled.

2.3.2 Commissioning and Witnessing Plans

The contractor shall submit for approval a detailed commissioning plan indicating step by step testing strategy for all equipment. The commissioning plan shall be developed in conjunction with the building trade construction programme and shall be submitted to the head contractor and consulting engineer for review prior to any commencement of commissioning. The fire services contractor shall be responsible for providing commissioning duration period to head contractor for inclusion in the construction programme.

2.4 POST-CONSTRUCTION SUBMISSIONS

2.4.1 As-Installed Drawings

Prior to practical completion, "As-Installed" drawings shall be submitted for approval.

As-Installed drawings shall be based from the approved Workshop drawings, amended to accurately reflect the final equipment selections and system installations on site.

Hard copies of the approved As-Installed drawings, along with a digital copy on a CD or USB flash drive, shall be included within the Operating and Maintenance Manuals.

2.4.2 Operating and Maintenance Manuals

One (1) hard copy of the Operations and Maintenance Manuals shall be submitted to the Consulting Engineer for review and comment prior to practical completion being achieved. Operating and Maintenance manuals shall be written in clear concise English, containing a title page listing suppliers' names, addresses and telephone numbers, a table of contents, and as a minimum include the following sections:

- Table of Contents
- Contractor's Name, Address, Telephone number and emergency telephone numbers available 24 hours
- General description of the installation, written as briefly as possible, consistent with providing a general understanding of its features and operation.
- Written text on the method of operation of all installed systems
- Suppliers contact details
- Schedule of Technical Data

- Equipment/Manufacturer's specifications and relevant datasheets
- List of guarantees and warrantees of Equipment Suppliers
- Commissioning documentation including Installer's Statements
- Alternative Solutions summary sheet
- Test data and authority certificates
- Hydraulic calculations
- Battery calculations
- Diesel pump exhaust sound pressure level testing
- Routine and Preventative inspection and maintenance requirements and procedure as specified in the referenced legislation, or manufacturer's specifications
- As installed drawings (Full size and A3 size) and CDROM of AutoCAD files (2 off) copy
- Fire Alarm Block plans including nomination of Gas Meter and Main Switch Board location (as applicable).

The Operating and Maintenance manual shall be A4 in size (with A3 drawings), printed or typed on durable printing paper, with each page consecutively numbered, and neatly bound in durable red vinyl hard back covers with embossed gold lettering on the front and on the spine.

Following review of this Operations and Maintenance Manual by the consulting engineer, the contractor shall make all relevant modifications to documentation and provide a minimum of three (3) hard copies in A4 lever arch folders and three (3) soft copies in PDF format on a write protected USB 'flash drive'.

3 QUALITY AND WORKMANSHIP

3.1 GENERAL

The tender drawings indicate the sizes of pipes and the approved pipework routes throughout the building. They do not, however, purport to show all minor pipework offsets, hangers, method of fixing and clearances, all of which must be coordinated with other trades, measured on site and in accordance with AS 2419.1 and AS 2118. All piping arrangements shall be shown in detail on shop drawings and approved in general detail prior to commencement of installation.

All work shall be installed in an approved manner to meet structural and architectural conditions.

3.2 DESIGN REQUIREMENTS

Design criteria below forms the basis of the design of the works inclusive of any alternative solutions pertaining to the Building Solution.

3.2.1 Design for Environmental Conditions

The following general design criteria are applicable to the entire installation. Equipment and pipework systems shall be selected and installed with guarantee to operate without fault or failure under the nominated conditions for each component.

Criterion	Requirement
Extreme ambient conditions (maxima) under which all systems and services shall operate	46°C dry bulb 24°C wet bulb Full solar load
Extreme ambient conditions (minima) under which all systems and services shall operate	2.0°C dry bulb

Componentry located externally to the building and exposed to the ambient environmental conditions shall be suitably selected and installed for protection against corrosion, and ingress of moisture and dust.

3.2.2 Design for Earthquake Actions

All fire services componentry must be designed to resist earthquake actions, in accordance with the requirements of AS 1170.4-2007, without exception.

Provide restraints and supports designed and certified by a structural engineer, to all plant, equipment, tanks, pipework, supports and isolation mounts in accordance with AS 1170.4-2007 Section 8, incorporating the following design criteria:

	Symbol	Factor
Criteria		
Importance Level	I	2
Annual Probability of Exceedance	yr	500
Soil Classification		De
Hazard Factor	Z	0.1
Probability Factor	Kp	1
Structural Classification	EDC	2

For further information regarding earthquake restraining, refer to following:-

- Gripple Seismic Installation Manual
- Tyco flow control, 2002, Unistrut seismic bracing systems
- Fema e-74, January 2011, reducing the risks of non-structural earthquake damage - a practical guide.

All restraints and supports shall be issued to the structural engineer to review the adequacy of the structure to support the services loads, including seismic forces. Proof of formal review and approval by structural engineer shall be provided as part of the shop drawing review process.

Where internal expertise is not available to the contractor, formal engagement of a registered structural engineer shall be sought for design of earthquake restraints. Cost of engagement shall be included in Tender pricing and listed as a separate item when applicable.

The spacing of bracing along a run of piping or conduit should not vary greatly in order to ensure uniform deflection and loading.

Each unit of equipment connected to a run of piping or conduit shall be individually and independently braced. Thermal expansion and contraction forces, where present, must be considered in the layout of transverse and longitudinal braces. Flexibility should be provided where pipes pass through structural seismic or expansion joints, or connect to equipment with vibration isolators.

Services components and supports shall have a minimum of 50 mm clearance from all ceiling hangers and the ceiling grid.

Do not core through, cut through or otherwise damage steel reinforcement in concrete slabs, beams or columns when installing seismic bracing.

3.3 UNIFORMITY

Uniformity of type and manufacturer of each individual device and fitting shall be maintained throughout the project.

All devices and equipment shall be approved and listed by CSIRO ActivFire, and/or FM Global and Underwriters Laboratories as applicable.

3.4 WARRANTIES

All equipment and workmanship to be provided with a warranty.

Warranties shall commence at date of practical completion and shall extend for a minimum of 12 months.

3.5 PAINTING

All concealed pipework and metal surfaces, excepting galvanised surfaces, shall be supplied with one coat of red zinc chromate primer applied. The paint shall be undiluted and in accordance with the appropriate SAA Code. All surfaces to be painted shall be thoroughly dry, cleaned down, free from weld splatter, burrs, dust, rust, cement and grease and the like.

Exposed pipes, valves, conduits, wiring ducts, cable trays, brackets, frames, covers, etc. shall be painted with at least two coats of best quality oil paint of a colour nominated by the consulting engineer.

Items of equipment e.g. pumpsets, switchboards, control panels etc. shall be painted off site. Where damage occurs to the paintwork of such equipment, the damaged item shall be refinished with primer and final coats to restore the surface to its specified conditions of colour, finish and quality.

All switchboards, control panels and the like shall be cleaned down and polished with automotive polish prior to practical completion.

Galvanised surfaces shall be etch-primed before painting.

Damaged or unsatisfactory painting shall be made good.

3.6 FIRE-STOPPING PENETRATIONS

Where services penetrate fire walls, floors or other fire-rated barrier, sealant for those penetrations shall be sealed to the approval of the relevant Authorities.

Tenderers shall note the specific requirements to fire stop all pipework and cable penetrations through each floor and fire-rated wall.

Submit details of proposed fire resistant sealants for approval prior to installations.

Upon completion of the project, provide written confirmation to the Superintendent that the above requirement has been complied with.

3.7 FIRE SERVICES DURING CONSTRUCTION

3.7.1 Progressive Installation

The Fire Services Contractor shall program their works so that the construction site is provided with an operational fire hydrant service in accordance with BCA clause E1.9. The required

hydrant booster connection must be installed early in the programme to enable the fire brigade to utilise the hydrant risers during construction.

The Fire Services Contractor shall allow to meet with the local fire brigade operations crew on site to discuss and agree the configuration of firefighting facilities on the site during construction.

3.7.2 Protection of Equipment

At all times during storage and during installation, pipes shall have snug fitting covers in place over open ends. Rag, wood plugs, etc., shall not be used to cover ends of pipes. Suitable covers shall be of pressed steel or plastic.

Electronic equipment shall be stored in protected areas or provided with shrouds once installed to prevent damage from weather, dust, spills and the like.

Protective caps for sprinkler heads and fire detection devices shall be fitted until all installation works have been completed. Remove caps prior to final inspections.

Where construction works introduce risk to installed components, provide suitable protection to prevent damage, or remove from site.

4 SITE WATER SUPPLY

4.1 GENERAL

The water supply for the site fire services systems shall consist of the following:

- A single dedicated ø150 fire services connection to the existing ø200 towns' mains in Prospect Road.

The water supply shall be a Grade 3 supply in accordance with AS 2118.1-1999.

4.2 AUTHORITY APPLICATIONS

The Contractor shall be responsible for making applications to the water authority for fire water connections to the towns mains. The Contractor shall pay all associated fees.

The Contractor shall be responsible for making applications to the water authority for combined domestic cold water and fire water connections to the towns mains. Coordinate payment of associated fees with the Hydraulic Services trade.

4.3 BACKFLOW PREVENTION

Provide all necessary backflow prevention valves in accordance with the requirements of the local water authority and as nominated on drawings.

Provide a testable single check valve on the incoming site water supply, located within the fire brigade booster assembly enclosure in an accessible location.

Refer to Section 10 for valve specifications.

5 FIRE BRIGADE BOOSTER ASSEMBLY

5.1 GENERAL

Provide a fire brigade booster assembly as located on drawings. The booster assembly shall generally incorporate the following components:

- Backflow prevention valve
- Isolation valve
- Double-headed feed fire hydrant from the towns mains supply
- Fire hydrant system boost (inlet) connections
- Fire sprinkler system boost (inlet) connections
- Pressure signage
- Pump discharge pressure gague.
- Flow direction arrows on pipework
- Block plans

Refer to drawings for specific arrangement and details.

5.1.1 Cross-References

Refer to Section 7 for fire brigade booster assembly requirements.

Refer to Section 10 for pipework material specifications.

5.2 DESIGN CRITERIA

The minimum design criteria that the fire brigade booster assembly must achieve are listed as follows:

Criterion	Requirement
Number of hydrant system booster connections	4
Number of sprinkler system booster connections	-
Number of feed hydrant connections	4
Minimum flow rate per feed hydrant	10 L/s
Minimum pressure at feed hydrant	200 kPa

5.2.1 Codes and Standard

The following Codes and Standards are applicable to the installation and must be adhered to in all respects unless otherwise noted.

Code/Standard	Year
AS 2118.1	1999
AS 2118.6	2006
AS 2419.1	2005

5.3 ENCLOSURE

The booster assembly shall be located at the front of the site, off Prospect Road within an enclosure constructed by the Head Contractor.

Doors shall be side-hung/lift-off type.

Provide handles and locks in accordance with AS 2419.1-2005.

Provide a concrete base for the booster assembly enclosure to the following specification:

- Minimum 150 mm high.
- Rigid fabricated galvanised sheet steel surround, 1.2 mm thick.
- Structural grade concrete filled with reinforcing mesh insert, trowel finished.
- Provide sloping floor where the enclosure is not lifted above the surface to allow drainage of surface water. Refer to AS 2419.1-2005 Section 7.8.

5.4 SIGNAGE

The fire services trade shall provide signage to the enclosure as per the requirements of AS 2419.1-2005.

The Head Contractor shall provide signage to the enclosure as per the requirements of AS 2419.1-2005. The fire services trade shall provide guidance to the Head Contractor to ensure signage is correctly provided.

Signage shall be as follows:

- Lettering shall be not less than 50 mm high, in a colour contrasting to the background.
- Signage shall state: "COMBINED SPRINKLER AND HYDRANT BOOSTER AND SPRINKLER CONTROL VALVE".
- "FH" symbols shall be provided as per the requirements of the relevant Standard where a feed hydrant is located within the enclosure.

6 PUMPS

6.1 GENERAL

The work covered by this section of the specification includes the finishing of all labour, equipment, materials and performance of all control functions associated with the Fire Services Pumps.

Comply with AS 2941-2013, AS 2118.1-1999, AS 2419.1-2005 and AS 2118.6-2012 and supply and install pumps designed and constructed in accordance with these Standards.

The following pumps shall be provided:

- In-line diesel pumpset located within fire pump enclosure within the ground floor carpark.
- Electric-drive automatic jockey pump to maintain uniform mains pressure in the system.

6.1.1 Cross-References

Refer to Section 10 for requirements for connection of pipework to pumpsets for movement and vibration isolation.

Refer to Section 12 for testing and commissioning requirements.

6.2 DESIGN CRITERIA

The minimum design criteria that the fire pumps must achieve are listed as follows:

Pump	Desig.	Drive	Duty Point 1	Duty Point 2
Fire Protection Pump 1	FP-1	Diesel	5 L/s @ 700 kPa + 50kPa derating	6.5 L/s @ 560 kPa
Jockey Pump	JP-1	Electric	1 L/s @ 1,000 kPa	N/A

6.2.1 Codes and Standards

The following Codes and Standards are applicable to the installation and must be adhered to in all respects unless otherwise noted.

Code/Standard	Year	Description
AS 2118.1	1999	Automatic Fire Sprinkler Systems, Part 1: General Requirements.
AS 2419.1	2005	Fire Hydrant Installations, Part 1: System Design, Installation and Commissioning.
AS 2941	2008	Fixed Fire Protection Installations – Pumpset System.

6.3 FIRE PROTECTION PUMPS – DIESEL TYPE

Use pumps and drivers of identical manufacture and type. Pumps shall be centrifugal, close coupled, single stage, end suction, single discharge, single suction and diesel/electric powered.

Ensure engines have ample capacity to carry system demands without overloading, with maximum impeller fitted, at the specified speed and minimum head.

Allow to provide fire sprinkler protection within the fire pump room. Where the pump room is remote from the building, allow to connect these fire sprinkler heads directly off the pump discharge manifold. Where fire sprinklers are prone to high temperature, allow to select appropriate fire sprinkler bulbs. Fit wire guards to all fire pump room fire sprinkler heads.

For pumps not provided with over speed shutdown, incorporate pump pressure relief valve between pump discharge and discharge non-return valve.

Interface to electrical power and controls/alarms as nominated and allow to provide remote fire pump controls at the booster enclosure.

6.3.1 Internal Combustion Engines

Engines shall be either naturally aspirated or supercharged diesel engine and shall incorporate integral heat exchanger for diesel engine cooling system and dry type air filter on air intakes.

Engines shall incorporate fuel tank, starting motor, two sets of batteries, generator, voltage regulator, exhaust system, fuel system, oil bath, air cleaner, gauges, spare parts and tools.

Incorporate a circulation relief valve.

6.3.2 Heating and Ventilation

The diesel engine shall be fitted with a thermostatically controlled electric crankcase or water jacket heater wired from the control panel to warm the engine so that full load can be accepted immediately after start up.

Air make up is necessary for enclosed pump rooms to avoid heat build-up and to meet combustion air intake requirements of the engine.

A ventilation fan shall be provided to the fire pump room and shall be interlinked to the pump set to operate upon activation of diesel pump set.

Ventilation air openings to room will need acoustic treatment and may need fire damper protection.

6.3.3 Exhaust Flue

Provide an exhaust flue and silencer, to discharge via the roof, for each diesel pumpset.

Exhaust flue shall be constructed of stainless steel, and shall be lagged with a minimum of 50 mm thickness of approved mineral fibre insulation where radiating heat may be a danger to personnel or to comply with codes where passing through the building structure. Provide 0.5 mm stainless steel sheath to all insulated lengths of flue. Sheath shall be painted to architect's approval.

Allow to provide weatherproof chrome discharge flap above roof level. Final location of weatherproof flap is to be coordinated on site.

Refer to Section 10 for noise control specification.

6.3.4 Reserve Fuel

Provide within the fire pump room a 205 L drum of reserve diesel fuel when diesel pump sets are installed.

Stand drum on hardwood timbers inside a 1.2 mm thick galvanised sheet metal drip tray, 100 mm deep.

Install a permanent manual operated rotary pump within fuel drum complete with oil impervious flexible connection pipe.

Install fixed copper piping from drum pump to diesel pump set fuel tank, complete with isolating valve at discharge over tank fill point. The pipe connection shall be configured to provide a minimum of 50 mm sludge space at the bottom of the tank and the sludge space shall be provided with a valved drain at the lowest point of the tank.

6.3.5 Spares and Equipment

Provide diesel pump spares including two off fuel filters, air filters, oil filters and primary drive belts

Locate within dedicated sheet metal cabinet, appropriately labelled.

6.4 PRESSURE MAINTENANCE PUMPS

Provide pressure maintenance pumps in accordance with AS 2941-2013 as scheduled.

6.4.1 Jockey Pumps

A jockey pump shall be provided to maintain uniform pressure within the complete system. The jockey pump shall operate to maintain pressure above the setpoint at which the fire protection pumpset is initiated.

Provide pumps as follows:

- Single or multi-stage centrifugal, direct coupled, in-line, vertical pump (similar to Grundfos CR Series).
- Stainless steel shaft, impeller, guide vanes and outer sleeve. Cast iron pump head, base and coupling. The shaft shall have a mechanical seal and separate anti-friction bearings.
- Jockey pump shall be automatically operated and be powered from the main pump control panel's 240V power supply. Provide manual on/off switch and weatherproof GPO within control valve assembly. Jockey pump shall be self-priming.
- Standalone jockey pumps shall be mounted on galvanised steel stand, bolted to floor slab utilising galvanised dynabolts or similar. Jockey pumps associated with booster pumps may be mounted to a common pump skid.

6.4.2 Pressure Vessel

Provide pressure vessel for pressure dampening to the system to prevent overload of automatic pressure maintenance pumps.

Pressure vessel is to be sized to suit system capacity but should be not less than 24 litres nominal capacity.

Ensure vessel is suitably pressured during pump system commissioning.

6.5 NOISE AND VIBRATION

6.5.1 Noise Control

Achieve specified noise and vibration level criteria.

Provide mufflers/silencers on combustion air intake and lagged exhaust pipe from each pump. Provide a muffler capable of sufficiently attenuating sound pressure levels at the point of discharge to atmosphere to no more than 65 dB(A). Verify this sound pressure level via testing during the commissioning stages of the project.

Silencers shall be provided with flanges or clamps to enable future replacement and shall be installed in accordance with equipment manufacturer's recommendation for size and location.

Statically and dynamically balance rotating machinery.

Complete systems, including individual components, shall not exceed satisfactory levels as set out in AS 1359.0 and AS 2625.

6.5.2 Vibration Control

Select anti-vibration mounts/hangers for life cycle of building.

Selection and installation of anti-vibration mounts shall not conflict with the requirements or performance of systems intended for earthquake control to comply with AS 1170.4-2007. Refer to Section 3.2.2 for seismic design requirement.

Separate from the structure with double thickness neoprene pads or equal, all static equipment in plant rooms with suspended floors.

Construct plinths for all floor mounted equipment.

Select and install anti vibration mounts and hangers in locations to prevent transmission of undue vibration to adjoining areas and distortion or fatigue of equipment, connecting piping and cabling.

Select vibration isolation mounts/hangers to allow for deflections of building structures and finishes and for minimum static deflection as specified.

Use approved methods of electrical cabling/conduit vibration control where connected to rotating equipment.

Neoprene Pads shall:

- Use up to 9mm static deflection.
- Provide loading not greater than 400kPa per pad.
- Protect from grease, oil or sunlight.

6.5.3 Plinths

Provide plinths for pressure maintenance pumps and fire hose reel pumps as follows:

- Minimum 150mm high.
- Rigid fabricated galvanised sheet steel surround, 1.2mm thick.
- Structural grade concrete filled with reinforcing mesh insert, trowel finished.

6.6 CONTROLS

6.6.1 Fire Protection Pumps

Control Panel

Provide an individual control panel for each fire protection pump.

Incorporate jockey pump controls onto one of the fire protection pump control panels.

Use remote control panels for each pump (not directly mounted to pumpset). A minimum of 800mm clear shall be provided in front of each control panel to enable safe access for maintenance and pump operation.

6.6.2 Pressure Maintenance Pumps

Jockey Pump

The jockey pump shall operate automatically as necessary to maintain uniform pressure within the system.

Incorporate jockey pump controls onto one of the fire protection pump control panels.

6.6.3 Pressure Setpoints

Nominal pressure setpoints for control and alarm of the fire protection pumps and pressure maintenance pumps are as follows. These setpoints are indicative only and must be adjusted and verified to suit the final design and installation during the commissioning phase.

Fire Hydrant System

Pressure shall be measured at the in the main hydrant pipework supply, downstream of the hydrant pump.

Pressure	Action
850 kPa	Fire Protection Pump switches ON

950 kPa	Jockey Pump switches ON
1,000 kPa	Target sustained system pressure
1,050 kPa	Jockey Pump switches OFF

6.7 ALARMS AND INDICATION

Comply with AS2941 for all alarms, warnings and indicators including but not limited to those below.

Pump Local Control:

- Activate red strobe and audible alarm at pump enclosure
- Audible alarm on control panel affected

Jockey Pump Automatic Run:

- Activate red strobe and audible alarm at pump room

Low fuel / Low oil pressure / Engine Over speed:

- Activate amber strobe and audible alarm at pump room
- Activate alarm at control panel affected
- Activate secondary alarm on ASE

6.8 TESTING FACILITIES

6.8.1 Flow-Measuring Facility

Provide a 150 mm diameter test pipe from the common manifold from the fire protection pumps, with spigot fittings appropriate for connection of a flow metering device.

Spigot fittings shall be located to ensure appropriate dimensions from valves and elbows are achieved.

Provide two geared butterfly valves complete with isolator. Upstream valves to be locked closed and tamper proof.

7 FIRE HYDRANT SYSTEM

7.1 GENERAL

The fire hydrant system shall reticulate throughout the building via the combined fire sprinkler and hydrant system and shall consist of a sprinkler/hydrant boost facility and single hydrant riser within the stair of the building. Isolated take-offs shall be provided for the supply of water to window wetting sprinklers on the second and third floors.

7.1.1 Cross-References

Refer to Section 5 for fire brigade booster assembly requirements.

Refer to Section 6 for fire hydrant pumpset details.

Refer to Section 10 for pipework material specifications.

7.2 DESIGN CRITERIA

The minimum design criteria that the fire hydrant system must achieve are listed as follows:

Criterion	Requirement
Number of hydrants required to flow	1
Minimum flow rate per hydrant, unassisted	5 L/s
Minimum pressure at hydrant, unassisted	700kPa
Minimum flow rate per hydrant, assisted	10 L/s
Minimum pressure per hydrant, assisted	700 kPa

7.2.1 Codes and Standards

The following Codes and Standards are applicable to the installation and must be adhered to in all respects unless otherwise noted.

Code/Standard	Year	Title/Description
BCA Section E1.3	2016	Fire Fighting Equipment: Fire Hydrants.
AS 2118.1	1999	Automatic Fire Sprinkler Systems, Part 1: General Requirements.
AS 2118.6	2006	Automatic Fire Sprinkler Systems, Part 6: Combined Sprinkler and Hydrant.
AS 2419.1	2005	Fire Hydrant Installations, Part 1: System Design, Installation and Commissioning.

7.3 FIRE HYDRANT VALVES

Provide fire hydrant valves in accordance with the local fire authority requirements with oval spindles or chain and padlocks (utilising Lockwood 003) to deter vandalism within the fire isolated stairways as indicated on drawings. Ensure that final fire hydrant and standpipe locations are coordinated with the final landscaping, civil and the like, design does not impede on egress requirements and that clearances around the fire hydrant valve are maintained in accordance with AS2419.1.

Ensure that each fire hydrant valve is provided with caps provided with captive chains and maintenance tags.

Ensure that all external fire hydrant up stands and valves are painted signal red (R13 as per AS2700).

7.4 FIRE RESISTANCE

For fire hydrant pipework located outside the fire isolated stairway in a non-sprinkler-protected area, it shall be provided with a means of protection from the effects of fire for a minimum duration of 60 minutes. This may be via:

- Enclosing fire hydrant pipework with fire-rated construction; or
- Provision of fire-rated treatment to the pipework supports to achieve a FRL not less than 60/-/- whilst maintaining a pipe-support temperature of 500°C when tested in accordance with AS 1530.4; or
- Other measures to prevent early collapse when exposed to fire.

7.5 TESTING FACILITIES

7.5.1 Remote Test Valve Assembly

Provide a remote test valve assembly at the location of the most hydraulically-disadvantages hydrant valve location.

Test piping shall be minimum 25 mm nominal bore, and shall extend to drain to waste.

Provide an isolation valve for the assembly in an accessible location. This isolation valve shall be secured in the closed position, and provided with a Lockwood 003 key. Provide a label to the isolation valve as follows:

- Lettering not less than 8 mm high, in a colour contrasting to the background.
- Label shall state: "HYDRANT REMOTE TEST VALVE – TO BE LOCKED SHUT".

Provide a pressure gauge adjacent the isolation valve in a visible location.

8 FIRE HOSE REELS

8.1 GENERAL

Provide fire hose reels as indicated on the drawings. Fire hose reels must be located no further than 4 metres from exit doors in accordance with the BCA, unless otherwise specified.

8.1.1 Cross-References

Refer to Section 10 for pipework material specifications.

8.2 DESIGN CRITERIA

The minimum design criteria that the fire hose reel system must achieve are listed as follows:

Criterion	Requirement
Relevant BCA Clause(s)	E1.4
Relevant Standard(s)	AS 1221-1997 AS 2441-2005 AS 2419-2005 (where connected to the fire hydrant system)
Minimum flow rate at nozzle	0.45 L/s
Minimum pressure at nozzle	210 kPa
Pressure reducing station operating range	Up to 1200kPa at a flow of 45L/s.

8.2.1 Codes and Standards

The following Codes and Standards are applicable to the installation and must be adhered to in all respects unless otherwise noted.

Code/Standard	Year	Description
AS 2118.1	1999	Automatic Fire Sprinkler Systems, Part 1: General Requirements.
AS 2118.6	2006	Automatic Fire Sprinkler Systems, Part 6: Combined Sprinkler and Hydrant.
AS 2419.1	2005	Fire Hydrant Installations, Part 1: System Design, Installation and Commissioning.

8.3 MANUFACTURE

Fire hose reels shall be manufactured in accordance with AS 1221. Fire hose reels shall be equipped with 19 mm x 36 m long fire hose reels and approved nozzle.

8.3.1 Colours and Finishes

Fire hose reels shall generally be of standard colour and finish, with exceptions as noted on drawings or as follows:

Location	Finish
Generally	Powdercoat Red

8.4 INSTALLATION

Fire hose reels shall be installed with heights and clearances as nominated in AS 2441-2005 unless otherwise noted.

8.4.1 Water Supplies and Isolation

Water supplies for fire hose reels shall be from the fire hydrant/automatic fire sprinkler/domestic cold water system and as indicated on drawings.

Provide isolation valves on the water supply for all fire hose reels. Isolating valves shall be fitted with an interlock, such that the fire hose nozzle may not be removed until the valve is opened.

Where the fire hose reel system reticulates from the fire hydrant system and serves two or more fire hose reels from a single point, an isolation valve shall be provided at the point of connection. This isolation valve shall be secured in the open position, and provided with a Lockwood 003 key. Provide a label to the isolation valve in accordance with AS 2419.1-2005 as follows:

- Lettering not less than 8 mm high, in a colour contrasting to the background.
- Label shall state: “FIRE SERVICE VALVE - CLOSE ONLY TO SERVICE FIRE HOSE REELS”.

8.4.2 Signage

Statutory signage must be installed as nominated on drawings and as per the requirements of AS 2441.

Obtain approval for locations of signage from the architect or consulting engineer on site prior to installation.

8.4.3 Installation in Cabinets

Where indicated on drawings, fire hose reels shall be concealed within cabinets or enclosures, generally in accordance with AS 2441.

Joinery cabinets shall be provided by other trades as nominated by the head contractor. Sheetmetal cabinets shall be provided by the fire services trade.

Extended guide arms shall be fitted, and must extend beyond the open cabinet door to reduce the risk of damaging or tangling the hose during operation.

Cabinets shall be provided as follows:

Location	**Cabinet Type**	**Finish/Colour**	**Handle/Lock**
Main entry foyer	Under Stair	As Specified by Architect	Pull-type handle

Sheetmetal cabinets located externally to the building shall be weatherproof.

Where indicated on drawings, sheetmetal cabinets shall extend to floor level to house portable fire extinguishers mounted below the fire hose reel.

9 AUTOMATIC FIRE SPRINKLER SYSTEM

9.1 GENERAL

Provide automatic fire sprinkler protection to the ground floor carpark and external window wetting sprinklers to second and third floor openings to the building as detailed within the fire services drawings in accordance with AS 2118 and the BCA.

The fire sprinkler system shall reticulate from the combined fire sprinkler and hydrant system and connect via a control valve located within the booster facility enclosure off Prospect Road.

Allow to undertake hydrostatic testing of system upon completion of all works to sprinkler system pipework before pressurising with water.

Commission and coordinate Annubar flow testing upon completion of the works and allow for payment of all associated fees (if applicable). Ensure that Annubar testing is undertaken simultaneously with fire hydrant testing if the fire sprinkler and hydrant systems are combined. Ensure all testing is scheduled with sufficient notice so as not to delay practical completion.

9.1.1 Cross-References

Refer to Section 4 for water supply details.

Refer to Section 6 for fire sprinkler system pumpset details.

Refer to Section 5 for fire brigade booster assembly requirements.

Refer to Section 10 for pipework material specifications.

9.2 DESIGN CRITERIA

The minimum design criteria that the automatic fire sprinkler system must achieve are listed as follows:

Criterion	Requirement
Relevant BCA Clause(s)	E1.5
Relevant Standard(s)	AS 2118.1-1999 AS 2118.6-2012 AS 2118.9-1995 AS 4118-1995

Area	Hazard	Flow Rate/Discharge	Minimum Pressure	Sprinkler Spacing
Ground Floor Carpark	OH II	5 mm/min over 144 m^2	35 kPa	Ordinary Hazard
Window-Wetting	-	75 L/s per head, up to 12 heads	70 kPa	Window-wetting

9.2.1 Codes and Standards

The following Codes and Standards are applicable to the installation and must be adhered to in all respects unless otherwise noted.

Code/Standard	Year	Description
AS 2118.1	1999	Automatic Fire Sprinkler Systems, Part 1: General Requirements
AS 2118.6	2006	Automatic Fire Sprinkler Systems, Part 6: Combined Sprinkler and Hydrant
AS 2419.1	2005	Fire Hydrant Installations, Part 1: System Design, Installation and Commissioning.

9.3 SPRINKLER CONTROL VALVE ASSEMBLIES

9.3.1 Main Componentry

Fire sprinkler control valve assemblies shall consist of (at minimum) the following componentry:

- Stop valve. The valve shall be strapped and padlocked in the normal operating position. Valve position to be monitored by the Fire Detection and Alarm System.
- Alarm valve. A swing check valve or approved equivalent which shall be arranged to admit water to the installation upon fire sprinkler head operation.
- A system test valve shall be installed to allow testing of the installation through it into the fire sprinkler drain. System drain down shall occur at ground level.
- An alarm test valve which shall be arranged so that it may be used for testing the operation of the check valve and pressure switch without the operation of any sprinkler.
- Listed flow switch. Flow switch shall incorporate a manual reset function to enable any alarm to be 'locked in' until reset by authorised personnel when returning system to normal status.
- Pressure gauges, which shall be of the 100 mm dial Bourdon type and shall be arranged to indicate the water pressure on either side of the check valve seat. Alarm setpoints shall be monitored by the Fire Detection and Alarm System. The gauges shall be provided with shut-off valves.

- Flow test facility appropriately sized for the sprinkler design duty point.

All valves (with the exception of drain valves) shall be clearly marked to indicate the direction of rotation and shall have indicators to show whether valve is open or closed. Hand over three (3) sets of all necessary keys to Head Contractor on completion.

9.3.2 Ancillary Equipment

The sprinkler control valve installation shall be provided with the following ancillary items:

- System block plan.
- A diagram of the valve arrangement.
- Emergency instructions in accordance with AS2118 complete with copy of 'as installed' drawings.
- A water and fade resistant block plan in accordance with AS2118.1 Clause 8.3 shall be installed in the sprinkler valve enclosure.

9.3.3 Location Identification

The door to the sprinkler control valve assembly cabinets shall be clearly identified with fade resistant sign as follows:

- With the lettering “SPRINKLER CONTROL VALVE”.
- The lettering shall be minimum height 50 mm in a colour contrasting with that of background.

9.3.4 Enclosure

Provide an enclosure for the sprinkler control valve assembly. The enclosure shall be constructed as follows:

- Fabricated from sheet metal and mounted hard to wall.
- Single hinged door secured with budget type budget (square) key lock.
- Powder coated to specified colour to the architect’s final selection.
- Sized adequately house all control valve assembly items.

9.4 SPRINKLER HEADS

9.4.1 General

Sprinkler heads shall generally be of the type as described below.

Unless otherwise clarified, all sprinkler heads shall be of the quartzoid bulb type, suitably rated and designed for fusing temperatures as follows:

Location	Sprinkler type
Ceiling Mounted sprinklers	
Ground Floor Toilet within Car Park	68°C 15 mm fast response, white powder coated semi recessed pendent type, with white two (2) piece screwed escutcheon plate.
Exposed Sprinklers	
Ground Floor Car Park	68°C 15 mm fast response brass upright type.
External wall wetting fire sprinklers:	93°C 15mm fast response brass side wall fire sprinkler head with wall wetting deflector of Tyco WS Type.

The numbers and arrangement of required sprinkler heads are indicated on the Drawings but not withstanding this, the entire sprinkler installation shall strictly conform to the requirements of AS2118.1.

Allow to provide an additional four (4) off exposed head sprinkler heads per level in addition to those shown on the drawings.

All sprinkler heads selected shall be listed and approved by CSIRO Activfire, FM Global and/or Underwriters Laboratories.

Installation of sprinkler heads shall be in accordance with Manufacturer's Data sheets.

9.4.2 Escutcheon Plates

Escutcheon plates shall be fabricated from steel, aluminium or brass and shall be flat, convex or top hat (recessed) profile to the requirements of the architect or as specified.

Painted escutcheons shall be factory finished with colours as specified by the architect.

9.4.3 Guards

Wherever sprinkler heads are subject to damage or if the head is less than 2300mm from finished floor level the sprinkler heads shall be protected with a passivated zinc plated steel guard suitable for the sprinkler head type installed. The guard shall not affect the spray pattern or function of the sprinkler head.

9.4.4 Baffles

Baffles shall be provided where necessary to prevent sprinkler heads from discharging directly onto electrical switchgear, motors etc. Shields shall be fabricated from galvanised steel and painted to match the surroundings.

9.4.5 Water Shields

Water shields shall be provided where necessary to shield from water discharge from other sprinklers. Shields shall be semi-spherical malleable iron fittings to fix flush to wall and not affect the spray pattern or function of the sprinkler head.

9.5 SPARE SPRINKLERS

A stock of spare sprinklers shall be provided in the Sprinkler Control Valve Cabinet. Spare sprinklers shall be stocked for all types and/or temperature ratings installed within the protected building in accordance with AS 2118.

9.6 TESTING FACILITIES

9.6.1 Remote Test Valve Assemblies

Provide a remote test valve assembly at the end of the most remote range pipe served by each sprinkler control valve set.

Test piping shall be minimum 25 mm nominal bore, and shall extend to drain to waste.

Provide an isolation valve for each assembly in an accessible location. This isolation valve shall be secured in the closed position, and provided with a Lockwood 003 key. Provide a label to the isolation valve as follows:

- Lettering not less than 8 mm high, in a colour contrasting to the background.
- Label shall state: “SPRINKLER REMOTE TEST VALVE – TO BE LOCKED SHUT”.

Provide a pressure gauge adjacent each isolation valve in a visible location.

10 PIPEWORK AND VALVES

10.1 GENERAL

Provide pipework and valves for fire suppression systems as applicable in accordance with this specification.

10.2 DESIGN CRITERIA

Final sizing of pipes shall be subject to final hydraulic calculations carried out by the Fire Services Trade incorporating the performance characteristics of the type of sprinkler head utilised in the installation.

The design, fabrication and installation for piping installed in the Works shall be suitable for a design working pressure of 1200 kPa and a maximum working pressure of one and one half times the design working pressure.

10.2.1 Codes and Standards

The following Codes and Standards are applicable to the installation and must be adhered to in all respects unless otherwise noted.

Code/Standard	Year	Description
AS 2118.1	1999	Automatic Fire Sprinkler Systems, Part 1: General Requirements.
AS 2118.6	2006	Automatic Fire Sprinkler Systems, Part 6: Combined Sprinkler Hydrant.
AS 2118.9	1995	Automatic Fire Sprinkler Systems, Part 9: Piping Support and Installation.
AS 2419.1	2005	Fire Hydrant Installations, Part 1: System Design, Installation and Commissioning.

10.3 PIPEWORK MATERIALS

All above ground pipework unless otherwise nominated shall be either medium wall thickness steel, or lightwall galvanised steel

CPVC pipework will not be accepted.

Light wall pipework will not be accepted

Copper piping will not be accepted for above ground installations

Pipework between the boundary check valve and the town's main shall be copper type A, double denso wrapped, and where necessary cast into the concrete footing. Ensure the Water Authority (or their representative) inspects the pipework prior to pouring of concrete or backfilling trench.

Flexible droppers will not be accepted unless:

- The installing contractor provides a written statement confirming that all flexible droppers are installed in accordance with the applicable standards and technical data.
- At the completion of works, all flexible droppers are realigned where necessary.
- At practical completion, all flexible droppers are realigned where necessary.
- The installing contractor undertakes an audit upon practical completion and provides an as-installed statement that the installation conforms with all applicable standards and technical data.

Comply with the following pipework manufacturing codes and standards:

- Light wall steel pipe and fittings must conform with the minimum wall thickness outlined in AS4118.2.1.
- AS 1074 for steel piping, medium weight grade as a minimum.
- AS 1432 for copper piping, Grade 'B' as a minimum.
- AS/NZS 2280: for ductile iron piping.
- AS/NZS 1477: for UPVC pipes.
- AS 4130 for HDPE pipes
- Comply with pipe fitting manufacturing Codes.
- BS 1640 and BS EN 10241
- ASME B16.9
- ASME B16.28
- Comply with AS/NZS 4791/4792 for hot dipped galvanising.

Do not utilise copper hydrant pipework within non-sprinkler protected buildings unless expressly directed by the Consulting Engineer.

HDPE or UPVC pipework to be utilised for in ground pipework only outside the building perimeter. Utilise Type A copper (double denso wrapped) or 316 stainless steel below building footings and slabs.

All underground pipework fittings shall match the pipework material. In the case of UPVC fittings, provide ductile iron, epoxy coated fittings.

Utilise approved densomastic petrolatum based wrapping system (two coats) for corrosion protection of all underground steel pipework. Extend wrapping 150mm above finished ground level.

Utilise heavy duty pipework support systems where installing galvanised steel hydrant pipework within non-sprinkler protected buildings. Provide sample of proposed pipework support system to the Consulting Engineer for approval prior to installation.

All hydrant pipework to be minimum PN (16) rated unless otherwise stated.

PN (20) pipework may be required to suit specific installation requirements. Obtain clarification form Consulting Engineer prior to ordering of pipework and materials.

10.3.1 Corrosion Protection

Wherever pipework is installed in damp or exposed locations and excessive corrosion may occur or where the Superintendent directs, all piping, supports or other mild steel components shall be corrosion protected by means of hot dipped galvanising or an approved equivalent.

All steel bolts and nuts installed in the locations noted above shall be corrosion protected by means of cadmium plating or approved equivalent.

10.3.2 Fabrication of Steel Piping

Steel piping generally shall be prefabricated at the Fire Sprinkler contractor's factory, using welded, flanged and/or screwed joints and fittings and shall be delivered to site ready for assembly. Welding on site shall not be permitted.

Long lengths of pipe and permanent joints shall be used except where otherwise specified. Pipe offcuts shall not be used to fabricate lengths of pipe.

All pipes shall be cut square with the run of pipe, preferably with a hacksaw, formed to the correct shape for welding and/or threading, ground off smooth and all sharp edges and burrs removed from the bore of the pipe.

10.4 FITTINGS AND PIPE COUPLINGS

For small bore pipework up to DN 50 size utilise screwed fittings as specified below.

For pipe sizes greater than DN 50 size utilise rolled groove fittings and couplings as specified herein.

Pipework shall comprise in-line galvanised coating of minimum weight 100 gm/m^2 in accordance with AS 1650 External Coatings, for pipes up to and including 100 DN and external/internal coating for pipes over 100 DN.

10.4.1 Screwed Fittings

Screwed fittings shall be selected for working pressure not exceeding 1000 kPa.

Malleable iron fittings shall be in accordance with BS1256 - 1968 Malleable Cast Iron Screwed Pipe Fittings, etc., or approved equal.

Screwed joints shall be kept to a minimum, pipes greater than 65mm NB shall not be screwed. Hexagon nipples may be used. Long threads and barrel nipples will not be approved.

Screwed tees shall be kept to a minimum, where range pipe takeoffs occur and/or where sprinkler heads are to be installed, either screwed sockets or welded components similar to "Thredolets" shall be used.

10.4.2 Screwed Joints

Screwed pipe threads shall be in accordance with AS 1722 - 1976 Pipe threads of Whitworth Forms.

Male threads shall be tapered and cut long enough to screw to full depth of female threads (sockets).

Screwed joints shall be sealed with a non-hardening material such as Teflon tape, spun yarn of New Zealand flax, white hemp or sintered PTFE mixed with a soft setting mineral lubricant, inert, non-toxic and solvent free. Only one type of jointing compound shall be used throughout the Works.

10.4.3 Butt Welded

Butt welded fittings shall be in accordance with BS 1640 Steel Butt Welding Pipe Fittings etc.

10.4.4 Fabricated

Fabricated tees, elbows and similar pipe fittings may be fabricated from steel pipe as previously specified. The Fire Sprinkler Trade Contractor shall submit for approval samples of proposed fittings, before commencing manufacture of same.

10.4.5 Mechanical Grooved Couplings

Pipes may be jointed by mechanical grooved couplings consisting of an approved combination of couplings, gaskets and grooves.

Grooves shall not be cut in pipes and rolled grooves shall be dimensionally compatible with coupling.

Gaskets shall be suitable for continuous service for both air and water in the temperature range -40 deg C to 150 deg C, and shall be pliable, smooth and free of obvious surface porosity and mould flash.

When coupling is assembled, gaskets shall be fully enclosed within the housing of the coupling.

10.4.6 Connection to Valves and Other Components

Where valves and other screwed components of plant are indicated, a union or flanged type joint shall be provided in the vicinity of the valve or component to enable same to be screwed without dismantling an extensive amount of piping.

10.5 INSTALLATION OF PIPING

10.5.1 General

All piping installed shall be set out in accordance with the directions of the related Tender documents and shall be installed to secure a neat and workmanlike appearance.

All piping shall be arranged, supported, graded, and drained to suit the duty and/or service conditions applicable and shall be installed complete with all fittings and components connected up and ready for testing.

10.5.2 Expansion and Contraction

The piping shall be arranged with bend and offsets so that the system is sufficiently flexible to absorb the whole of its own expansion and contraction without developing excessive stress in the piping, or in the supporting structure.

10.5.3 Grading and Drainage of Pipes

Sprinkler piping shall be so installed that the system can be thoroughly drained. As far as practicable, all pipes shall be graded to drain to the installation drain valves.

10.5.4 Cleaning Out of Piping Systems

All piping shall be thoroughly cleansed of loose scale and dirt before erection and following erection and sealing of joints shall be thoroughly cleaned out in the presence of and to the satisfaction of the Superintendent.

All piping shall be flushed through with clean water at the highest practicable velocity and the flushing out process shall continue until all foreign matter is removed. The water used shall be progressively discharged from selected points in the system, either to drain or other suitable location.

10.5.5 Pipe Sleeves and Cover Plates

Unless otherwise indicated or approved where pipes exposed to view, pass through walls, floor and ceilings, approved galvanised steel cover plates and sleeves shall be provided, except that where pipe sleeves are located in concealed spaces, plant room etc., cover plates are not required.

Pipes passing through ceiling shall be offset sufficiently to prevent fouling of cornices, mouldings etc.

Grouting in of pipes of size larger than 50mm NB where they pass through walls and/or floors, will not be permitted. Loose fitting cover plates will not be accepted.

10.6 UNDERGROUND PIPEWORK

10.6.1 Segregation

Pipe installed below ground must be adequately segregated from other pipework e.g. stormwater, sewage, domestic water by a minimum of 1500 mm. It is the Contractor's responsibility to liaise with other trades to ensure this segregation is maintained at all times. Thrust blocks shall be installed as required at any change in direction or other locations as specified in the manufacturer's specifications.

10.6.2 Trench Identification

The Contractor shall provide adequate trench identification for all pipework installed.

10.6.3 Trench Excavation

The Contractor shall carry out excavation of substances encountered to the required depths, lengths, breadths, grades and alignment as may be necessary for the construction of the pipe drains in accordance with the Drawings.

If trenches are to be in bitumen or concrete paving, the surface shall be saw-cut where paving consists of unit pavers, blocks shall be removed.

Trenches are to be excavated to the correct line and level with vertical sides at least 300 mm wider (150 mm on each side) than the external diameter of the pipes to be laid in them. Sufficient extra width and depth is to be excavated at each joint to allow the pipes to be properly jointed.

Trenches must be kept clear of water at all times and timbered where necessary to prevent collapse. They shall be excavated only sufficiently in advance of pipe laying to allow that work to proceed without delay.

Excess excavation below the required level shall be backfilled at the Fire Contractor's expense with sand, gravel or other material as directed by the Superintendent, and thoroughly compacted. Any soft or yielding material shall be removed and replaced with sound material and compacted to the satisfaction of the Superintendent.

Suitable safety barriers shall be provided around the excavation at all times. The barriers shall be suitably defined by approved lighting during the appropriate light up time for the area.

The barriers shall not be removed until completion of all work.

Excavated material shall be removed off site. All cartage costs and tipping fees shall be paid by the Fire Contractor. The cost of all works specified above shall be included in the scheduled item for the supply delivery and laying of pipes.

10.6.4 Trench Backfilling

No joints shall be covered or trench backfilled until pipe laying and jointing has been approved by the Superintendent and relevant authorities.

It shall be the Fire Contractor’s responsibility to ensure the inspection and approval of the pipe drains prior to the backfilling.

Failure to observe this clause shall render the Fire Contractor liable for re-opening at his own expense any trench backfilled without approval.

Backfill material shall comply with the relevant services specification section. Generally backfill, including the overlay zone shall be:

- In paved areas or under buildings - quarry sand

Backfill shall be placed in layers not greater than 150 mm thick and compacted to:

- In paved areas or under buildings - 95% Modified Compaction Maximum Dry Density

- Fire contractor to employ independent contractor to perform a minimum of 3 compactions tests with results forwarded to the superintendent and architect. A copy is to be inserted in the hydraulic manuals defining locations of the tests.

10.6.5 Reinstatement of Surfaces

Where surfaces require reinstatement by the fire services contractor, the following shall apply:

For lawn areas: provide 150mm of loam and re-sow the lawn over the trench and other disturbed areas.

- Paving and Roads: reinstate to match adjacent road or paved surfaces and reinstate assets disturbed or removed during excavation of trenches.

- Concrete Surfaces: reinstate concrete surfaces to the original level. If required, provide steel reinforcement fixed to the adjacent concrete and laid to prevent the reinstalled concrete from subsiding and cracking.

- Bituminous Surfaces: Provide crushed rock base and sub base to match the adjacent areas. Prime coat the edges of the existing surfacing with bitumen. Lay and compact asphalt so that the edges are flush and centre is cambered 10mm above the existing pavement. Asphalt thickness must be equal to adjacent pavement thickness but must not be less than 50 mm.

10.7 PIPE SUPPORTS

Pipe supports shall generally be in accordance with AS 2118.9.

Unless otherwise approved or directed, supports shall be of a design which provides for longitudinal movement of the piping. Supports except where otherwise specified, shall be fabricated from substantial mild steel sections and shall be securely fixed in position. Supports and their fixings shall be of adequate strength to withstand the hydraulic and/or other forces to be encountered.

Unless otherwise directed, all pipe supports shall be adjusted prior to painting.

10.7.1 Pipe Support Attachments for Steel Piping

Straps or clips for steel piping shall be of mild steel of the single pear-shape type and shall be of approved proprietary manufacture.

10.7.2 Saddle Type Support

Saddle type supports shall be of rolled steel section of 25mm wide x 1.6mm thick double side type and the saddle shall be securely fixed to the building member or supporting structure.

Saddle type supports will not be approved as a means of supporting pipes over 50mm NB.

Provide a neoprene strip shall be provided between the pipework and support saddle in all locations.

10.7.3 Bolts and Nuts

All bolts and coach screws shall be sized to suit the load but in no case shall the diameter be less than 8mm.

10.7.4 Span of Supports

The distance between pipe supports shall not exceed that specified in manufacturer's specifications or Australian Standards.

Exposed pipework risers shall be secured at floor and ceiling; pipes up to 25 NB shall have at least two intermediate supports.

10.7.5 Fastening of Supports

Where the structure is of masonry or concrete, the supports shall be fastened with approved expanding type bolts.

Explosive powder fastening tools shall only be used where specifically approved beforehand by the Superintendent.

Coach screws shall be used for fastening supports to timber. All coach screws must be hot dipped galvanised.

10.8 NOISE AND VIBRATION

Achieve specified noise and vibration level criteria.

Acoustically seal pipework penetrations through plant rooms, sound-rated walls and acoustic enclosures.

10.8.1 Spring Hangers

Isolate pipework hangers or brackets to prevent vibration and noise transmission, particularly for pipework connected to pumps, as follows:

- Incorporate neoprene inserts to hangers.
- Use up to 40mm static deflection.
- Include for minimum 99% isolation efficiency.
- Provide loading relevant to code pipe hanger spacing requirements.

10.9 VALVES

10.9.1 General

All valves utilised within the fire system shall be FM Listed or UL Approved for use in fire systems.

All valves utilised in contact with potable water supplies, such as from the town's main connection up to and including the backflow prevention device and associated isolation valves, shall be Water Marked approved in accordance with the NCC.

10.9.2 Backflow Prevention Valves

Provide a remote test valve arrangement on each sprinkler system and hydrant system in accordance with the following:

- The test piping shall be 25mm NB minimum, and taken from the end of the most remote range pipe served by each sprinkler control valve set.
- A remote test point shall be located at the most hydraulically disadvantaged hydrant valve location.
- Each remote test valve point shall be provided with a pressure gauge, drain to waste, padlock keyed to Lockwood 003, and labelling to read Sprinkler (or Hydrant) remote test valve to be locked shut.

10.9.3 Valve Monitoring and Security

Valve monitoring devices (tamper switches) shall be IP-rated, waterproof, weatherproof and of robust construction. The devices must be rigidly secured to the valve assembly in a position protected from damage.

All isolating valves shall be padlocked in the open or closed position as applicable. Padlocks shall be keyed Lockwood 003.

All alarm cocks shall be padlocked in the open position.

11 PORTABLE FIRE EXTINGUISHERS AND FIRE BLANKETS

11.1 GENERAL

Supply and install all portable fire extinguishers and fire blankets to the locations shown on the drawings, including mounting brackets, location and identification signs.

Final location of all portable extinguishers and associated signage is to be determined by site inspection and approval from the local fire authority prior to installation.

11.2 DESIGN CRITERIA

11.2.1 Codes and Standards

The following Codes and Standards are applicable to the installation and must be adhered to in all respects unless otherwise noted.

Code/Standard	Year	Description
AS 2444	2001	Portable Fire Extinguishers and Fire Blankets – Selection and location.
AS 1841.1	2007	Portable Fire Extinguishers, General Requirements.
AS 1841.2	2007	Portable fire extinguishers – Specific requirements for water type extinguishers.
AS 1841.5	2007	Portable fire extinguishers – Specific requirements for powder type extinguishers.
AS 1841.6	2007	Portable fire extinguishers – Specific requirements for carbon dioxide type extinguishers.
AS 1850	1997	Portable Fire Extinguishers – Classification, rating and performance testing.

11.3 PORTABLE FIRE EXTINGUISHERS

Provide portable fire extinguishers of the following type in the locations and quantities nominated on drawings:

Level/Area	Type	Capacity	Rating
Generally	Dry chemical	4.5kg	4A:80BE
Main Switch Board	Carbon dioxide	5.0kg	10BE

Obtain architect's approval of locations on site prior to installation.

12 TESTING AND COMMISSIONING

12.1 GENERAL

Prepare and submit Inspection and Test Plans 10 working weeks prior to the scheduled testing and commissioning period for review and approval.

Provide sufficient notice (minimum 5 working days) so that all testing and commissioning may be witnessed by the Building Services Consulting Engineer for the purposes of certifying to the Building Owner that all work has been completed in accordance with specification requirements.

Ensure the correct phase sequence is maintained throughout the installation.

Provide test certificates and Certificates of Compliance for approval. Include copies within Installation Manuals.

Obtain approval before energising newly installed or reconnected wiring or equipment.

During testing, replace any component and equipment damaged as a result of incorrect installation work.

12.2 TESTING

12.2.1 Pumps

Measure vibration levels at positions to be agreed (in the event that vibration levels exceed acceptance criteria and are clearly perceptible).

Measure and record vibration signatures in both radial and axial directions for major equipment.

Measure vibration signatures with equipment/system completely assembled and in full working order.

Scheduled equipment to be equipped with permanent mounting points for accelerometers within the octave band range 10 Hz to 10,000 Hz.

12.2.2 Pipework

Each pipework system shall be tested in sections as the work proceeds in accordance with the relevant Australian Standard Code and with the following requirements:

- Test pressure shall be applied during the construction period, with each section being blanked until further tests are made.
- All equipment, material and labour necessary for testing shall be provided and all necessary "blanking off" shall be done to prevent excessive pressure to equipment, seals or other similar parts of the system.
- Open and close all control valves under water pressure to ensure proper operation.

- Apply a test pressure of 1400kPa (sprinkler) and 1700kPa (hydrant) to the section under the test, or 1.5 system working pressure, whichever is the greater and;
    - Retain section under test without makeup pressure for the longer duration of two hours or the time necessary to inspect all joints in the test section.
    - The test section shall be considered satisfactory if there is no pressure drop for the duration of the test and no leaks are apparent in the test section.
    - All defects disclosed during testing shall be immediately rectified and fresh tests carried out as required by the Superintendent.
- Pressure testing shall be carried out as follows:
    - Before piping is boxed in or otherwise covered.
    - Before ceilings are replaced or installed and finishing trades have commenced their work.

The Fire Services Trade shall submit a programme indicating proposed sections of pipework system to be tested. All pressure testing dates, duration and pressure are to be noted on a record set of drawings.

12.2.3 Portable Fire Extinguishers

Portable fire extinguishers shall be factory-tested prior to delivery to site.

Test mounting brackets and the like for robustness and ease of operation.

12.3 COMMISSIONING

12.3.1 Pumps

- Arrange with fire authority or independent commissioning authority to attend site and carry out flow test of hydrant system.

12.3.2 Fire Brigade Booster Assembly

- Commission and coordinate booster flow testing upon completion of the works and allow for payment of all associated fees. Ensure that booster testing is scheduled with sufficient notice so as not to delay practical completion.

12.3.3 Fire Hydrant System

- Arrange with fire authority or independent commissioning authority to attend site and carry out flow test of hydrant system simultaneously with sprinkler flow test.

12.3.4 Fire Hose Reels

- Arrange with independent commissioning authority to attend site and carry out flow test of fire hose reels simultaneously with sprinkler flow test.

12.3.5 Automatic Fire Sprinkler System

- Arrange with fire authority or independent commissioning authority to attend site and carry out flow test of hydrant system simultaneously with sprinkler flow test.

13 SERVICE AND MAINTENANCE

13.1 SERVICE CONTRACT

Provide 24-hour emergency call-out services and arrive on site to rectify defective items within 2 hours of notification of a defective item.

13.2 MAINTENANCE WORKS

The maintenance period shall be 12 months from the date of Practical Completion.

After commissioning of the system, provide full maintenance support through the maintenance period. This support shall include all action necessary to maintain the system operating correctly as specified, and shall include but not be limited to:

- Carry out weekly tests as required by the relevant standards;
- Carry out monthly inspections and perform maintenance work at the frequencies and following the procedures recommended by the manufacturers of the supplied equipment;
- Repair and/or return of faulty modules, printed circuit boards or any other item or sub-system comprising the total system.
- Promptly rectify faults. Replace faulty materials and equipment.
- Routine adjustment and servicing of all equipment including ancillary equipment.
- Supply of consumable spares such as fuses and lamps that require replacement from time to time.

During the Warranty and Maintenance Period, this general maintenance support shall be free of charge to the Proprietor. Maintenance support costs shall be deemed to be included in the Tender price.

Provide maintenance check sheets and arrange for signing of these by the nominated site representation. Provide a copy of the check sheets to the principal on a monthly basis.

13.3 ONGOING TRAINING

Coinciding with Commissioning and routine inspection visits, at times to be agreed with the principal, instruct the Principal's operational maintenance staff in the recommended methods of operation and maintenance of the systems.

In addition, provide a time allowance of 8 hours for the initial instruction in the operation of all systems.

13.4 CERTIFICATION

At 12 months from the date of practical completion, allow to provide a maintenance certificate in accordance with the relevant legislative requirements.

At the end of the maintenance period make a final service visit and, upon satisfactory completion of the above procedures, certify in writing that the installation is operating correctly.

Approval for the release of retention monies will not be granted until 12 consecutive monthly check sheets have been received by the Proprietor.

APPENDIX A TENDER PRICE BREAKDOWN

This schedule is required to be filled out at time of Tender Submission. The amounts indicated in the total Tender price including administration costs and profit for sections of the work are as follows:

ITEM		AMOUNT TENDERED
Fire Hydrant System	$	.....
Fire Pumpset	$	.....
Automatic Fire Sprinkler System	$	.....
Fire Hose Reel	$	.....
Portable Fire Extinguishers	$	.....
For Approval/Workshop Drawings	$	.....
General provisions including		
O&M Manuals/Block Plans	$	.....
Testing and Commissioning	$	.....
Fire Authority Commissioning	$	.....
User Training	$	.....
12 months maintenance and new log books	$	.....
Other (specify)	$	.....
TOTAL (EXCL. 10% GST)	$	
GST	$	
TOTAL (INCL. 10% GST)	$	

Tenderer ..... **Date** .....

APPENDIX B SCHEDULE OF RATES

The following rates will be used to price variations including any fit out works and shall include all costs, profit and GST associated with the design, supply, installation, testing, commissioning and defects liability associated with such works. The rates shall allow for all materials, workshop drawing alterations, system programming, labour, cartage, freight, tools, plant scaffolding, painting appliances, etc.

Should the Tenderer require differing rates for variation additions as distinct from variation omissions or reductions or differing rates during the various stages of construction and defect liability period, then these additional rates shall be provided in addition to the following:

Automatic Fire Sprinkler System

Ceiling mounted fire sprinkler including pipework modifications, excluding drain down and recharge	$
Exposed fire sprinkler including pipework modifications, excluding drain down and recharge	$
Window Wetting fire sprinkler head including pipework excluding drain down and recharge	$
Unit rate for 1 off drain down and recharge of fire sprinkler installation.	$

Fire Extinguisher

Supply and installation of a 3.5 kg CO2 extinguisher including brackets and signage.	$
Supply and installation of a 4.5 kg dry chemical powder extinguisher including brackets and signage.	$

GENERAL

The following trades shall be charged at the rates per hour:

Trade	Normal	Time/Half	Double Time
Sprinkler Fitter	$	$	$
Site Electrician	$	$	$
Shop Electrician	$	$	$
Draftsman	$	$	$

Tenderer ..... **Date** .....

APPENDIX C SCHEDULE OF TECHNICAL DATA – SUPPRESSION SYSTEMS

Complete this schedule of material items proposed and include with Tender. All items shall comply with the specification unless the Tender nominates and includes details of the nonconformity.

---

1 .Sprinkler Heads – Ceiling Mounted

Make .....

Model/Nos .....

2. Sprinkler Heads – External

Make .....

Model/Nos .....

3. Sprinkler Heads – Window Wetting

Make .....

Model/Nos .....

4. Alarm Valve

Make .....

Model/Nos .....

7. Pressure Switch

Make .....

Model/Nos .....

8. Valve Monitoring Device

Make .....

Model/Nos .....

11. Automatic Jacking Pump

Make .....

Model/Nos .....

12. Isolation Valve

Make

Tenderer ..... **Date** .....

.....

Model/Nos .....

13. Check Valve

Make .....

Model/Nos .....

14. Backflow Prevention Valve

Make .....

Model/Nos .....

10. Fire Pumpset

Make .....

Model/Nos .....

11. Automatic Jocking Pump

Make .....

Model/Nos .....

DETAIL – EQUIPMENT CONFORMITY

Items below all points where tendered items differ from the specification:

Tenderer ..... **Date** .....

APPENDIX D SCHEDULE OF SUBCONTRACTORS AND PERSONNEL

Identify below Sub-Contractors included within the tender submission.

ITEM	SUB-CONTRACTOR
Suppression Systems	.....
Trenching and Excavation	.....
Other	.....

Identify key personnel identified to be involved in the project:

Personnel	Name	Years Experience	Years with Company
Project Manager	.....	.....	.....
Foreman	.....	.....	.....

Tenderer ..... **Date** .....

LUCID
CONSULTING AUSTRALIA

PROSPECT APARTMENTS

168 PROSPECT ROAD, PROSPECT

Project No: LCE12584

Hydraulic Services

Specification

Tender Issue

Revision T1

SPECIFICATION ISSUE REGISTER

REVISION	DESCRIPTION	DATE ISSUED	AUTHOR	REVIEWED
T1	Tender Issue	2.06.2017	WL	PL

PROJECT DIRECTORY

BUILDER	Bert Farina Constructions 11 Indama Street Regency Park SA 5010
ARCHITECT	Studio Nine Architects 9 King William Street Kent Town SA 5067
MECHANICAL, ELECTRICAL, HYDRAULIC AND FIRE PROTECTION SERVICES	Lucid Consulting Australia Level 3/169 Pirie Street Adelaide, SA 5000
STRUCTURAL AND CIVIL CONSULTING ENGINEERS	TMK Consulting Engineers 100 Pirie Street Adelaide, SA 5000

CONTENTS

1 GENERAL 1

1.1 CROSS REFERENCES 1
1.2 PROJECT DETAILS 1
1.3 DEFINITION OF TERMS 1
1.4 CONTRACT 2
1.5 DRAWINGS 2
1.6 SCOPE 3
1.7 ASSOCIATED WORKS 8
1.8 STANDARDS 9

2 CONTRACT SUBMISSIONS 13

2.1 GENERAL 13
2.2 TENDER SUBMISSONS 13
2.3 PRE-CONSTRUCTION SUBMISSIONS 13
2.4 CONSTRUCTION SUBMISSIONS 15

3 WORKMANSHIP 18

3.1 GENERAL 18
3.2 QUALITY ASSURANCE 18
3.3 EXISTING SITE CONDITIONS 18
3.4 WARRANTIES 19
3.5 INSTALLATION COORDINATION 19
3.6 INSTALLATION REQUIREMENTS 20
3.7 PENETRATIONS 21
3.8 PROTECTION 22
3.9 FLUSHING OF SERVICES 22
3.10 CLEANING UP 22
3.11 SEISMIC RESTRAINT, EARTHQUAKE BRACING, FIXINGS AND SUPPORTS 22
3.12 GENERAL PIPING INSTALLATION REQUIREMENTS 23
3.13 PIPE SUPPORTS 24
3.14 INSTALLATION REQUIREMENTS FOR PVC PIPING AND FITTINGS 24
3.15 INSTALLATION REQUIREMENTS FOR HDPE/PVC PIPING AND FITTINGS INGROUND 25
3.16 ELECTROFUSION JOINTING REQUIREMENTS FOR POLYETHYLENE PRESSURE PIPEWORK SYSTEM 26
3.17 INSTALLATION REQUIREMENTS FOR POLYETHYLENE NON-PRESSURE PIPEWORK SYSTEM 27
3.18 INSTALLATION REQUIREMENTS FOR 'REHAU RAUPIANO' SANITARY PLUMBING DRAINAGE AND STORMWATER SYSTEM 28
3.19 INSTALLATION REQUIREMENTS FOR COPPER PIPES 30
3.20 INSTALLATION REQUIREMENTS FOR CROSS LINKED POLYETHYLENE PIPES 30
3.21 SLEEVES 30
3.22 BRAZING 31
3.23 CHROMIUM PLATING 31
3.24 DISSIMILAR METALS 31
3.25 JOINTS IN PIPEWORK 31
3.26 GRADES 32
3.27 INSPECTION AND TESTS 32
3.28 TRENCH EXCAVATION, BACKFILLING AND COMPACTION 34
3.29 TREATMENT OF PIPEWORK PENETRATIONS 36
3.30 ACOUSTIC REQUIREMENTS 37

4 PIPING AND MATERIALS 39

4.1 GENERAL MATERIALS 39
4.2 UNIFORMITY AND QUALITY 40
4.3 PIPE AND ISOLATION VALVE/METER IDENTIFICATION 45

5 SANITARY FIXTURES AND TAPWARE 46

5.1 GENERAL 46

6 SOIL, WASTE & VENT PIPES 47

6.1 GENERAL 47
6.2 INSTALLATION REQUIREMENTS FOR PVC PIPING AND FITTINGS 47
6.3 PIPEWORK AND FITTINGS 47
6.4 MATERIALS 49
6.5 PIPEWORK FINISHES 49
6.6 FIRE STOP COLLARS 49
6.7 ACOUSTIC INSULATION TO ALL SUSPENDED DRAINAGE 50
6.8 AIR ADMITTANCE VALVES 50

7 COLD WATER SERVICE 52

7.1 GENERAL 52
7.2 TAPS AND VALVES 52
7.3 TESTING 53
7.4 VALVE IDENTIFICATION 53
7.5 BACKFLOW PREVENTION VALVES 53
7.6 PURGING 54

8 HOT WATER SERVICE 55

8.1 GENERAL 55
8.2 HOT WATER AND WARM WATER PIPING INSULATION 55
8.3 TAPS AND VALVES 55
8.4 TESTING 55
8.5 DOMESTIC HOT WATER UNITS 55
8.6 PURGING 55
8.7 THERMAL INSULATION TO ALL HOT WATER RETICULATION 55

9 NATURAL GAS SERVICE 57

9.1 GENERAL 57
9.2 PIPEWORK AND JOINTING 57
9.3 INSTALLATION 57
9.4 TESTING 58
9.5 COMPLETION 58

10 EQUIPMENT 59

10.1 HOT WATER PLANT 59
10.2 DOMESTIC HOT WATER CIRCULATING PUMP ASSEMBLY 59
10.3 PURGING 60
10.4 BALANCING VALVES 60
10.5 PRIVATE COLD WATER METERS 60
10.6 PRESSURE REDUCTION VALVE 61

11 COMMISSIONING AND HANDING OVER 62

11.1 PRE-HANDOVER 62
11.2 HANDING OVER AND PRINCIPALS INSTRUCTION 62
11.3 AS-BUILT DRAWINGS AND DOCUMENTATION 62
11.4 AS INSTALLED DETAILS 62

11.5 MAINTENANCE AND GUARANTEE PERIOD 62
11.6 INSPECTIONS 63
11.7 TESTING 63

APPENDIX A – SECTION COSTS AND UNIT RATES - SANITARY AND HYDRAULIC SERVICES 0

APPENDIX B – TECHNICAL DATA SCHEDULES – HYDRAULIC SERVICES 3

APPENDIX C – SANITARYWARE, TAPWARE AND FIXTURE SCHEDULE 8

1 GENERAL

1.1 CROSS REFERENCES

All work covered within this specification shall be read in conjunction with the following trade packages and contracts. Should any discrepancy occur between the references the larger/greater shall be assumed and referred to the Engineer prior to proceeding with any works.

- Preliminaries and General Contract Conditions.
- Architectural Documentation
- Mechanical Services Documentation
- Electrical Services Documentation
- Structural Services Documentation.
- Civil Documentation.
- Geotechnical Soil Report.

The above documentation shall be made available upon request through the head contractor.

1.2 PROJECT DETAILS

The works described within this specification pertain to the Hydraulic Services installation at 168 Prospect Road, Prospect.

1.3 DEFINITION OF TERMS

Consulting Engineers	-	Lucid Consulting Australia
Proprietor	-	Client or end user of the proposed building
Architect	-	Studio Nine Architects
Head Contractor/Builder	-	Registered Building Contractor appointed to carry out the construction of the building. Hydraulic Contractor shall enter contact to undertake the Hydraulic Services installation with the successful builder. In this case the Head Contractor and Client representative is Bert Farina Constructions.
Contractor	-	Installer undertaking the works.
Works	-	As described within this specification
Provide	-	Supply, install, commission and place into service
Equal Approved	-	Alternative product/method of installation which is presented to the consulting engineer and written approval is received.
Local Power Authority	-	SA Power Networks
Local Gas Authority	-	Envestra (APA Group)
Local Water Authority	-	SA Water Corporation
Technical Regulator Authority	-	Office of the Technical Regulator
Local Fire Authority	-	South Australian Metropolitan Fire Services (SAMFS)

1.4 CONTRACT

Fixed Price Lump Sum Contract

The Hydraulic Contractor is to enter into a fixed price lump sum type contract. The following specification and accompanying drawings outline the general scope of works and have been prepared to enable specialist Plumbing Contractors to submit fixed sum tender prices for the plumbing installation. The drawings are intended to indicate the principles of design and should not be taken to define all offsets, bends etc which may be required to complete the installation and or be coordinated with other services. The Plumbing Services Contractor will be responsible for final coordination with other trades and for final coordination with Architectural Drawings and building structure.

The tender drawings are not to be used for architectural or structural work but are to be read in conjunction with architectural, structural and other relevant drawings.

Coordinate all pipe runs with "MECHANICAL, FIRE AND ELECTRICAL SERVICES" trade to ensure non-clashing of services.

Deviation from the design principals shown will not be permitted without the written consent of the Superintendent.

Any discrepancies which may affect the installations shall be brought to the Superintendents attention before the work proceeds.

The Contractor shall also familiarise himself with the location of existing pipe and cable runs. No variation will be issued for any damage caused to existing services.

1.5 DRAWINGS

Tender Drawings

Drawings associated with and forming part of this specification are scheduled below:

Drawing No.	Drawing Title
LCE12584-H01	SITE PLAN, GENERAL NOTES, DRAWING INDEX, LEGEND OF SYMBOLS, LEGEND OF PIPEWORK AND LEGEND OF ABBREVIATIONS.
LCE12584-H02	GROUND FLOOR AND LEVEL 1 SANITARY DRAINAGE ARRANGEMENT
LCE12584-H03	LEVEL 2 AND LEVEL 2 SANITARY DRAINAGE ARRANGEMENT.
LCE12584-H04	ROOF SANITARY DRAINAGE ARRANGEMENT AND DETAILS.
LCE12584-H05	GROUND FLOOR AND LEVEL 1 WATER AND GAS RETICULATION ARRANGEMENT.
LCE12584-H06	LEVEL 2 AND LEVEL 3 WATER AND GAS RETICULATION ARRANGEMENT.

The Hydraulic Services drawings and associated specification along with the architectural drawings are intended to define the principles of design and scope of the Hydraulic Services installation. Tender drawings provide sufficient detail to define the scope and extent of the works sufficient to enable specialist Plumbing Contractors experienced in hydraulic services installations for low rise multi-residential buildings to submit fixed tender prices for the hydraulic services installation.

The drawings are intended to indicate the principles of design and should not be taken to define all offsets, bends etc which may be required to complete the installation and avoid other services. The Plumbing Services Contractor will be responsible for final coordination with other trades and for final coordination with Architectural Drawings and building structure.

The tender drawings are not to be used for the purpose of defining the Architectural intent however are to be read in conjunction with architectural, structural and other relevant drawings.

Coordinate all pipe runs with all other trades to ensure non clashing of services.

Deviation from the design principals shown will not be permitted without the written consent of the Superintendent.

Any discrepancies which may affect the installations shall be brought to the Superintendents attention before the work proceeds.

The Contractor shall also familiarise himself with the location of existing street infrastructure services and to coordinate with the Services Utilities for the required new services connections to the site. No variation will be approved for any damage caused to existing services or for failure to coordinate with the Services Utilities.

1.6 SCOPE

The work covered by this section of the specification includes the following:

General Requirements

- The work covered by this specification includes the following:
- The provision of a Hydraulic Services installation that satisfies all statutory legislative and code requirements and satisfies the general details herein.
- The planning, scheduling, procurement of components and installation to meet the programme, coordination and liaison with the head contractor and other trade packages.
- Full responsibility for the execution of the complete installation in accordance with the specification and drawings.
- The installation, testing, commissioning, maintenance, service and warranty and all sundry and material items, whether mentioned in detail or not, required to complete the installation and place into working order.
- Compliance with all relevant Work Health and Safety legislation and best practice including any site-specific requirements or regulations such as attendance at site inductions and adherence to the procedures covered in such inductions.
- Full responsibility for the execution of the complete installation in accordance with the specification and drawings, and related authority requirements. Provide all manufactured items, materials, labour, cartage, tools, plant, appliances, and fixings necessary for the proper execution of the works, together with all minor and incidental works.
- Final co-ordination, manufacture, supply, installation, testing, commissioning and subsequent maintenance service and warranty for the stipulated period, of the work specified herein and shown on the accompanying drawings.
- The whole of the works shall comply with all relevant Regulations and to all Local Authority requirements. The cost of any materials or equipment required to meet such regulations

and requirements shall be included in the Tender whether specifically shown or described in the documents or not.

Infrastructure Requirements

Make application to SA Water Corporation including payment of associated fees for the following works.

- Disconnection of the existing redundant 100 mm sewer connection off Williamson Lane at rear and the existing 20mm water meter off Prospect Road. Timing of this work shall be coordinated with the builder as existing services will be utilised to service construction site amenities.
- New 150 mm sewer connection off Williamson Lane.
- New 1 x 40mm authority water meter off Prospect Road including cast iron footpath box.

Note: Contractor shall confirm the connection fees with SA Water Corporation during the tender phase to avoid additional costs for non- standard connections.

Application to APA Group and payment of associated fee for the following works:

- For the installation of a new incoming gas inlet feed and gas meter capable of 650MJ/hr at 2.75kPa.

Note: Provision of a slab rebate for gas inlet service and ventilated gas meter enclosure to be provided by builder.

The Contractor shall liaise with the Builder and temporarily maintain existing water, sewer and stormwater connections for connection to Builder's Amenities, with final scope of works to be resolved with Main Contractor.

The Contractor shall bear full responsibility for verifying required invert level and boundary set-off dimension for new sewer connection prior to commencement of any underfloor drainage works. Abortive work caused due to failure to verify the above shall be at the cost of the plumbing contractor.

The Contractor shall confirm set-out dimensions for all new services connections with the related Services Utilities when making the applications prior to commencement of works.

Building Requirements – General

The following systems and services shall generally be included:

- Connection to new incoming water supply, establishment of site backflow prevention device and reticulation of domestic cold water to ground floor fixtures and to each apartment.
- Natural gas reticulation from building gas meter to each apartment cook top and to bulk hot water plant located on ground floor.
- Hot and cold water, hot water return and natural gas connections to bulk hot water plant. Allow to coordinate with Origin Energy - Hot Water Services for delivery and on-site installation of bulk hot water plant and for termination of services connections to suit the configuration of the assembly, including provision of tundish for receipt of discharge from hot water system storage tank pressure relief valves.

- Soil, waste and vent pipework system to serve fixtures and waste points throughout the building.
- Fire stop collars to all drainage pipework penetrations through floors including where pipework contained within vertical services ducts. Drainage piping within vertical services ducts shall be fitted with fire stop collars.
- Fire stopping floor penetrations for all hot and cold water and natural gas piping installed within vertical services ducts.
- Sanitary fixtures and tapware as specified by architect. Supply all fittings and fixings as required.
- Testing and commissioning of the above systems.
- Work-as-executed drawings and installation manuals.
- Warranty, Defects Liability and maintenance for 12 months from completion

Sewer and Sanitary Waste Drainage System

- External sewer drainage system extending from new sewer connection point in accordance with AS/NZS 3500.2.
- Provide a reflux valve at boundary in lieu of flood gully, finish at surface with;
  - Cast iron cover at finished surface level with screwed cap below.
- Establishment of gully to site drainage system. Top of gully to be;
  - 20mm above surrounding ground surface, with paving falling away from gully.
- Plumbing and drainage systems installed in reactive soils to comply with Australian Standard AS2870 -2011.
- Internal sewer drainage and vent system in accordance with AS/NZS 3500.2.
- Air admittance valves to drainage branch vents where indicated on drawings.
- Waste drainage and vent system in accordance with AS/NZS 3500.2 and the local Authority requirements.
- Floor waste gullies shall be suitable for reduced ceiling heights such as Rehau Raupiano or equal approved.
- Acoustic lagging to all suspended sanitary drainage pipework within the ceiling space above the apartment and within vertical services ducts. Refer to further details within this specification. Acoustic lagging shall extend to soil and waste stacks located within the vertical services ducts. Alternatively utilise 'Raupiano' acoustic pipe.
- Exposed sanitary drainage pipework within carpark shall be provided with mechanical protection as indicated on hydraulic services drawings where required.
- In-wall tundishes are to be provided for mechanical condensate where shown in hydraulic services drawings.
- Waste drainage is to be installed where required in-wall to cater for reduced ceiling heights.
- Identification labels to pipework and valves and in ground detectable tape to drainage systems.

Stormwater Drainage System (refer architectural and civil drawings)

Water and Gas Reticulation

- Potable cold water reticulation system in accordance to AS/NZS 3500.
- Potable hot water reticulation system in accordance to AS/NZS 3500.
- Hot water flow and return reticulation system in accordance with AS3500 to services all apartments via multiple pipe risers (hot water flow) and pipe droppers (hot water return).
- Provision of hot water return balancing valve assemblies fitted to each hot water return dropper complete with isolation valves and balance valves at base of each dropper accessible from carpark to permit service and removal.
- Provision of hot water reticulation system extending to each apartment via an isolation valve and liaison with Origin Energy to supply remote read hot water meters for installation by contractor in ceiling space adjacent access panels. Contractor shall coordinate supply of meters to suit and supply fittings as required.
- Take delivery of hot water meters and supply cold water meters (of same make) and associated transmitters for pre-assembly with apartment hot and cold water isolation valves and tempering valve. The valve and meter assembly shall be fixed to a pre-cut MDF or equal approved panel, labelled with the apartment no served and delivered to site for connection to the apartment cold, hot and tempered water services.
- Supply and installation of tempering valves as indicated on drawings.
- Backflow prevention assembly (testable double check valve) to the incoming water mains extending from SA Water Corporation water meter connection and bin wash area.
- Vacuum breaker hose connections to screw nose bibcocks installed on ground floor for refuse room and outside water supply.
- Miscellaneous backflow prevention devices to zones or individual fixtures in accordance with AS3500 and OTR requirements.
- Natural gas reticulation system in accordance to AS 5601 to each apartment cooktop via apartment isolation valve and bulk hot water service. Locate cooktop isolation valve in an accessible location within joinery cupboard.
- Liaise with Origin Energy for the connection of hot flow and return, cold water and natural gas services to the bulk hot water plant. Locate isolation valves for each piped service directly adjacent the hot water plant where directed by Origin Energy, for final connection by Origin Energy.
- Provide 50mm site backflow valve (testable double check valve) on-wall within bin room store.
- Identification Labels, Tags to equipment, valves, pipework and detectable tape to in-ground pipework.

Plant and Equipment

- Provision of cold water, gas and hot water flow and return isolation valves connections to the gas fired bulk hot water plant. Hot water plant shall be supplied and installed by Origin Energy, including final connections to isolation valves provided adjacent by the Plumbing Trade.
- Installation of remote read pulse output hot meters supplied by Origin Energy for each apartment.

- Supply and installation of remote read pulse output 20mm cold water meters adjacent each apartment hot water meter. Obtain cold water meters from same supplier as Origin Energy.
- Provision of building hot water circulating pump assembly comprising duty and stand-by pumps with valve arrangement to allow complete removal of one pump whilst second pump continues to operate. Provide a control panel to allow lead lag operation with the lead pump alternating operation on a 24-hour cycle.
- Supply and installation of all sanitary fixtures and tapware as scheduled in the architectural Schedules.
- Provision for commissioning by the manufacture of all plant supplied and installed and payment of associated fees.

General Requirements

- Provision and installation of timber trimmers in walls for securing of equipment, fixtures and water pipework connection points.
- Fire stop collars to all PVC penetrations associated with the sanitary drainage and stormwater drainage systems where pipework penetrates fire rated floors including where located within plumbing ducts and/or service rooms.
- Casting in sleeves or fire stop collars for pipe penetrations located within plumbing ducts. Liaise with Mechanical Services and allow to cast in sleeves for reticulation of refrigerant piping and controls/power cabling.
- Fire stopping all pipework penetrations at floor level and where penetrating bounding walls.
- Trenching and backfilling associated with service connections to the site. All compaction shall be strictly in accordance with the requirements of Local Council. Apply for permits and pay all necessary fees for temporary road and/or footpath closure.
- Set-out or cause set-out of all plumbing penetrations, including the installation of all necessary sleeves. The plumber shall be responsible for this set-out and any rectification works necessary by incorrect set-out.
- Provision of roof over flashing to all pipe penetrations through roof where applicable, under flashing to be provided by roofing contactor
- Allow for trenching and backfilling necessary to complete the work. Upon completion of backfilling, the work area and it's surrounds shall be left tidy and level, and all surplus soil removed from site and disposed of by the plumber and at the plumbers cost.
- All rubbish is to be disposed of in the designated waste disposal area as directed on site. All rubbish is to be disposed of in this manner the same day that it is generated.
- Apply for all necessary approvals to perform the described works and pay all relevant and required fees.
- Provide compaction testing of service trenches as per the civil and structural engineer's approval.
- Provide traffic control/management to works where required.
- Temporary service connections to site amenities. Refer to Builder's scope of works in relation to temporary connections required during the construction period.
- Maintenance and Defects Liability Period of 12 months.
- Testing and commissioning of the above systems.

- Work-as-executed drawings prepared from Bluebeam format and transferred to CAD format and preparation installation of manuals.
- Warranty, Defects Liability and maintenance for 12 months from completion

Variations to the Scope

Instructions may be issued throughout the project which may alter the scope of works. Any aspects of any such works which are not specifically mentioned in any instruction are to comply with this specification.

Any claims for any additional costs or credits for any such variations must be submitted with a complete breakdown of costs including quantities and rates for all labour, materials and equipment. Variation Claims submitted without breakdowns will be rejected.

Substitutions

Where a substitution to the specification is proposed, the contractor shall submit each substitution, incorporating technical details and a cost breakdown, to the head contractor. The substitution shall be reviewed by the consulting engineer and the client for consideration. Unless approved by the consulting engineer and the client, the substitution will not be acceptable as an equal or approved approach to the specification.

1.7 ASSOCIATED WORKS

The following works related to the Hydraulic Services installation shall be carried out under other trade packages at the direction of the head contractor unless otherwise indicated. Cabling is to be terminated by the trade responsible for running the cable. Coordinate all cable locations, runs / routes, terminal strip locations and ensure that information is provided to other trades to facilitate cabling and termination.

Electrical Services Trade

- Provision of 2 off weatherproof 240V power supply double GPOs for connection to building central hot water plant.
- Provision of 240V power supply and isolator adjacent to the building's hot water circulating pump assembly control panel with final connection to control panel.
- 240 volt GPO located adjacent to each dishwasher within cupboard space adjacent dishwasher recess, within each apartment. Arrange with Joiner for cable and plug access via joinery divider.
- 240 volt GPO located under gas hot plate within each apartment.
- 2 x 240 volt GPO adjacent communications cabinet in the car park for connection to Origin Energy's 'Gateway' data logger with 4G wireless access.

Structural Services

- Concrete plinth detail for mounting the gas fired Bulk Hot Water Assembly. Plumbing Trade to confirm set-out and plinth final dimension.

Builders Related Trades

- Construction of fire rated plumbing ducts. Plumbing Contractor to cast in sleeves or fire stop collars as required and fire seal penetrations prior to plumbing ducts being closed up.

- Construction of ventilated gas meter enclosure to APA Group for approval.
- Provision for rebates in slab/footing to facilitate the installation of incoming gas main to the gas meter enclosure without traversing under the slab, all in accordance with APA requirements. .
- Supply and installation of Bathroom Hardware i.e. towel rails, soap holders etc.
- Installation of roof pipe penetration up stands.
- Concrete base for central hot water service. Plumbing Contractor to confirm final size prior to construction.
- Supply of gas hot plates (by Joinery Trade) and installation by plumbing contractor.
- Supply of dishwashers for installation and connection to apartment services by Plumbing Contractor.
- Supply and installation of ceiling access panels.

Builders Related Trades

- Provision of extending condensate drains over tundish with air gap.

1.8 STANDARDS

GENERAL REQUIREMENTS

Comply in all respects with the requirements of the current standards applicable to the works in respect to equipment, material, workmanship and installation techniques.

Comply with the following standards and regulations:

- Building Code of Australia
- Australian Standards
- SA Water Corporation Regulations
- Office of the Technical Regulator (OTR) Regulations
- APA Group
- SA Health Department
- Work Health and Safety Regulations
- SA Power Networks Supply Regulations
- SA Government Acts governing the works
- Local Council
- SA 76 – Ministers Specification – testing and maintenance of essential safety provisions

Note - The whole of the sanitary plumbing and water supply shall be carried out by, or under the direct supervision of, a registered fully Licensed Contractor Plumber and licensed Gas Fitter. All work shall be done in accordance with the relevant provisions of AS/NZS 3500, AS 5601– AG 601, the regulations and directions of the SA Water Corporation, Office of the Technical Regulator (OTR) and to the complete satisfaction of the Superintendent.

Approvals

The documents evidencing approval of such authorities, which are to be forwarded to the Superintendent before final payments and the notice of Practical Completion is issues, shall include the SA Water Corporation and OTR Certificates of Compliance which shall be completed and issued by the contractor.

Works by Authority

If the responsible authority is required to or, pursuant to the statutory powers vested in it, elects to perform or supply part of the works or to inspect or test the Works during construction, make the necessary arrangements with the authority and pay and bear the fees payable in connection therewith.

Australian Standards and Codes

Australian Standards, Codes and Statutory Authority Requirements current at the date of tendering are applicable in respect of all workmanship except where they conflict with the provisions of this Specification.

The following codes which specifically form part of this specification insofar as they are appropriate together with such other codes as required by the Authorities having jurisdiction shall be complied with:

Hot Water and Cold Water and Natural Gas Services	
AS1345	Identification of the contents of piping, conduits and ducts.
AS1432	Copper tubes for water, gas and sanitation.
AS1585	Capillary and brazing fittings of copper and copper alloy.
AS1590	Copper alloy threaded pipe fittings for use with tubes threaded with pipe threads of Whitworth form.
AS1628	Copper alloy gate valves and non-return valves for use in water supply and hot water services.
AS1645	Copper and copper alloy compression fittings for use in water supply and hot water services.
AS1718	Copper alloy draw-off taps, stop taps, and ferrule or main taps for use in water supply and hot water services.
AS2129	Flanges for pipes, valves and fittings.
AS2845	Water Supply backflow prevention devices.
AS/NZS3500-1.2	Water Supply – acceptable solutions.
AS2492	Crosslinked polyethylene (XLPE) pipe for hot and cold water applications.
AS2537	Mechanical jointing fittings for use with crosslinked polyethylene (XLPE) pipe for hot and cold water applications.

Sanitary Plumbing and Drainage	
AS1260	Unplasticised PVC (UPVC) pipes and fittings for sewerage applications.
AS1289	Methods of testing soils for engineering purposes.
AS1304	Welded wire reinforcing fabric for concrete.
AS1415	Unplasticised PVC (UPVC) pipes and fittings for soil, waste and vent (SWV) applications.
AS1432	Copper tubes for water, gas and sanitation.
AS1589	Copper and copper based alloy fittings for use in sanitary plumbing installations.
AS1650	Galvanised coatings.
AS2032	Code of practice for installation of UPVC pipe systems.
AS2129	Flanges for pipes, valves and fittings.
AS2870	drainage Design Requirements, Residential Slabs and Footings
AS2887	Plastic waste traps.
AS/NZS3500-2	National Plumbing and Drainage Code.
AS3879	Solvent - welding cements for use with rigid PVC pipe and fittings.
Stormwater Drainage	
AS1152	Specification for test sieves
AS1260	Unplasticised PVC (UPVC) pipes and fittings for sewer drainage applications
AS1289	Methods for testing soils for engineering purposes
AS1304	Welded wire reinforcing fabric for concrete
AS1646	Elastomeric seals for waterworks purposes
AS2032	Code of practice for installation of UPVC pipe systems
AS/NZS3500.3	National Plumbing and Drainage Code – Part 3: Stormwater Drainage
AS3725	Loads on buried concrete pipes
AS4058	Precast concrete pipes (pressure and non-pressure)
Water Heating	
AS1308	Thermostats and over-temperature energy cut-outs for automatic electric water heaters (metric units).
AS/NZS3500-4	Hot Water Supply Systems.

Natural Gas Service	
AS5601-AG601	Gas Installation Code.

2 CONTRACT SUBMISSIONS

2.1 GENERAL

The contractor shall prepare and submit the items in each section identified below to the consulting engineer for approval.

2.2 TENDER SUBMISSONS

The submissions required at Tender shall incorporate, as a minimum, all information defined within the Appendices of this Specification. Any appendices not completely filled out will be rejected.

In addition to the Appendices the Manufacturer's selections data shall be provided incorporating the following:

- Electrical full load amps, voltage and phase data
- Performance data relevant to the equipment specification clause
- Acoustic data measured in Sound Power as per the equipment specification clause
- Size and weight information including maintenance clearance

Identical equipment to that approved by the consulting engineer must be installed on site. Equipment will only be considered "equal approved" if it has been approved by the consulting engineer. Approval of equipment does not override the requirement to comply with the requirements of the specification.

Select manufacturers with local representation, technical support and expertise, proven local long-term performance and readily-available spare parts.

2.3 PRE-CONSTRUCTION SUBMISSIONS

2.3.1 SAMPLES

Submit the following sample fittings and accessories to obtain approval prior to ordering:

Note: Samples to be provided upon contract commencement

- Sanitary Fixtures and tapware, A4 colour print out showing items specified including product codes, Note, physical samples may be requested and supplied at Nil cost to the contract
- Acoustic pipe sample - A4 colour print including product codes.
- Identification labels and stickers, physical sample.
- Bracketing systems - A4 colour print including product codes.
- Tundish boxes - A4 colour print including product codes.
- Tempering valves – A4 colour print including product codes.
- Cold water meters – A4 colour print including product codes.
- Acoustic wrapping - A4 colour print including product codes.
- Hot water circulation pump- A4 colour print including product codes.
- Thermal lagging - A4 colour print including product codes.

- Deliver the samples to the project site office at least 14 days before approval is required and notify the Head Contractor of their arrival.

2.3.2 SHOP DRAWINGS

Prepare and submit for approval before commencing manufacture or installation, 1 copy of shop drawings from which the contract works shall be built to be provided within 2 working weeks of contract commencement. Further copies shall be required upon review of the preliminary issue of workshop drawings

Shop drawings shall all be on the same size drawings sheets and shall be of a scale not less than 1:100 and larger where necessary.

Bluebeam Revu x64 format drawings of the tender drawings will be provided from Lucid Consulting Engineers at nil cost via the Head Contractor (one single coordinated electronic transfer to the Head Contractor). NOTE: AUTOCAD files in DWG format shall not be provided.

Shop drawings shall cover the following parts of the work.

- All wall, ceiling and roof penetrations, location of ceiling access panels including full dimensions.
- Hot Water Plant and pipework layouts including manufacturer's equipment details.
- Major equipment support details including details of loads imposed on the building structure.
- Location of other building engineering services for coordination purposes.
- Dimensioned Penetration layouts of all pipe work.
- 1:50 scale Shop Drawing of pipework Arrangement.

Examination of shop drawings shall not remove from the Contractor the responsibility for the correctness of the dimensions on such drawings nor compliance with Statutory Regulations.

The Hydraulic Services Contractor shall supply Drawings in up-to-date CAD files to the Mechanical Services contractor to ensure coordination so that non-clashes of services.

The Mechanical Services Contractor shall take the lead role in the shop drawings process and produce a combined services formed slab and pre-cast wall penetration drawing for review and use by the concrete trade contractor.

Submit shop drawings with due account for the construction programme. Allow for 5 working days for the return of such drawings. Complete shop drawings ordering of equipment and accept responsibility for dimensions and configuration of equipment ordered to suit the spatial restrictions of the project.

2.3.3 AUTHORITIES, PERMITS, FEES, CERTIFICATES AND APPROVALS

Make applications, obtain all permits, and arrange testing, as necessary for the installation and placing into operation of the works where required by any Authority including:

- SA Water Corporation
- SA Power Networks
- Worksafe SA

- Office of the Technical Regulator
- APA Group
- Local Council Authority

Provide all associated documentation required for the applications and pay all associated fees.

The hydraulic contractor shall co-ordinate approval of equipment (hot water units, pump packages, and the like) on behalf of the proprietor as required to comply with federal, state and local legislation.

2.3.4 MANUFACTURERS TEST CERTIFICATION

Provide manufacturers test certificates for the following:

- Hot Water Units.
- Pump systems.
- Backflow Valves.

2.4 CONSTRUCTION SUBMISSIONS

General

The Contractor shall instruct the Proprietor's representative in the correct practice, routine adjustment and maintenance of the installation before it has reached practical completion.

Instructions shall continue as required during the period of operation preceding the date of issue of the Certificate of Practical Completion during which time the Contractor shall be responsible for operation supervision and correcting faults.

2.4.1 OPERATING AND MAINTENANCE INSTRUCTIONS

General

The Contractor shall instruct the Proprietor's representative in the correct practice, routine adjustment and maintenance of the installation before it has reached practical completion.

The contractor shall confirm instruction of Proprietor's representative by completing training record and incorporating into Operating and Maintenance manual.

Instructions shall continue as required during the period of operation preceding the date of issue of the Certificate of Practical Completion during which time the Contractor shall be responsible for operation supervision and correcting faults.

Maintenance and Operating Manuals

Initially one (1) copy shall be prepared and submitted to the Consulting Engineer for approval.

Within 30 days prior to reaching Practical Completion hand over three (3) copies of an Installation Manual.

The manual shall contain the following as a minimum:

- Index

- Project Directory and Emergency Contact Details.
- Detailed Description of Hydraulic Services Installation
- Operating Instructions for Equipment Installed
- Maintenance Instructions
  - Routine
  - Preventative
- List of Equipment Suppliers
- Schedule of Technical Data
- Equipment Suppliers Literature
- Acceptance Certificates, Commissioning Certificates, etc
- Work-as-executed Drawings
- Copy of completed training record
- USB with the full PDF copy of Operating and Maintenance manual (including CAD 'As-Installed' drawings)

The manual shall be professionally prepared and bound in a vinyl hard-back folder with insert sleeves on the front to an approved format.

In addition, the project title and "Hydraulic Services" shall be inserted vertically along the spine insert sleeve of the folder.

The manual cover format shall be considered with the other services trades and shall be submitted for approval prior to ordering.

In addition to the above, the Plumbing Contractor shall allow to laminate the buildings hot and cold water, and natural gas schematic diagrams and mount where directed on site or adjacent hot water plant.

The Plumbing Contractor should note that the certificates of practical completion will not be issued and final payment will not be made until the above requirements have been complied with.

Operating Instruction Summary

Provide a brief summary of plant operating instructions including project specific features and control procedures on a single laminated card to be handed to the client's representative. Submit a draft of the Operating Instruction summary with the Installation Manual.

Equipment Registration

Ensure registration and certification of all equipment as required. As a minimum comply with the following:

- HWU Registration & Certification
- HW Pump packages –Certification
- Backflow device's

Provide all associated documentation required for the applications and pay all associated fees.

2.4.2 USER TRAINING

Carry out training on systems as nominated within this specification with user groups and other parties as nominated by the Superintendent. Provide a program for user training for approval by the Superintendent and Building Services Consulting Engineer.

The contractor shall confirm instruction of Proprietor's representative by completing training record and incorporating into Operating and Maintenance manual.

2.4.3 COMMISSIONING & WITNESSING PLANS

The contractor shall submit for approval a detailed commissioning plan indicating step by step testing strategy for all equipment. The commissioning plan shall be developed in conjunction with the building trade construction programme and shall be required to be submitted to the head contractor and consulting engineer for review prior to any commencement of commissioning. The hydraulic services contractor shall be responsible for providing commissioning duration period to head contractor for inclusion in the construction programme.

Any witnessing of commissioning required by the consulting engineer, prior to practical completion, shall be allowed for within the commissioning plan. The consulting engineer will hold the right to refuse witnessing any plant until the Hydraulic contractor provides all commissioning results in accordance with this specification.

2.4.4 AS-INSTALLED DRAWINGS

Prior to the date of practical completion "as-installed" drawings shall be provided with the installation manuals. These drawings are to be prepared on AutoCAD computer aided drafting system version 2009 or later. Hard copies of the work-as-executed drawings along with copies of the AutoCAD Drawings are to be included on CD within the Operation and Maintenance Instructions. The work-as-executed drawings must indicate the full installation within the area of the works as it exists at the completion of the project including any design modifications which occurred during the project and any existing equipment.

The following minimum shall be included in the As-Installed drawings by modifying the Consultant's "For Construction "drawings:

- All set ups and set downs including invert levels and locations for underfloor drains.
- Location of all above ground piping and drains.
- Installed grades.
- Locations of all isolating valves and meters in ceilings.
- Piping schematics for the buildings hot and cold water, and natural gas pipework reticulation systems.

NOTE: Bluebeam Revu x64 design drawings shall be provided. Contractor is responsible for producing AUTOCAD DWG format as-installed drawings.

3 WORKMANSHIP

3.1 GENERAL

This section of the Specification shall be read in conjunction with all other sections of this specification and the drawings.

Workmanship shall be of a high standard and each section of the work shall be properly and neatly executed to the best trade practice.

Untidy work whether exposed to view or concealed will not be accepted and rectified at nil cost.

3.2 QUALITY ASSURANCE

Implement a Quality Assurance System for the works in accordance with the following Australian Standards:

- AS 3900
- AS 3901

The Quality Assurance System shall cover the following minimum aspects:

Detailed plan setting out supervision, quality control and checking (witness point) procedures.

Details of the Plumbing Contractor's Quality Assurance Plan shall be submitted to the Superintendent upon request.

3.3 EXISTING SITE CONDITIONS

The Plumbing Contractor shall check with all relevant authorities as to possible locations of any underground services in adjacent footpaths and locate same before commencing excavation.

The Plumbing Contractor shall determine the location of all existing services on site before commencement of demolition. The Plumbing Contractor shall allow to terminate redundant services as necessary to allow demolition to commence.

The contractor shall verify the depths of existing sewer connection on site prior to commencement of drainage works on site.

The Contractor shall employ a pipe location service contractor to detect all existing services below the ground.

The Contractor shall also carry out their own investigations of the existing services reticulation to verify the details indicated on the tender drawings.

The contractor shall visit the site to familiarize himself with the extent of work. No extras shall be considered arising from neglect of this provision.

Any loss or damage arising from negligence in not carrying out the above requirements shall be made good in a manner acceptable to the proprietor and no claim shall be made for costs incurred due to this negligence.

The Contractor shall allow to seal off all existing services that may become redundant during the progress of the works. All such services shall be sealed off at the connection to the associated supply main, and removed where practicable.

The Contractor shall allow for satisfactory supervision on site to prevent any damage to new or existing (still in use) plumbing services as a result of the contract works.

3.4 WARRANTIES

Warranties shall extend for a minimum of 12 months.

All equipment and workmanship to be provided with a warranty.

Warranty to commence at date of practical completion, not the date of installation.

3.5 INSTALLATION COORDINATION

Check on site at regular intervals the building working dimensions, tolerances and the setting out of the associated works. Immediately report any discrepancy.

General

The positions of equipment shown on Drawings accompanying the Specification are for Tender purposes and are diagrammatic only. Check on site for positions and obtain approval and verification of all locations with the Principal prior to installation.

When any relocating is required to conform to the above, undertake such relocation without additional costs to the Principal. Allow relocation of accessories and equipment a distance of 3m without variation to the contract.

Verify locations of all equipment, including controls to ensure:

- Co-ordination with final layouts;
- Co-ordination with other trades construction workshop drawings;
- The work of any other trade does not interfere with the hydraulic installation;
- Equipment is not obstructed by door swings and tracks, furniture or equipment;
- Full compliance with relevant Authorities and Australian Standards.

Discrepancies

Promptly report any discrepancies, for consideration and instructions. Work proceeding without obtaining approval, and subsequently rejected by the Superintendent shall be made good at nil additional expense to the Principal.

Co-ordination

Ensure all equipment has been coordinated with other trades and reviewed by the consulting engineer and architect before placing orders and before commencement of the relevant trade construction workshop drawings.

3.6 INSTALLATION REQUIREMENTS

The following clauses set out the general requirements for the works. These requirements are not intended to cover all aspects of the installation and must be read in conjunction with the Conditions of Contract, Special Conditions of Contract, other sections of the Specification and the drawings.

Working Dimensions and Tolerances

Check on site at regular intervals the building working dimensions, tolerances and the setting out of the associated works. Immediately report any discrepancy.

Core Holes and Penetrations Set out

Set out and provide all sleeving and/or core holes as required for the passage of pipes and/or conduits throughout the structure.

NOTE: Coring and cutting of concrete elements to be approved by structural engineer.

Equipment, Materials and Installation

Obtain approval for and maintain uniformity of the manufacturer and type of all materials and equipment. Use only new, current manufacture, first quality materials and equipment.

Comply with the manufacturer's recommendations in respect to installation techniques and the requirements for associated materials, access clearances, equipment, components and devices.

Ensure compatibility of materials and equipment with the installed environment in respect of ambient temperatures, utilities supplies and vibration.

Support all Hydraulic services equipment including pipework, cabling and the like, independently of other services and/or non-structural building elements.

Electrical Interference

Design and use electrical equipment which will not cause interference with electronic and electrical equipment in the vicinity. In the event that the inherent characteristics of equipment make interference possible, fit effective suppressors to eliminate the interference.

Maintain radio and television interference level within the limits set out in Australian/New Zealand Standard 1044 – Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.

Maintain electrical disturbances within the limits set out in Australian Standard 2279 – Disturbances in mains supply networks. Comply with Australian Standard 4252 – Electromagnetic compatibility – Generic immunity standard.

Balancing and Phase Rotation

Balance each section of the installation evenly over all phases and ensure that phase rotation is correct throughout.

3.7 PENETRATIONS

Provide treatment to the penetrations as follows. Refer to architectural drawings for indication of all fire walls, floors ceilings, and the like, for allowance required to fire rated penetrations throughout:

Penetrating Fire Rated Walls and Floors

Provide fire rated insulation to pipework or equipment and the like, where installed within fire rated wall as applicable, with an approved fire retardant insulation as required to maintain the fire wall/floor integrity. Maintain vapour seal to pipework insulation in accordance with the "Pipework" section of this specification. Pack around the insulation at both sides of the penetration with an approved fire resistant joint filler and or approved fire collar. Extent of filler (depth) or fire collar shall be appropriate to maintain the integrity of the fire barrier. Obtain certification from manufacturer for the installation on completion. Refer to treatment of penetrations in this section for further details.

Flashing Through Roof

Supply and install weatherproof under flashing and over flashing to all penetrations.

Supply and install weatherproof over flashing to all penetrations, under flashing to be provided by nominated roofing contractor.

The over flashing shall be of the same material as the pipe passing through the roof and shall be securely fixed to it.

On completion, the Plumbing Services Contractor shall test all penetrations for leaks to the satisfaction of the Architect.

Exposed Penetrations

In addition to the above, flash pipework and penetrations where exposed to view with Colourbond sheet metal escutcheon plates. Sheet metal shall be to the architects approved colour

Protection of Penetrations

All floor and wall penetrations shall be protected to ensure no personnel can fall through or be injured from the penetration at all times during works.

Concealed Services

Conceal all services in areas other than plant or utility areas. Install services as follows:

- Cavity walls, hollow block and dry walls – install services concealed within cavity.
- Single leaf brickwork, concrete – surface mounted conduit or "mini-duct" and seek approval prior to installation.
- Do not chase walls or floors without prior approval from structural engineer.

3.8 PROTECTION

All pipework shall be protected against the entry of foreign matter at all times. Temporarily seal wastes, open ends of pipes, tundishes with fitted covers of pressed steel or UPVC. Rags, paper or wood plugs are not acceptable.

Sanitary fixtures are to be adequately protected against damage. Any item not considered to be in first class condition at the completion of the work shall be removed and replaced at no additional cost upon receipt of notice from the Architect.

3.9 FLUSHING OF SERVICES

All hydraulic services shall be thoroughly flushed to remove all foreign matter including silt, metal particles, etc. Valves, taps and washers shall be inspected and repacked or rewashed if necessary.

- Sewer service – ensure floor traps and waste drainage pipes are clear of debris and construction material during and upon practical completion of the project. Floor trap shall be tested to ensure they run at full volume.
- CCTV inspection of sewer may be requested during construction or upon practical completion of the project if sewer blockages occur, work shall be carried out and NIL cost to rectify the pipework
- Water service – ensure all services are flushed and made clear of debris prior to commissioning of equipment. Ensure all aerators, strainers and filters have been cleaned prior to final handover.
- Flushing of water services shall be carried out according to volume capacity
- Gas service – ensure all services are flushed and made clear of debris prior to commissioning of equipment.

3.10 CLEANING UP

Thoroughly clean all fixtures and fittings and leave the installation in a first class working condition.

Remove all floor grates and inspection covers, clean all threads, grease and refit.

3.11 SEISMIC RESTRAINT, EARTHQUAKE BRACING, FIXINGS AND SUPPORTS

All plant, equipment and piping systems, shall comply with the requirements of Australian Standard 1170.4 - SAA Loading Code – Earthquake, AS2670 – Vibration, AS2625

Where greater incorporate the Design, Selection and Installation with requirements of ASHRAE Handbook 2011, Applications Chapter 48.

For further information regarding earthquake restraining, refer to following:-

- Gripple Seismic Installation Manual
- Tyco flow control, 2002,unistrut seismic bracing systems
- Fema e-74, January 2011, reducing the risks of non-structural earthquake damage - a practical guide.

Provide restraints and supports designed and certified by a structural engineer, to all plant, equipment, tanks pipework and isolation mounts in accordance with Australian Standard 1170.4-2007 Section 8, incorporating the following:

Criteria	**Unit**	**Factor**
Importance Level	I	2
Annual Probability of Exceedance	yr	500
Soil Classification		H_D
Hazard Factor	Z	0.10
Probability Factor	Kp	1

All restraints and supports shall be issued to the structural engineer to review the adequacy of the structure to support the services loads, including seismic forces.

The following do not require seismic bracing:

- Piping less than 32mm internal diameter in plant rooms.
- All other piping less than 64mm internal diameter
- All piping suspended by individual hangers 300mm or less in length from the top of the pipe to the bottom of the support for the hanger

Spacing of the bracing may need to be reduced for example:

- Brace both sides of piping, conduit at flexible connections
- Brace to avoid collision between piping, conduit and other non-structural components
- Brace within 600mm of changes in direction, whether it be horizontal or vertical changes
- Brace where components penetrate floors or ceilings
- Brace in both directions at the top of all risers where risers exceed 900mm

The spacing of bracing along a run of piping, conduit should not vary greatly in order to ensure uniform deflection and loading.

Equipment connected to a run of piping, conduit shall be individually and independently braced. Thermal expansion and contraction forces, where present, must be considered in the layout of transverse and longitudinal braces. Flexibility should be provided where pipes pass through seismic or expansion joints or connect to equipment with vibration isolators.

Bracing of pipework shall be at every second support.

Services braced in accordance with AS 1170.1-2007 section 8 shall have a minimum of 50mm clearance from all ceiling hangers and the ceiling grid.

Do not core through, cut through or otherwise damage steel reinforcement in concrete slabs, beams or columns when installing seismic bracing.

3.12 GENERAL PIPING INSTALLATION REQUIREMENTS

All screwed joints shall be made with the best quality pipe jointing compound, carefully placed on the threads of the pipe and not through fittings.

All cut and threaded pipe shall have the cutting burrs and sharp edges reamed out.

When erecting pipework, care shall be taken to protect the pipe. Dented or otherwise damaged pipework shall be replaced at the Contractors expense.

The general pipework arrangements shall be as indicated on the Drawings.

Pipework shall be installed as directly as possible between connecting points and run parallel to walls or ceilings.

All connections between pipework and isolation valves and balance, pressure limiting valves shall be provided with flared compression joint unions or barrel unions for ease of removal.

Provide flared compression joint unions on all connections to equipment and plant.

3.13 PIPE SUPPORTS

All pipes shall be adequately supported and appropriately restrained by proprietary hangers and brackets designed to suit the requirements of each piping system. All pipework shall be fixed clear of each other with galvanised pipe clamps. Between pipe clamps and copper tube, wrap tube with 4 layers of approved plastic tape or EPDM rubber.

All piping concealed in roof spaces or above ceilings shall be supported from common supports where practicable and shall be run in neat pipe groups.

Pipework must be free to move without causing stresses in the pipework or pipe joints. Where provision has been made for movement in mains, the branch lines shall be unrestrained and in the case of copper tube, annealed for a minimum of 1800mm from the main. Where this is not achieved, some other approved provision for movement shall be made. Vertical pipes passing through floors shall be supported at a maximum of 1800mm centres.

Any noise from movement shall be rectified during the maintenance period.

All steel supports and associated fittings exposed to moisture, condensation or external elements shall be hot dip galvanised after fabrication. Dissimilar metals shall be isolated from one another as specified elsewhere in this specification.

3.14 INSTALLATION REQUIREMENTS FOR PVC PIPING AND FITTINGS

The installation of UPVC pipe and fittings shall be in accordance with Office of the Technical Regulator requirements and AS/NZS 3500 as amended and AS2032.

Pipes and fittings must not be stressed by straining into grade or alignment. Pipe ends must be cut square. Butts and swarf shall be removed.

Care must be taken to ensure that the end of the pipe is entered into the socket squarely and in correct alignment to match the grade of the preceding pipes or fittings.

Joints shall be solvent welded joint to AS2032 and in accordance with manufacturer's specifications and recommendations.

Surplus solvent cement is to be cleaned off.

All UPVC pipes cast in concrete shall be wrapped in 40mm thick minimum FORMFLEX polyethylene foam expansion material and shall be over wrapped in plastic surround.

3.15 INSTALLATION REQUIREMENTS FOR HDPE/PVC PIPING AND FITTINGS INGROUND

All HDPE/UPVC pipes cast in concrete shall be wrapped in 40mm thick FORMFLEX polyethylene foam expansion material and shall be wrapped in plastic surround.

Where HDPE/UPVC Piping and Fittings are installed in soils of moderately, highly or extremely reactive classification the following shall apply:

The base of trenches shall be sloped away from the building. Trenches shall be

- Backfilled with clay in the top 300 mm within 1.5 m of the building. The clay used for backfilling shall be compacted.
- Where pipes pass under the footing system, the trench shall be backfilled full depth with clay or concrete to restrict the ingress of water beneath the footing system.
- Where pipes pass under the footing system, the trench shall be backfilled full depth with clay to act as a barrier to the ingress of water beneath the footing system. Alternatively, a plastic membrane across the cross-section of the trench, taped to the pipe and keyed into the sides and base of the trench may be used.
- Penetrations of the edge beams of a raft and perimeter strip footings shall be avoided where practicable, but where necessary shall be detailed to allow for movement. Closed-cell polyethylene lagging shall be used around all stormwater and sanitary plumbing drain pipe penetrations through footings. The lagging shall be a minimum of 20 mm thick on Class H1 sites and 40 mm thick on Class H2 and Class E sites. Vertical penetrations do not require lagging.
    - NOTE: Sleeves allowing equivalent movements may be used as an alternative to the lagging.
- Drains attached to or emerging from underneath the building shall incorporate flexible joints immediately outside the footing and commencing within 1 m of the building perimeter to accommodate a total range of differential movement in any direction equal to the estimated characteristic surface movement of the site (ys). In the absence of specific design guidance, the fittings or other devices that are provided to allow for the movement shall be set at the mid-position of their range of possible movement at the time of installation, so as to allow for movement equal to 0.5ys in any direction from the initial setting. This requirement applies to all stormwater and sanitary plumbing drains and discharge pipes.
- Drainage risers under slab shall be provided with Swivel/expansion joints and where piping systems are reduced below 100mm long expansion joints shall be fitted.
    - NOTES:
    - HDPE pipes may be encased in concrete or in recesses in the slab when provided with 40mm lagging and flexible joints at the exterior of the slab and lagged for entire length encased.
    - Methods used should comply with the AS/NZS 3500 series.

3.16 ELECTROFUSION JOINTING REQUIREMENTS FOR POLYETHYLENE PRESSURE PIPEWORK SYSTEM

All pipework to be jointed shall be new, current manufacture, first quality materials and equipment.

Preparation:

- Ensure hands and tools are free from surface contaminants, including creams oils, detergents and surfactants.
- Equipment shall be in suitable working order protected from inclement weather.
- Trenches shall be excavated to ensure a minimum clearance of 150mm surrounding the pipework.
- The pipe to be fusion jointed may be washed with clean water if necessary and dried with lint free material.
- Pipe ends shall be cut square to the axis and burrs and swarf shall be removed.
- Clean the fitting and bore the external surface of the pipe to be jointed with clean manufacturer approved alcohol wipes to remove traces of dirt and other contaminants. Do not use detergent or surfactants to clean the pipe surfaces.
- Fittings shall remain in the bag, place along the pipe and insert first witness mark on the pipe at half the fitting length with additional secondary witness mark placed 40mm further along pipework to enable visual checking of scrapped area after jointing is complete.
- Ensure pipe clamps are the correct size for the pipes to be jointed.
- Jointing tools shall be clean of dirt prior to use.
- Using a manufacturer approved peeling tool remove the surface of the pipe to the first witness mark. Note: Metal files, rasps, emery papers or hand held scrapers shall not be approved for use.
- Jointing process shall be undertaken at temperatures within the range of -10˚C to +45˚C.

Jointing Method:

- Ensure the prepared surfaces are completely dry before proceeding.
- Wipe the prepared surface with only the manufacturer approved alcohol wipe to the area about to be welded to remove any dust residue and contaminants. Methyl ethyl ketone or other solvents including rags are not approved for use. Note: one alcohol wipe shall be used per joint to avoid contamination of the fusion zone area.
- Remove the fitting from its packaging and check the bore of the fitting is clean. Wipe with an approved isopropyl wipe as necessary.
- Ensure all surfaces are clean and dry before fitting the pipe ends with fittings in place.
- Insert the pipe on to the fitting and align with the first witness mark.
- The pipe end must be correctly aligned and free from any bending stress.
- Install pipe clamps to ensure the pipework cannot move and the fitting is satisfactory supported to prevent sagging during the fusion procedure.
- Fit the control box output leads to the fitting terminals ensuring they are fully inserted

- Where automatic or manual control boxes are used and fusion times are entered or barcode scanners are provided jointing times shall be as per manufacturer's data.
- Press the start button on the control panel and check that the heating cycle is proceeding as indicated on the display.
- On completion of the heating cycle both melt indicators within the processed part of the fitting should have risen.
- Where indicator pins have not risen the contractor shall refer to the manufacturer's guidelines or control box indicators for faults. Re-welding the fitting after the cooling off period shall be only as recommended by the manufacturer.
- The complete joint should be left in the clamps for cooling. The time needed will be specific on the fitting, or by its manufacturer data, or in the display of the automatic control box.
- When the joint has cooled remove clamps from the pipework.

Equipment:

- Equipment shall be well maintained and cleaned at all times.
- The welding apparatus should be serviced and calibrated regularly and should not exceed 12 months from last calibration.
- The sharpness of the peeling tool cutter head shall be checked on a monthly basis or as required to ensure even removal of piping services.

3.17 INSTALLATION REQUIREMENTS FOR POLYETHYLENE NON-PRESSURE PIPEWORK SYSTEM

All pipework to be jointed shall be new, current manufacture, first quality materials and equipment.

Preparation:

- Ensure hands and tools are free from surface contaminants, including creams oils, detergents and surfactants.
- Equipment shall be in suitable working order protected from inclement weather.
- Trenches shall be excavated to ensure a minimum clearance of 150mm surrounding the pipework.
- The pipe to be fusion jointed may be washed with clean water if necessary and dried with lint free material.
- Pipe ends shall be cut square to the axis and burrs and swarf shall be removed.
- Clean the fitting and bore the external surface of the pipe to be jointed with clean manufacturer approved alcohol wipes to remove traces of dirt and other contaminants. Do not use detergent or surfactants to clean the pipe surfaces.
- Fittings shall remain clean, place along the pipe and insert first witness mark on the pipe at half the fitting length with additional secondary witness mark placed 40mm further along pipework to enable visual checking of scrapped area after jointing is complete.
- Ensure pipe clamps or restraints are suitable for the pipes to be jointed.
- Jointing tools shall be clean of dirt prior to use.
- Using a manufacturer approved peeling device remove the surface of the pipe to the first witness mark. Note: Rasps or emery papers shall not be approved for use.

- Jointing process shall be undertaken at temperatures within the range of -10˚C to +45˚C.

Jointing Method:

- Ensure the prepared surfaces are completely dry before proceeding.
- Wipe the prepared surface with only the manufacturer approved alcohol wipe to the area about to be welded to remove any dust residue and contaminants. Methyl ethyl ketone or other solvents including rags are not approved for use. Note: one alcohol wipe shall be used per joint to avoid contamination of the fusion zone area.
- Ensure the fitting is clean and where required wipe with an approved isopropyl wipe as necessary.
- Ensure all surfaces are clean and dry before fitting the pipe ends with fittings in place.
- Insert the pipe on to the fitting and align with the first witness mark.
- The pipe end must be correctly aligned and free from any bending stress.
- Install pipe restraints to ensure the pipework cannot move and the fitting is satisfactory supported to prevent sagging during the fusion procedure.
- Fit the control box output leads to the fitting terminals ensuring they are fully inserted.
- Where automatic or manual control boxes are used and fusion times are entered or barcode scanners are provided jointing times shall be as per manufacturer's data.
- Press the start button on the control panel and check that the heating cycle is proceeding as indicated on the display.
- On completion of the heating cycle both melt indicators within the processed part of the fitting should have risen.
- Where indicator pins have not risen the contractor shall refer to the manufacturer's guidelines or control box indicators for faults. Re-welding the fitting after the cooling off period shall be only as recommended by the manufacturer.
- The complete joint should be left in the clamps for cooling. The time needed will be specific on the fitting, or by its manufacturer data, or in the display of the automatic control box.
- When the joint has cooled remove joint restraints from the pipework.

Equipment:

- Equipment shall be well maintained and cleaned at all times.
- The welding apparatus should be serviced and calibrated regularly and should not exceed 12 months from last calibration.
- The sharpness of the peeling tool cutter head shall be checked on a monthly basis or as required to ensure even removal of piping services.

3.18 INSTALLATION REQUIREMENTS FOR 'REHAU RAUPIANO' SANITARY PLUMBING DRAINAGE AND STORMWATER SYSTEM

As an alternative to acoustically wrapping suspended drainage pipework in the ceiling space of the apartments, the Plumbing Contractor may adopt the use REHAU RAUPIANO piping system above ground and suspended sewer and stormwater drainage.

RAUPIANO PLUS pipe – Polypropylene (PP-MD), mineral-filled, halogen free

Pipe materials shall be composite polypropylene, consisting of polypropylene inner layer, mineral-filled polypropylene middle layer and UV-stabilized polypropylene outer layer, complying with AS/NZS 7671 for gravity drainage and storm water drainage system in residential and commercial applications, colour white (RAL 9003).

The pipes shall be designed for a temperature of 90°C and can temporarily withstand temperatures of up to 95°C and marked with ice crystal to indicated suitability for installations under extreme low temperatures up to -10°C. The pipes shall have excellent chemical resistance, withstanding acidity level from pH 2 - 12.

The pipes shall be certified under Water Mark scheme for dimensions

DN (OD) 40 – 50 – 75 – 90 – 110 – 125 – 160 – 200mm.

Available lengths shall be from 150 to 3000 mm.

Ring stiffness: > 4 KN / m^2 Mean elongation: 0.09 mm / (m.K) Resistant: up to 100kPa = 10m water column (pressure test certificate on request)

The pipe materials shall be packaged to reduce UV-radiation effect to the pipe materials themselves and to protect the pipe materials from dirt and other foreign materials.

RAUPIANO PLUS fitting – Polypropylene (RAU-PP), mineral-filled

Fitting materials shall be mineral-filled polypropylene for acoustic performance enhancement, complying with AS/NZS 7671 for gravity drainage and storm water drainage system in residential and commercial applications, colour white (RAL 9003). The fittings shall have an inserted SBR sealing ring

The fittings shall be designed for a temperature of 90°C and can temporarily withstand temperatures of up to 95°C and suitable for installations under extreme low temperatures up to -10°C. The fittings shall have excellent chemical resistance, withstanding acidity level from pH 2 - 12.

The fitting materials shall be certified under Standards Mark scheme for dimensions

DN (OD) 40 – 50 – 75 – 90 – 110 – 125 – 160 – 200mm.

RAUPIANO PLUS floor-gully – Acrylonitrile Butadiene Styrene (RAU-ABS)

Floor gully material shall be the Acrylonitrile Butadiene Styrene. The floor gully shall have 1 main inlet in dimension DN (OD) 110mm and 3 additional inlets in dimension DN (OD) 50mm. The outlet shall be of dimension DN (OD) 75mm. Each inlet and outlet shall have an inserted SBR sealing ring. The floor gully shall have a removable access plug. The height shall be 250 mm.

RAUPIANO PLUS floor-gully – Polypropylene (RAU-PP), mineral-filled

Floor gully material shall be the Polypropylene. The floor gully shall have 1 main inlet in dimension DN (OD) 110mm and 3 additional inlets in dimension DN (OD) 50mm. The outlet shall be of dimension DN (OD) 75mm. The main inlet (DN 110mm) shall have an inserted SBR sealing ring. All other inlet and outlets shall be male connector type. The floor gully shall have a removable inserted trap. The height shall be 222 mm minimum.

RAUPIANO PLUS sound-dampening bracket

Sound-dampening bracket shall be rubber-lined with vibration-decoupling system to reduce the structure-borne noise transmitted from the DWV system. Material shall be galvanized steel, including hanger bolt.

3.19 INSTALLATION REQUIREMENTS FOR COPPER PIPES

Copper pipework shall be installed in accordance with AS4809

Pipes and fittings must not be stressed by straining into grade or alignment.

Copper pipe runs shall be fabricated from the longest possible lengths and building up sections with short lengths will not be accepted.

Where copper pipes terminate in walls, eg. at taps or traps, a suitable anchor is to be used to securely fasten the fitting in position.

All copper pipes and fittings installed below building footprint and where penetrating footings up to 2.0 meters in length shall be wrapped with two layers of Denso Type 600 tape and 10mm formflex or equal approved unless otherwise noted to allow vertical and lateral movement. Pipework installed more than 2.0meters below building footprint shall be placed within PVC sleeve.

All domestic water pipes and fittings installed underground shall be protected from corrosion by encasing in polyethylene sleeving. Refer Piping and Materials section for details. Incoming building services shall be provided with approved flexible expansion loops to withstand potential soil movement.

Heated water piping shall be installed in accordance with AS3500 including provisions for expansion loops, offset or bends.

3.20 INSTALLATION REQUIREMENTS FOR CROSS LINKED POLYETHYLENE PIPES

Supporting of pipework in both horizontal and vertical direction shall be in accordance with manufacturer's recommendations and in any case shall not exceed AS/NZS 3500,

Pipework and fittings shall be mechanically joined by proprietary compression sleeves. Bends shall be formed and held utilising proprietary bend bracket (bending radius = 8 x outer diameter).

Note: The pipework supplier's representative shall be required to inspect the first fix installation and certify in writing that the system has been installed to their recommendations.

3.21 SLEEVES

All service piping passing through walls, floors and footings shall be provided with sleeves, the location of which shall be accurately determined and installed to the approval of the Structural Engineer during construction. Provide shop drawings indicating location and size of all service penetrations for approval by the Structural Engineer.

3.22 BRAZING

At completion of all joints, residual flux shall be removed by quenching in water and cleaning with a steel wire brush.

3.23 CHROMIUM PLATING

Any pipes exposed within buildings excluding store rooms, are to be heavily nickel plated and then chromium plated. Where such pipes pass through walls or floors, a chromium plated wall plate is to be fitted unless otherwise detailed. All basin wastes and traps are to be chrome plated where exposed.

Chromium plating not required to specialised fixture such as laboratory sinks etc as nominated.

Chromium plated pipework shall be secured by chromium plated clips. Screws and bolts shall be chromium plated brass or be manufactured from 316 gauge stainless steel. Tradewaste system pipework and traps shall be HDPE where exposed and not in the view of public.

3.24 DISSIMILAR METALS

Where clips, brackets, and pipe supports are of dissimilar metal to the actual piping used, completely insulate the piping at all fixing points with at least four layers of 50mm wide black polyethylene tape wrapped around the pipe prior to fixing in position.

3.25 JOINTS IN PIPEWORK

COPPER PIPING

All joints in copper pipework shall be made by brazing with low temperature silver brazing alloy containing not less than 5% silver. Use oxy-acetylene heating for all low temperature brazing.

Flux shall be as recommended by brazing alloy manufacturer. Slip joints shall be permitted to join lengths of copper pipes and shall be made by annealing and expanding ends with a proper tool to form a slip (capillary) joint in accordance with the following table.

Pipe Size OD	Min Length of Slip Joint
15mm to 20mm	10mm
25mm to 32mm	15mm
40mm to 65mm	15mm
80mm to 100mm	20mm

Where straight sections of pipe of different diameter are to be joined, proprietary reducer fittings shall be utilised. Crimped joints will not be permitted.

Fabricated tees or junctions in copper pipes will not be permitted.

Valves shall not be brazed direct onto pipes. Valves shall be indirectly joined to the pipes by the use of flanged or screwed adaptors, which shall be silver brazed onto the pipe and then screwed to the valve. Care shall be taken to prevent distortion to the valve and/or valve seat.

PRESSFIT JOINTS

All pressfit jointing shall be in accordance with manufacturer's guidelines and requirements. Contractor shall ensure fittings used are suitable for the fluid or gas to be transported. Contractor shall request manufacturer certificate of installation on completion.

The copper press-fittings shall be KemPress® Copper or equivalent, be of press fit type, complying with AS 3688. All fittings, excluding GAS fittings with HNBR type O-rings, shall have Watermark approval.

3.26 GRADES

All grades and inverts indicated on the drawings shall be established with the use of approved surveying instruments. Check the topography and finished floor elevations before commencing any excavation work.

The setting of all inverts, etc. at correct elevations is a prime and definite requirement of this Specification. Grades to drains shall generally be as shown on the drawings or where this information is not provided, as required by the relevant authorities and plumbing standards.

All water piping shall be graded at 0.25% to facilitate draining at a low level drainage point.

3.27 INSPECTION AND TESTS

During Manufacture

- Every facility is to be afforded the authorities and/or the Superintendent's representative for the inspection of any part of the work or apparatus during the course of manufacture and, upon completion, testing is to be undertaken in the manufacturers workshop if applicable.

Hydrostatic Tests – Water Services

- All pipework shall be hydrostatically tested to a head of one and a half times the working head and not less than 1500 kPa. Hydraulic (testing) pumps shall be disconnected immediately after pressurisation and all test heads shall be maintained until the Superintendent's representative or Regulatory Authority has satisfied himself as to the soundness of the pipework and equipment.

In no case shall the period of test be less than 2 hours.

Before applying specified test head, all air shall be expelled from the piping being tested.

Equipment is not to be connected to the respective services while hydrostatic tests are being carried out.

Provide a suitable pump and gauge and do all necessary work for carrying out the tests.

All testing of pipework is to be carried out before:

- Ceilings are installed.
- Service ducts are clad.
- Pipework insulated prior to testing shall have the ability to inspect joints to confirm compliance.

At completion of testing cold water lines shall be kept charged full of water at all times.

Air Testing – Sewer Services

- Air testing of drains shall or may be carried out to all drainage pipework where domestic mains water used for a hydrostatic test is not recycled or stored on site for reuse. Contractor shall perform an air pressure test by pressurising the drains as follows:
    - The sewer drainage pipework shall be pressurised to the initial pressure of 20KPA for sewer drains to 0- 1.5 meters in depth and 25KPA for sewer drains 1.5metres - 3.0meters in depth for a minimum of 3minutes to stabilise the temperature.
    - After the 3 minute stabilisation period the pressure shall be dropped to the test pressure of 15KPA for sewer drains to 1.5meters in depth and 20 KPA for sewer drains 1.5meters – 3.0 metres in depth and the test timing for the particular sewer shall then commence.
    - A pressure of not more than 5kpa pressure drop over 3 minutes shall be achieved prior to the test procedure being passed.
    - All pressure tests to be inspected and passed in accordance with AS3500 and Office of the Technical Regulator requirements.

All drainage pipework above ground shall be tested at a test pressure of 15KPA.

Hydrostatic Tests – Sanitary Services

All sanitary drains above and below ground shall be water tested by plugging at the lowest or other approved positions, and filling with water to the overflow level with 1m of head at the top most section of drain.

Tests shall be maintained until the authorities, including Architect, have satisfied themselves to the soundness of the pipework.

In no case shall the period of test be less than one hour.

Fixtures are not to be connected to the respective services while tests are being carried out.

Provide all necessary plugs and do all necessary work for the carrying out of these tests.

All testing of the above systems shall be carried out before:

- Finishing trades have commenced their work.
- Backfilling has commenced.

Natural Gas Pipework Pressure Testing

All gas services are to be tested in accordance with AS 5601.2004 section 2 and table E

Tests shall be maintained until the authorities, including Superintendent, have satisfied themselves to the soundness of the pipework.

In no case shall the period of test be less than one hour.

Appliances are not to be connected to the respective services while tests are being carried out.

Provide all necessary plugs and do all necessary work for the carrying out of these tests.

All testing of the above systems shall be carried out before:

- Finishing trades have commenced their work.
- Backfilling has commenced.
- Appliances are connected

Fixtures

Fixtures shall be filled to spill level with water after installation and visually checked for leaks.

Test of Completion

Upon completion the Hydraulic works shall be tested under normal working conditions and as directed by the Superintendent's representative. Such tests shall continue until Superintendent's representative is satisfied that the terms of this specification has been complied with and that the Hydraulic works are capable of meeting all requirements.

All defects disclosed during the tests shall be remedied immediately and, if required by the Architect, additional tests shall be carried out.

The duration of the tests will be decided by the Superintendent's representative and the maximum duration of any one test will not exceed eight hours.

The Superintendent's representative shall be given two (2) days clear notice that any system is ready for test.

Provide all equipment and labour required for tests.

The Superintendent reserves the right to check any aspect with his own equipment.

All tests shall be carried out in the presence of, and to the satisfaction of, all local authorities, as well as the Superintendent's representative.

Record Keeping

Contractor shall keep a record of all tests completed and inspection requested by the OTR with dates the tests were performed, pressure applied to the relevant pipe being tested and end result as a pass or fail. Records shall include the name of the operator performing the test and witness of the result. Records shall be inserted within manuals for future reference.

3.28 TRENCH EXCAVATION, BACKFILLING AND COMPACTION

Trench Excavation

The Contractor shall do all excavation of whatever substances encountered to the required depths, lengths, breadths, grades and alignment as may be necessary for the construction of the pipe drains in accordance with the Drawings.

Where trenches are to be in bitumen or concrete paving, the surface shall be saw-cut where paving consists of unit pavers, blocks shall be removed.

Trenches are to be excavated to the correct line and level with vertical sides at least 300 mm wider (150 mm on each side) than the external diameter of the pipes to be laid in them. Sufficient

extra width and depth is to be excavated at each joint to allow the pipes to be properly jointed. Excavation shall be 75mm lower than required for 75mm thick compacted sand base or 10mm sieve metal screenings for pipework bedding.

Trenches must be kept clear of water at all times and timbered where necessary to prevent collapse. They shall be excavated only sufficiently in advance of pipe laying to allow that work to proceed without delay.

Excess excavation below the required level shall be backfilled at the Plumbing Contractor's expense with sand, gravel or other material as directed by the Superintendent, and thoroughly compacted. Any soft or yielding material shall be removed and replaced with sound material and compacted to the satisfaction of the Superintendent.

Suitable safety barriers shall be provided around the excavation at all times. The barriers shall be suitably defined by approved lighting during the appropriate light up time for the area.

The barriers shall not be removed until completion of all work.

Excavated material shall be removed off site. All cartage costs and tipping fees shall be paid by the Plumbing Contractor.

Pipe Bedding/Support

Pipes shall have a minimum 75mm bed of compacted sand base or 10mm sieve metal screening provided in accordance with AS3500.

The bedding surface shall provide a firm foundation, carefully shaped true to line and grade.

Laying Pipes

Pipes shall bear evenly on the bed prepared as specified above and laid with the sockets pointed up-grade. All pipes shall be laid in straight lines, to true invert levels.

Trench Backfilling

No joints shall be covered or trench backfilled until pipe laying and jointing has been approved by Superintendent’s representative.

It shall be the Plumbing Contractor’s responsibility to ensure the inspection and approval of the pipe drains prior to the backfilling.

Failure to observe this clause shall render the Plumbing Contractor liable for re-opening at his own expense any trench backfilled without approval.

Backfill material shall comply with the relevant services specification section. Generally, backfill, including the overlay zone shall be:

- In paved areas or under buildings - quarry sand

Backfill shall be placed in layers not greater than 150 mm thick and compacted to:

- In paved areas or under buildings - 98% Modified Compaction Maximum Dry Density
- Note: Contractor shall engage independent engineer to perform compaction testing of trenches on completion. Test results shall confirm 95% compaction has been achieved. A

minimum of 4 compaction tests are required for the ground floor drainage with test sheets inserted within manuals for review.

Weather Damage and Flooding of Excavations

Keep excavations free from water and seepage and take all necessary precautions throughout the duration of the Contract to maintain the safety and stability of the excavation.

Over Excavation

Backfill over-excavated trenching with approved granular material or concrete as directed by Superintendent's representative and/or the Office of the Technical Regulator.

Barriers and Accessibility

Provide all necessary barricades and lighting to excavations to protect the public, as well as the work during the course of all excavations.

All necessary arrangements for access over trenches and safety lighting shall be made so that paths and doorways are trafficable at all times.

Shoring of Trenches

Where necessary and/or required by the Authorities for safe and efficient completion of the work, supply, erect shoring, timbering, planking, etc. of sufficient strength and quality to prevent earth and other materials entering the excavations, tunnels, etc.

Work shall be carried out in accordance with Safe Work SA requirements.

Remove all shoring and timbering in an approved manner on completion of the work and after the inspections have taken place.

Minimum Cover to All Pipes

All service pipes shall be installed with the minimum cover as noted hereafter or in excess of these as noted on the drawings or specified elsewhere.

Sewer	600mm in areas subject to vehicular traffic
	450 elsewhere
Water	450mm minimum
Natural Gas	600mm
Separation	100mm for services up to and equal to 50mm
	300mm for services above 65mm

3.29 TREATMENT OF PIPEWORK PENETRATIONS

Where hot and cold water pipework penetrates fire rated walls or plumbing ducts, penetrations shall be fire stopped, utilising a resilient gunnable compound with a -/120/- 120 FRL.

Where hot and cold water pipework penetrates non fire rated bounding walls or plumbing ducts, penetrations shall sealed, utilising a resilient gunnable compound.

Where copper hot and cold water pipework penetrates concrete floor slabs the fire rating of the floor shall be maintained. The annular space between the outside of the pipe and the floor penetrations shall therefore be filled with a fire rated grout, fire rated mastic or IBS foam strip. Note: All copper pipework shall be spirally wrapped with plastic film through penetration to prevent contact with fire rated grout.

Where UPVC, HDPE, CROSS LINKED POLYETHYLENE or any plastic pipework penetrates fire rated bounding stud walls or plumbing ducts, penetrations shall be fire stopped utilising an approved Retro-fit fire stop collar.

Where UPVC, HDPE, CROSS LINKED POLYETHYLENE or any plastic pipework penetrates concrete floor slabs the fire rating of the floor shall be maintained. The penetration shall be fire stopped utilising an approved fire stop collar.

Note: Any pipe penetrations with an open floor grate above, must be protected with an approved floor waste fire stop collar in accordance with the BCA and AS1530.4

All pipework penetrations must be treated utilising a fire rated product designed for the application. The contractor is required for the fire stop manufacturer's representative to inspect the installation and certify in writing that the correct product has been installed to their recommendations.

All pipework installed within fire rated walls shall be fire rated with approved insulation or collar as directed by manufacturer to maintain the integrity of the wall.

3.30 ACOUSTIC REQUIREMENTS

Refer to Specification for details of approved proprietary acoustic pipe lagging systems.

Support of Pipework

Drainage pipework in ceilings must be supported off the slab above and must not contact any lightweight ceiling support members, stud wall framing or other services.

Drainage pipes in plumbing ducts must be fixed with approved isolations pipe clamps and gaskets. Approved isolated pipe clamps and gasket systems include:

"Kwik-smart" pipe clips by Binder Engineering

"Ezyclip" pipe clamps by Flexistrut

Rehau Raupiano bracketing system for acoustic piping.

Hot and Cold Water Pipes and Plumbing Fittings

To control structure borne sound from water supply pipes, flexible water supply pipe such as "Rehau" or similar product shall be used within the Apartments.

The flexible pipework can be fixed direct to the slab soffit or be run in wall cavities without special acoustic treatment, except at the metal connectors. Where the pipe is fixed to a common

partition such as the slab soffit or within a bounding wall between apartments, the metal connectors must be isolated using non-setting flexible acoustic sealant.

Flexible connections are required to be fitted to drain pipes serving dishwashers, washing machines etc. materials

4 PIPING AND MATERIALS

4.1 GENERAL MATERIALS

Type	Application	Jointing	Bracketing	Insulation	Location
UPVC- Ø100 - SN6 Ø150-225 -SN8	Sewer/Stormwater	Cleaning Fluid. Solvent cement. (Type N).	Hanging/ offset brackets.	Acoustically wrapped	Internal, external, suspended, inground
HDPE - 40-56mm PN6 63-160mm PN4	Trade Waste/ Sewer Stacks.	Electrofusion welded coupling	Hanging/ offset brackets.	Acoustically wrapped	Internal, external, suspended, inground
Copper - Type B Minimum	Domestic Water, Gas, Drainage.	Welded or Compression.	Hanging/ offset/ Unistrut system.	Thermal/ acoustic as required	Internal, external, suspended, inground
Cross linked Polyethylene - PN20	Domestic Cold and Hot water, Rainwater, Recycled water,	compression	As per the manufactured bracketing system.	Thermal/ acoustic as required	Suspended, internal in concealed areas only
Cross Linked Polyethylene – Aluminium lined	Natural / LP Gas	Compression	As per the manufactured bracketing system.		Suspended, internal in concealed areas only. Not for external use.
Medium Density Polyethylene Blue Stripe - PN12.5 min.,	Domestic Cold water.	Electrofusion welded coupling	In-ground only	N/A	External, inground
Medium Density Polyethylene Purple Stripe - PN12.5 min.	Recycled Water	Electrofusion welded coupling	In-ground only	N/A	External, inground
Medium Density Polyethylene Yellow Stripe - SDR11	Gas	Electrofusion welded coupling	In-ground only	N/A	External, inground

Polypropylene	Waste Fixture traps only		As per the manufactured bracketing system.		
Acoustic Drainage	Suspended drainage	Rubber ring	As per the manufactured bracketing system.	N/A	Internal
Stainless Steel	Domestic Cold and Hot water, Rainwater, Recycled water, gas	Press Fit	As per the manufactured bracketing system.	As specified	External/internal above ground
Stainless Steel	Sanitary Drainage	Rubber Ring	As per the manufactured bracketing system.	N/A	Inground

4.2 UNIFORMITY AND QUALITY

Obtain approval for and maintain uniformity of the manufacturer and type of all materials and equipment. Use only new, current manufacture, first quality materials and equipment.

Comply with the manufacturer's recommendations in respect to installation techniques and the requirements for associated materials, access clearances, equipment, components and devices.

Ensure compatibility of materials and equipment with the installed environment in respect of ambient temperatures, utilities supplies and vibration.

Support all equipment including pipework, cabling and the like, independently of other services and/or non-structural building elements.

Copper Pipes - Sanitary Plumbing, Domestic Hot and Cold Water, Natural Gas Service

Copper pipes are to be solid drawn tubes, manufactured in accordance with AS 1432-1973, and to be of the gauges specified or as shown. The use of Table 5 copper tube will NOT be permitted.

Type 'B' tube or heavier shall be used below ground and above ground.

Wall thickness for hot water pipes shall be the same as those required for the cold water piping, but shall be not less than Table 'B' of AS 1432 - 1973 with a minimum wall thickness of 1.0mm.

Fittings shall be approved by the OTR and APA group and all joints shall be silver soldered.

Fittings for copper tubing shall be used in accordance with the following schedule:

- For Sanitary Plumbing
  - Brass, as approved for use by the OTR, AS3500 and local authority or equal approved.
- For Hot and Cold Water

- Brass or copper acceptable to the tapware manufacturer, in order to maintain tapware guarantees and suitable for silver soldering.

All brazing shall be carried out with a suitable silver brazing alloy containing not less than 2% silver and 6% phosphorous such as S.B.A. No. 115 or Handley's No 15. Only one brand may be used throughout the job. Bronze welding will NOT be permitted. Remove all flux on completion of brazing.

Cross Linked Polyethylene - Domestic Hot and Cold Water Service (extending from isolation valves, assemblies and where concealed within wall frames and/or ceiling space)

Cross linked polyethylene equal to 'Rehau HIS311' system PN20.

Cross linked high density polyethylene pipework and fittings shall conform to AS2492 and AS2537 respectively. Pipe sizes nominated on drawings are equivalent copper sizes.

Supporting of pipework in both horizontal and vertical direction shall be in accordance with manufacturer's recommendations and in any case shall not exceed AS/NZS3500.

Pipework and fittings shall be mechanically joined by proprietary compression sleeves. Bends shall be formed and held utilising proprietary bend bracket (bending radius = 8 x outer diameter).

Note: The pipework supplier's representative shall be required to inspect the prototype ensuite first fix installation and certify in writing that the system has been installed to their recommendations.

Above Ground- Natural Gas Services (Internal Only)

Cross linked polyethylene aluminium polyethylene multilayer pipe complying with AS4176.8 RAUTITAN gas stabil gas pipe, Rautitan gas fittings and compression sleeves or similar approved and installed in compliance with AS5601.

Where pipework is installed within wall cavities and inaccessible areas Rauguard flexible metal conduit shall be placed over the pipe for protection.

UPVC Pipes - Sanitary Plumbing, Sewer and Stormwater Drainage (in non-acoustic areas only)

All unplasticised polyvinyl chloride pipes and fittings shall conform with AS1415 and the type 'N' heavy duty non-pressure pipe and shall conform with the requirements of OTR, and be as manufactured by Iplex Plastics, or equal approved and shall be installed in accordance with AS2032.

Fittings shall be by the same manufacturer as the pipe and shall be compatible in every respect and be in accordance with AS1260-Moulded Rigid UPVC Fittings and be certified in accordance with the NCPDP scheme.

All UPVC pipes cast in concrete where permitted shall be wrapped in polyethylene foam and all shall be wrapped in plastic surround.

Jointing a Method: Solvent Cement Joints to AS2032.

Acoustic Piping- Sanitary plumbing and stormwater drainage

The piping shall conform to the following criteria:

Polypropylene (PP-MD), mineral-filled, halogen free

Pipe materials shall be composite polypropylene, consisting of polypropylene inner layer, mineral-filled polypropylene middle layer and UV-stabilized polypropylene outer layer, complying with AS/NZS 7671 for gravity drainage and storm water drainage system in residential and commercial applications, colour white (RAL 9003).

The pipes shall be designed for a temperature of 90°C and can temporarily withstand temperatures of up to 95°C and marked with ice crystal to indicated suitability for installations under extreme low temperatures up to -10°C. The pipes shall have excellent chemical resistance, withstanding acidity level from pH 2 - 12.

The pipes shall be certified under WaterMark scheme for dimensions

DN (OD) 40 – 50 – 75 – 90 – 110 – 125 – 160 – 200mm.

Available lengths shall be from 150 to 3000 mm.

Ring stiffness: > 4 KN / m^2 Mean elongation: 0.09 mm / (m.K) Resistant: up to 100kPa = 10m water column (pressure test certificate on request)

The pipe materials shall be packaged to reduce UV-radiation effect to the pipe materials themselves and to protect the pipe materials from dirt and other foreign materials.

Fitting – Polypropylene (RAU-PP), mineral-filled

Fitting materials shall be mineral-filled polypropylene for acoustic performance enhancement, complying with AS/NZS 7671 for gravity drainage and storm water drainage system in residential and commercial applications, colour white (RAL 9003). The fittings shall have an inserted SBR sealing ring

The fittings shall be designed for a temperature of 90°C and can temporarily withstand temperatures of up to 95°C and suitable for installations under extreme low temperatures up to -10°C. The fittings shall have excellent chemical resistance, withstanding acidity level from pH 2 - 12.

The fitting materials shall be certified under Standards Mark scheme for dimensions

DN (OD) 40 – 50 – 75 – 90 – 110 – 125 – 160 – 200mm.

Floor-gully – Acrylonitrile Butadiene Styrene (RAU-ABS)

Floor gully material shall be the Acrylonitrile Butadiene Styrene. The floor gully shall have 1 main inlet in dimension DN (OD) 110mm and 3 additional inlets in dimension DN (OD) 50mm. The outlet shall be of dimension DN (OD) 75mm. Each inlet and outlet shall have an inserted SBR sealing ring. The floor gully shall have a removable access plug. The height shall be 250 mm.

Floor-gully – Polypropylene (RAU-PP), mineral-filled

Floor gully material shall be the Polypropylene. The floor gully shall have 1 main inlet in dimension DN (OD) 110mm and 3 additional inlets in dimension DN (OD) 50mm. The outlet shall be of dimension DN (OD) 75mm. The main inlet (DN 110mm) shall have an inserted SBR sealing ring. All other inlet and outlets shall be male connector type. The floor gully shall have a removable inserted trap. The height shall be 222 mm minimum.

Sound-dampening bracket

Sound-dampening bracket shall be rubber-lined with vibration-decoupling system to reduce the structure-borne noise transmitted from the DWV system. Material shall be galvanized steel, including hanger bolt.

Hot and Warm Water Piping Insulation

All internal hot water flow and return mains and riser piping where indicated shall be insulated with 19mm thick (minimum) 'Armaflex' or, approved equal insulation, fitted in accordance with the manufacturer's instructions

All hot water flow and return mains and riser piping installed externally shall be insulated with 25mm thick (minimum) 'Armaflex' or, approved equal insulation, fitted in accordance with the manufacturer's instructions- refer below for further details on pipe and fitting insulation installed internally and externally.

- Provide removable insulated casings to all valves comprising insulation, metal covers and quick release type hinge and catches. Accurately shape insulation to closely fit all valves and fittings. Ensure that the insulation can be removed and replaced to provide a vapour seal upon replacement.
- Complete the vapour seal around all bends, joints and fittings utilising proprietary sealing compound in accordance with the manufacturer's recommendations.
- Replace the insulation material with non-compressible ferrules (pipe support blocks) such as "Insulco - Insubloc", or equal approved, at all support points

All hot water and warm water branch piping (dead legs) shall be insulated with 13mm thick (minimum) 'Armaflex' or, approved equal insulation, fitted in accordance with the manufacturer's instructions.

Insulation shall possess the following characteristics or a minimum – Spread of Flame Index – 0, Smoke Developed Index – 3, Thermal Conductivity 0.038w/mk at 0・C mean temperature.

All hot water pipework insulation exposed to weather shall be metal clad utilising galvanised sheet metal, custom formed to the pipework profile and securely fixed utilising 6mm x 8 gauge Stainless Steel screws.

All joints and caps to be made watertight and bends rolled and formed to completely cover all hot water pipework insulation. Installation is to be left in a tradesman like manner with all pipework plumbed and securely fixed.

Note: All sealants and adhesives used on insulation where PEX piping is utilised shall be a neutral cure sealant only- Acetone based adhesives or sealants shall not be approved for use.

Cold Water Insulation

Cold water pipework built in masonry walls shall be wrapped in two layers of non-adhesive plastic film.

Note: Domestic cold water services pipework mains traversing in ceiling and voids shall be provided with acoustic pipe lagging as indicated in section specification 8.7

Valves

Generally

Provide and install all valves indicated on the plans and as required for correct operation and drainage of all systems.

All valves shall be of approved types suitable for the temperature, working pressure, testing pressure and, particular service in which they are installed.

Where possible all valves shall be by the same manufacturer and one type of valve shall be used for different systems.

Valves 65mm or greater shall have flanged ends and valves 50mm or less shall have screwed ends, unless otherwise specified.

Valves installed in the Hydraulic Services shall be approved by the local Authorities;

All stop and check valves shall have an arrow cast into the body to indicate direction of flow.

Note: All isolation valves sized 15mm > 50mm installed above ground shall be ISIS D.R ball valves with Stainless steel handles or similar approved.

Note: All isolation valves sized 15mm> 50mm installed below ground shall be Stainless Steel Fratelli ball valves or similar approved.

Copper Pipe Services

- General
  - All valves shall be of all brass or stainless-steel construction unless otherwise specified tested and stamped for the duty.
- Cold Water
  - Full bore D.R. brass or stainless-steel ball valves the same nominal diameter as the pipe to which they are fitted. Refer to details on valves for construction type.
  - Valves to be installed with a brass tube bush brazed to the pipe on the inlet side with a flared type K.G.L. union connection on the outlet side.
- Hot Water Units and/or Heat Exchangers
  - Refer to schematic diagram on drawings for details on valves and fittings associated with hot water systems.
- Check Valves
  - Zinc free bronze spring loaded check valves shall be fitted to hot water units.
  - Check valves to other equipment up to and including 50mm NB shall be Johns spring loaded type or approved equivalent.

- Hose Cocks
  - Hose cocks shall be 20mm chrome plated brass with flanged bib extension fitted with hose connection vacuum breaker devices.
  - Location: Refer drawings for details.
- WC Cisterns
  - WC Cisterns shall have 15mm right angle cistern cock with chrome plated wall plate and chrome plated copper connector, unless noted otherwise. Note: Exposed stainless steel braided hose connections shall not be approved for use.
- Concrete
  - All concrete used in plumbing work shall conform to the requirements of the Structural engineer and as listed in AS3500 or as indicated on the drawings.
- Alternative Materials and Equipment
  - Should the Plumbing Services Contractor wish to consider alternative materials or equipment to specified requirements, details of same shall be included in the tender offer for consideration. The alternative material or equipment shall not be built into the works unless written approval for its use has been received from the Superintendent. Approval for use of an alternate product shall include certification from the manufacturer the piping system has been installed in accordance with manufacturer guidelines and the contractor is sufficiently trained in the use of the product.

4.3 PIPE AND ISOLATION VALVE/METER IDENTIFICATION

Pipework

All accessible and exposed pipework shall be identified and colour coded by colour bands fitted at 3000mm intervals. Coloured bands shall be located in a visible position, with a corresponding arrow indicating the direction of flow and label identifying the services.

Pipe identification colour code shall be in accordance with Australian Standard 1345.

Valves and meters

All isolation valves and meters installed in the hydraulic services installation shall be identified with engraved plates (white lettering on black background fixed to hand wheel).

Submit samples of all labelling and engraved plates for approval prior to ordering.

5 SANITARY FIXTURES AND TAPWARE

5.1 GENERAL

Supply and install sanitary fixtures and tapware, complete with chrome plated on brass outlet, brackets, fixing bolts and screws wherever required etc, as required to complete the installation.

All fixing shall be plumb and level, neatly finished in a tradesmanlike manner and without damage.

Upon taking delivery, if any of the Sanitary fixtures are damaged during installation, the Hydraulic Services Trade shall replace the fixture at no expense to the proprietor.

Except where otherwise specified, all vitreous sanitary fixtures shall be white.

White sanitary fixtures where inset or vanity shall be finished with white non-setting mastic.

Fixing of Fixtures and Fittings in Cupboards etc

Where fittings and fixtures are fixed in vanity units, cupboards etc, the Contractor shall co-operate with and allow for attendance of the Joiner to ensure:

- That the fixtures, fittings and taps are on site to allow the Joiner to cut holes in the bench tops before the benches or cupboards are permanently fixed and sealed in position.
- That the fixtures are fixed and sealed as recommended by the manufacturer and to the satisfaction of Superintendent's representative.
- That no sealant putty shall be visible beyond the sealing rim of the fixture.

Fixing of Fixtures to Walls

Supply and install timber trimmers as necessary for the fixing of sanitary fixtures to walls.

Sanitary Fixtures and Tapware Schedule

Refer to Architectural Sanitary Fixtures and Tapware Schedules for details of fixtures to be supplied as part of these works. Install Sanitary fixtures where shown ready for connection to drainage system.

The Plumbing Contractor shall allow to provide suitable secure storage on site for same.

6 SOIL, WASTE & VENT PIPES

6.1 GENERAL

Supply and install all soil, waste and vent pipes as detailed on the drawings and in accordance with the Directions of the Office of the Technical Regulator and AS/NZS 3500 Part 2 and as specified in Materials and Workmanship Subsections.

The whole of the work shall be carried out by, or under the direct supervision of a Fully Licenced Plumber in strict accordance with the regulations and requirements of the Office of the Technical Regulator, Local Authorities and to the entire satisfaction of the Architect.

The systems shall be complete with all necessary bends, junctions, expansion joints, traps, fixed points, clips, bolts and inspection openings provided with screwed or bolted covers.

Set all floor traps, inspection openings tops and gully grates flush with the finished floor level or as indicated on the drawings.

6.2 INSTALLATION REQUIREMENTS FOR PVC PIPING AND FITTINGS

The installation of UPVC pipe and fittings shall be in accordance with watermark approved requirements and AS/NZS 3500 as amended and AS 2032.

Where all drainage pipework is cast within concrete the pipework shall be provided with an expansion swivel joint at the exit point.

Pipes and fittings must not be stressed by straining into grade or alignment. Pipe ends must be cut square. Butts and swarf shall be removed.

Care must be taken to ensure that the end of the pipe is entered into the socket squarely and in correct alignment to match the grade of the preceding pipes or fittings.

Joints shall be solvent welded joint to AS2032 and in accordance with manufacturer's specifications and recommendations.

Surplus solvent cement is to be cleaned off.

All UPVC pipes cast in concrete shall be wrapped in FORMFLEX polyethylene foam expansion material and shall be wrapped in plastic surround.

6.3 PIPEWORK AND FITTINGS

Material Types

Install all pipework as shown as drawings and as scheduled.

Waste Pipes

Provide and fix waste branch lines, which shall be in UPVC to all sanitary fixtures, except where noted otherwise. All waste pipe risers within all wet areas through all floors shall be fitted with approved puddle floor flange, fully sealed to riser and structural floor.

Plug and Washers

Provide plug and washers to fixtures in accordance with the manufactures requirements and ad required to ensure correction operation of the fixture

- Hand Basin - chrome plated brass plug and washer, unless integral or stated otherwise.
- Kitchen Sink, stainless steel to manufactures requirement
- Baths -chrome plated brass plug and washer.
- Cleaners sink - chrome plated brass plug and washer

Floor Wastes

Provide floor wastes adjacent to sanitary fixtures of the sizes indicated on the drawings and provide risers as required to accommodate the wastes shown discharging into riser. Riser shall be complete with '80mm (shower) or 80mm (floor) square chrome plated brass grating. Grates shall be set at a level to enable floor to be graded to same. Floor waste gullies shall be suitable for reduced ceiling heights such as Rehau Raupiano or equal approved.

The set-out of the floor wastes shall be closely coordinated with the tiling layout. Refer Architectural Drawings for specific set-out requirements.

Floor Grates

HDPE

All floor grates shall be connected to drainage pipework utilising approved connections, puddle flanges and provide water tight seal.

Vinyl:

All floor grates used covered with vinyl shall be provided with approved clamping and grate.

Vent Pipes

Vents where applicable shall be UPVC unless otherwise indicated.

All roof penetrations shall be sealed waterproofed utilising 'Dektite' over flashing.

On completion, the Plumbing Contractor shall test all penetrations for leaks to the satisfaction of the Superintendent.

Tundishes

Tundishes to serve common air conditioning discharges shall be located in car park and wet areas within apartments as indicated in hydraulic services drawings.

Box type tundishes for receipt of mechanical or hydraulic services shall be of copper or stainless steel construction and set at 50mm above finished surface level.

Provide tundishes to the following items

- Bulk Hot Water assembly
- Air Conditioning Condensate (as per above)

Inspection Points

Inspection points shall be approved brass, chrome plated brass or cast iron suitable for application required.

In the following positions these shall be:

(a) 150mm brass trap screws where set in external concrete paving and subject to foot traffic only.

(b) As for (a) but 100mm chrome plated type, in internal tiled floor areas, set flush with finished tile level.

(c) As for (a) but 100mm non slip chrome plated type internal vinyl floor areas complete with approved clamping ring to surface level.

(d) Cast iron where located in carparks, roadways or areas subject to vehicular traffic (Marked 'S').

6.4 MATERIALS

Shall be generally as noted on drawings and as follows:

- All sewer drains below ground shall be UPVC pipe as shown on drawings.
- All suspended sanitary drainage and downpipes above ground within apartment ceilings shall be Rehau Raupiano pipe as shown on drawings and or acoustically wrapped UPVC where required.
- Soil stacks and downpipes shall be Rehau Raupiano and or acoustically wrapped UPVC pipe where approved.
- Fixture traps to hand basins, shall be 40mm polypropylene P-Trap or S-Trap where concealed and chrome plated copper traps and waste pipes where visible.
- Fixture traps to sinks, etc. shall be 50mm Polypropylene where concealed and chrome plated copper traps and waste pipes where visible.

Note: Contractor may submit cost for use of UPVC with acoustic wrap for above ground suspended drainage.

6.5 PIPEWORK FINISHES

In addition to the protective coating specified in the Materials and Workmanship Subsection of this Section provide the following:

Pipework Finishes Schedule

Specification Cross Reference: PAINTING

There is no requirement to paint exposed pipework in carpark.

6.6 FIRE STOP COLLARS

Provide 'PROMASEAL' (as supplied by Promat) or equal approved fire stop collars to all UPVC pipework penetrations through floors and plumbing ducts throughout the building. Fire collars must be tested and approved for use with UPVC.

For the HDPE material soil stacks, the fire stop collars must be a Drop In, Cast In or Retrofit type that has been tested and approved with HDPE (as supplied by Promat).

All fire stop collars must be installed to manufacturer's specification.

Contractor shall refer to the architectural drawings for details on fire rating requirements for floor at individual floors. Note: Ground and level one penetration shall be provided with 3-hour fire rating.

Note: Any pipe penetrations with an open floor grate above, must be protected with an approved floor waste fire stop collar in accordance with the BCA and AS1530.4

All pipework penetrations must be treated utilising a fire rated product designed for the application. The contractor is required for the fire stop manufacturer's representative to inspect the installation and certify in writing that the correct product has been installed to their recommendations.

6.7 ACOUSTIC INSULATION TO ALL SUSPENDED DRAINAGE

Sanitary drainage and stormwater pipework shall be acoustically wrapped in locations scheduled below. Acoustic lagging shall comprise with 'SOUNDLAG 4525C' comprising 25mm thick convoluted hydrolysis-resistant foam acoustic insulating material, with a flexible loaded vinyl (5kg/m2 unless otherwise noted below) and protective layer of reinforced foil with a Four Zero fire rating to AS1530.3 or equal.

Alternatively utilise RAPUIANO acoustically rated pipe.

The acoustic insulation to the suspended wastes pipes that traverse from the fixture outlet to over the wet area ceiling over the apartment bathroom below, shall be increased in density to two layers of Sound/AG 4525C, in order to meet the BCA Clause F5.6 requirement, i.e. the pipe must be separated from the room of any sole occupancy unit by construction with Rw + Ctr (airborne) not less than 40 if the adjacent room is a habitable room.

For this project, in addition to the 'SOUNDLAG 4525C' by Pryotek, the following alternative makes are considered equal and may be offered;

Armacell- **Armawave 2540** acoustic lagging

The Hydraulics Services Trades shall arrange for the Acoustic Insulation Manufacturer's Technical Representative to attend site prior to ceilings being installed and provide written confirmation that the insulation has been installed in accordance with the product requirements.

Schedule of Areas/Pipework Sections which require Acoustic Lagging installed

- Sanitary Drainage Pipework suspended over the apartments.
- Soil stacks installed within the apartment plumbing ducts.
- Stormwater drainage pipework suspended over the apartments.

6.8 AIR ADMITTANCE VALVES

Air Admittance Valves of 'Studor' or equal approved manufacturer shall be incorporated in the sanitary drainage system where indicated on the drawings.

The Air Admittance Valves must be installed vertically in accessible locations, strictly in accordance with the manufacturer's recommendations.

7 COLD WATER SERVICE

7.1 GENERAL

Make application to SA Water Corporation and pay all associated fees for 1 off 40mm water meter off the adjacent towns mains as indicated on the drawings.

Make application to SA Water Corporation and pay all associated fees for the disconnection of 1 off 20mm water meter off the adjacent towns mains.

The incoming cold water supply will reticulate via the carpark and extend via multiple risers to each apartment and to central hot water plant located at rear of the ground floor carpark.

Cold water risers located within builder's plumbing duct will be utilised to reticulate cold water to each apartment. The cold water branch feed off the respective riser will reticulate to each apartment's cold water isolation valve and remote read-out cold water.

The remote read-out cold water metering system comprising 20mm Elster water meters and associated transmitters and central Gateway shall be purchased from Ausmeter (tel no 03 9437 0255).

The Plumbing Contractor shall take delivery of the cold water meters and install within the apartment hot and cold water meter/isolation valve and tempering valve assembly, fixed to a pre-cut MDF board ready for connection to the apartment hot, cold and tempered water supplies.

Pressure reducing valve (adjustable type) shall be installed to the site incoming cold water main to limit the maximum water supply pressure to a maximum 500 kPa (approx).

General

Not more than one outlet shall be taken from a 15mm supply branch and no service pipe shall reduce to 15mm diameter in excess of 2m of the fitting it is to serve.

With the exception of chromium plated connections to fixtures, no other water pipes are to be exposed within the Buildings (unless otherwise noted on drawings).

The cold water system shall be complete with connection to new water meter, piping, fittings, valves etc, and as further specified under this part and as generally shown on the drawings.

Label all accessible water pipework with an approved self adhesive marker, at not greater than 3 metres centres indicating the nature of the service and the direction of flow.

7.2 TAPS AND VALVES

Generally

Provide and fix taps and valves to all cold water points and as scheduled elsewhere in this specification. All taps and valves are to be of the same nominal diameter as the pipes to which they are fitted and to be tested and stamped by water mark approval.

Faucets, Cocks and Outlets

Unless specifically stated otherwise all taps, faucets and associated fittings shall be of manufacture as nominated in Tapware Schedule.

Water cocks shall be high pressure type unless otherwise specified, and of approved manufacture with brass bodies.

External hose cocks shall be polished chrome plated brass keyed head type.

All cocks are to be of the same nominal diameter as the pipes to which they are fitted and to be tested, approved and stamped by the water marked approval and be manufactured to AS1628 and 1718.

Tapsets shall be complete with concealed breeching pieces.

All tapsets built in walls to have fluid aprons fitted at wall junction and installed as per manufacturer requirements.

Cocks and outlets serving fixtures shall be chromium plated with vandal-proof heads and colour coded (hot and cold) buttons as applicable.

Outlets shall match cocks.

7.3 TESTING

Allow for subjecting the domestic water service to a pressure test as previously specified.

Provide test sheets recording section tested, date of test, and pressure to which pipework is tested. Test sheets shall be included in the Operating and Maintenance Manual.

7.4 VALVE IDENTIFICATION

All isolating valves shall be clearly marked by service and function served.

Labels shall be black on white engraved laminated plastic labels securely attached to the valve.

7.5 BACKFLOW PREVENTION VALVES

Provide approved backflow prevention devices to all items of equipment scheduled for backflow prevention valves as included in the tapware schedule and below, or as shown on the drawings.

Location	Type
Incoming Cold Water Supply	50mm Wilkins 950 XL testable double check valve assembly.
Reuse Room Water Supply	20mm Wilkins 950 XL testable double check valve assembly.

All backflow prevention devices shall be installed in accordance with AS/NZS3500.1 complete with isolating valves to inlet and outlet, strainer to inlet and test cocks complete to accept hose kit connections.

All backflow prevention valves are to be tested and commissioned prior to practical completion by an appropriately licensed person. Test certificates to be included within Operating and Maintenance Manual. Testing shall be repeated at the end of the Defects Liability period and the relevant documentation lodged with Office of the Technical Regulator and copied to the Proprietor.

In addition to the above, all screwnose hosecocks are to be fitted with hose connector type syphon breakers.

7.6 PURGING

Every care shall be taken during the installation to minimise the entrance of sand, grit or foreign matter in the supply piping.

Cold water supply pipes to the hot water heaters are to be purged prior to the installation of the heater and all hot water supply pipes from the heater to hot water draw off points are to be purged prior to installation of faucets, cocks etc.

The installation to be left charged and ready for use when occupied.

8

8 HOT WATER SERVICE

8.1 GENERAL

The works shall include the whole of the Domestic Hot Water Service to the outlets where shown, including the connection to the bulk hot water assembly supplied by Origin Energy - Hot Water Services.

8.2 HOT WATER AND WARM WATER PIPING INSULATION

All hot water and warm water pipework shall be insulated as specified in the 'Materials' clause of this section of this Specification.

All hot water pipework insulation exposed to weather is to be metal clad utilising galvanised sheetmetal, custom formed to the pipework profile and securely fixed utilising 6mm x 8 gauge Stainless Steel screws.

All joints and caps to be made watertight and bends rolled and formed to completely cover all hot water pipework insulation. Installation is to be left in a tradesman like manner with all pipework plumbed and securely fixed.

8.3 TAPS AND VALVES

Refer to "DOMESTIC COLD WATER SERVICE" clauses for details.

8.4 TESTING

Allow for subjecting the hot water system to a pressure test as previously specified. Isolate the water heater from the hot water service being tested.

8.5 DOMESTIC HOT WATER UNITS

Refer to Equipment section of this specification.

8.6 PURGING

Every care shall be taken during the installation to minimise the entrance of sand, grit or foreign matter in the supply piping.

Cold water supply pipes to the heater are to be purged prior to the installation of the heater and all hot water supply pipes from the heater to hot water draw off points are to be purged prior to the installation of faucets, cocks etc. The installation to be left charged and ready for use when occupied.

8.7 THERMAL INSULATION TO ALL HOT WATER RETICULATION

Thermal Piping Insulation

All hot water and warm water pipework shall be insulated as specified in the 'Materials' clause of this section of this Specification.

All hot water pipework insulation exposed to weather is to be metal clad utilising galvanised sheetmetal, custom formed to the pipework profile and securely fixed utilising 6mm x 8 gauge Stainless Steel screws.

All joints and caps to be made watertight and bends rolled and formed to completely cover all hot water pipework insulation. Installation is to be left in a tradesman like manner with all pipework plumbed and securely fixed.

All external and exposed water reticulation pipework within carpark shall be provided with UV rated thermal piping insulation, shall be insulated with 25mm thick (minimum) 'Armaflex' or, approved equal insulation, fitted in accordance with the manufacturer's instructions.

- Accurately shape insulation to closely fit all fittings. Ensure that the insulation can be removed and replaced to provide a vapour seal upon replacement.
- Complete the vapour seal around all bends, joints and fittings utilising proprietary sealing compound in accordance with the manufacturer's recommendations.

Note: where insulation is placed over PEX piping a neutral cure adhesive (silicone)shall be used in lieu of acetone based adhesive.

- Replace the insulation material with non-compressible ferrules (pipe support blocks) such as "Insulco – Insubloc", or equal approved, at all support joints.

Insulation shall possess the following characteristics or a minimum – Spread of Flame Index – 0, Smoke Developed Index – 3, Thermal Conductivity 0.038w/mk at 0℃ mean temperature.

Split insulation and duct tape shall not be approved.

Note: Refer to piping and materials section for further details on insulation requirements for internal piping and warm water piping.

9 NATURAL GAS SERVICE

9.1 GENERAL

Arrange with APA group for a natural gas connection to the site and establishment of a common gas meter to service the site off the natural gas mains in the adjacent roadway:

- 1 x common gas meter .

Meter duty : 1650 Mj/hr at 2.75kPa

Builder to construct a fire rated enclosure with ventilated access doors to house the gas meter. Contractor to provide drawings to APA Group for review and approval prior to construction.

Contractor shall provide all necessary excavation where required to satisfy APA group requirements.

Reticulate from the gas meter to the respective items of equipment or appliances served as indicated on the drawings. Provide an isolation valve at base of each common NG pipe riser and a dedicated apartment isolation valve in each apartment and at each appliance together with main incoming gas isolation valve adjacent the Bulk Hot Water assembly.

The installation shall comply with AS5601:2000 – AG601:2000.

9.2 PIPEWORK AND JOINTING

Above and Below Ground

Type B copper tube to AS1432 (hard drawn). Silver brazed jointing method in accordance with AS5601:2000 – AG601:2000. Connections to all appliances to be flared compression fittings to AS3688 and as approved by relevant Australian Standards.

Kinko nut compression fittings will not be permitted.

Above Ground - (Internal)

Cross linked polyethylene aluminium polyethylene multilayer pipe complying with AS4176.8 RAUTITAN gas stabil gas pipe, Rautitan gas fittings and compression sleeves or similar approved and installed in compliance with AS5601.

Where pipework is installed within wall cavities and inaccessible areas Rauguard flexible metal conduit shall be placed over the pipe for protection.

A system identification label shall be installed in the gas meter box.

Note: The pipework supplier's representative shall be required to inspect the first fix installation and certify in writing that the system has been installed to their recommendations.

9.3 INSTALLATION

General

Refer Workmanship Subsection.

Labelling

Label all accessible or exposed natural gas pipework with an approved self adhesive marker, at not greater than 3 metre centres. Labels to comply with AS1345.

9.4 TESTING

Allow for subjecting the gas pipework installation to pressure tests. Provide test sheets recording section tested, date and pressure to which pipework tested.

9.5 COMPLETION

On completion of installation and testing, turn on isolating and control valves and purge and charge the installation.

10 EQUIPMENT

10.1 HOT WATER PLANT

General

The central bulk hot water assembly shall be supplied and installed by Origin Energy, in accordance with agreement with developer. The Plumbing Contractor shall provide the incoming hot and cold water, hot water return and natural gas connections to the assembly terminating with isolation valves where directed by Origin's Installer.

The Plumbing Contractor shall also provide a waste tundish adjacent the hot water plant and a duty/stand-by hot water circulating pump assembly as part of the hot water return piping installation.

Central Hot Water System

Apartments

Origin Energy will supply a Rheem 'Tankpak' hot water package comprising 2 x gas fired hot water, storage units (Rheem 631265), a primary hot water pump and associated piping, fittings and controls.

Contractor shall include all necessary incoming connections and valves to complete the system.

The Plumbing Contractor shall be the liaison between Origin Energy and the Builder and coordinate with builder for construction of a suitably sized concrete plinth for mounting of the hot water heater assembly.

System Requirement

The system shall be capable of delivering as a minimum, 1240 litres of hot water in the first hour period @ 50oC rise in temperature (65°C delivery temperature).

10.2 DOMESTIC HOT WATER CIRCULATING PUMP ASSEMBLY

Primary Circulating Pump

The primary circulating pump for circulating of hot water from the Bulk Hot Water system storage tank shall be supplied as part of the Origin Energy Bulk Hot Water System assembly and form an integral part of the hot water package.

Domestic Hot Water Circulating Pump Assembly

The domestic hot water system circulating pump assembly shall be supplied and installed by the Plumbing Contractor and shall comprise a twin pump assembly configured as duty/stand-by operation. The pump assembly shall be supplied pre-plumbed including pipework, fittings, check valves, valves etc. as necessary, ready to connect to the hot water return pipework. The system controller shall automatically alternate duty pumps on a weekly basis.

The hot water circulating pump shall be a Rheem Redi-set dual hot water auto changeover circulator 20-60N number 890665.

The hot water circulation pump assembly shall be provided with vented colour bond cover to project pumps from weather. Colour to be confirmed with architect prior to order.

Installation Pumps

Pumps shall be mounted strictly in accordance with manufacturer's recommendation. Installation to include isolation valves, check valves and be installed complete with weatherproof colour bond cover. Contractor shall engage manufacturer for final commissioning and pay associated costs.

Electrical Contractor

The Electrical Services Trade shall provide a weatherproof isolating switch adjacent to each pump or pump control panel as applicable. Plumbing contractor shall coordinate with electrical contractor and complete final connection.

10.3 PURGING

Every care shall be taken during the installation to minimise the entrance of sand, grit or foreign matter in the supply piping.

Cold water supply pipes to the heater are to be purged prior to the installation of the heater and all hot water supply pipes from the heater to hot water draw off points are to be purged prior to the installation of faucets, cocks etc. The installation to be left charged and ready for use when occupied.

10.4 BALANCING VALVES

Hot water return pipe balancing valves shall be Water Marked Tour Andersson, TA-Therm 15mm or equal approved.

Allow to fully commission the hot water recirculation system making required valve adjustments in accordance with the valve manufacturers' instructions. All balancing valves shall be fitted with isolation valves either side of the valve with barrel unions or compression joints fitted to permit easy removal. Provide commissioning certificate on completion for insertion into manuals

Note: Contractor shall confirm final size of the hot water balance valves prior to order to suit the required hot water return flow rate. Estimated flow rate per riser shall be set at 0.03L/sec. Contractor shall confirm flow rates prior to commissioning.

10.5 PRIVATE COLD WATER METERS

Remote read-out cold water meters shall be 20mm 'Elster V100' water meters to match the make of hot water meters.

Contact David Gestro at Ausmeter (03 9437 0255) for supply and commissioning of cold water meters.

Ausmeter shall be directed to liaise with the buildings appointed strata managers with respect to format and timing for quarterly meter read information.

The water meter shall be piston type meter with an extra dry register and no gears are in contact with water. The meter shall provide long term accuracy. The meter cap shall be irreversible and totally tamperproof without the use of lead seals.

10.6 PRESSURE REDUCTION VALVE

Pressure reduction valve shall be Wilkins or equal approved. The valve shall be adjustable type to limit the outlet pressure to level 1 apartments and ground floor structures to 500kpa. The static pressure as indicated by flow test conducted by "SAWC" is approximately 340kPa.

11 COMMISSIONING AND HANDING OVER

11.1 PRE-HANDOVER

Notify Origin Energy – Hot Water Services and Ausmeter 30 days prior to hand-over to enable the bulk hot water system and associated hot and cold water metering system to be commissioned prior to hand-over.

11.2 HANDING OVER AND PRINCIPALS INSTRUCTION

Complete the testing balancing and commissioning of all systems, provide all commissioning and performance data and provide the installation manuals including post contract drawings prior to handing over the installation.

Completion will not be granted until the above requirements have been met.

11.3 AS-BUILT DRAWINGS AND DOCUMENTATION

Submit as-built drawings and details of all Hydraulic Services installed in pdf format on a CD-ROM. These must clearly show, as a minimum:

- Location of all fixtures and fittings.
- Location of plant and equipment.
- Location of above and below ground pipework.

11.4 AS INSTALLED DETAILS

Provide a complete set of as-built drawings for all hydraulic systems (pdf and dwg formats) and a comprehensive Operations and Maintenance (O&M) manual (word and pdf formats) on a CD-ROM.

11.5 MAINTENANCE AND GUARANTEE PERIOD

A minimum of two (2) maintenance inspections shall be carried out during the defects period. Maintenance inspections shall be limited to inspection of the circulating pump assembly and backflow prevention assemblies installed to the building.

Systems to be maintained include the following:

- Circulation pumps.
- Backflow devices

During this period the Plumbing Services Contractor shall at his own expense attend to any work which proves defective due to faulty workmanship, materials or design.

At the 12-month stage, all back flow devices shall be retested and confirmation issued to the OTR and SAWC

The responsibility shall include provision of labour and all incidental costs necessary for the removal and replacement of all defective parts and components.

All works must be executed by properly qualified Plumbing Services tradesman.

11.6 INSPECTIONS

Notice: Give sufficient notice to the Main Contractor's site representative and/or the Superintendent so that inspection may be made at the following minimum stages:

- Excavated surfaces prior to placing pipe bedding material.
- Works ready for specified testing.
- Testing of the installation.
- Concealed and underground work prior to covering, concealing or backfilling.

Minimum notice required for all required inspections, 2 working days.

11.7 TESTING

Requirement

Carry out required tests. Supply the apparatus and materials necessary. Submit the test results in writing.

Preparation for Testing

Seal off items of equipment not designed to withstand the test pressure. Securely anchor pipes and fittings in position to prevent movement during the tests.

Concealed Work

Do not cover or conceal work until it has been tested. Leave pipe joints exposed to enable observation during the test.

Fire holed piping shall be galvanised steel consistent with the fire hydrant main construction.

APPENDIX A – SECTION COSTS AND UNIT RATES - SANITARY AND HYDRAULIC SERVICES

This schedule is to be completed and submitted with Tender submissions. The amounts indicated in the total tender price including administration costs and profit for sections of the work are as follows:

ITEM		AMOUNT TENDERED
Common Services		
Site Establishment and Preliminaries	$	
Authority Fees	$	
Inground Drainage Services	$	
Cold Water Services to each apartment and central HW plant.	$	
Hot water reticulation to each apartment.	$	
Hot water circulation pumps- supply and install	$	
Bulk Hot Water Plant- Installation of services connections only	$	
Apartment Hot water meters- install only	$	
Apartment Cold water meters- Supply and install	$	
Gas services to each apartment and central HW plant.	$	
Backflow and pressure reduction Valves	$	
Soil, waste and vent pipework installation	$	
Stormwater Downpipes	$	
Apartments		
Domestic cold water, hot water flow pipework reticulation within apartment	$	
Acoustic insulation to suspended drainage – supply and installation	$	
Soil, waste and vent pipework including suspended drainage and vertical stacks	$	
Gas reticulation within each apartment.	$	
Sanitary fixtures and fittings - Supply and installation	$	
	$	
General		
Maintenance and Defects Liability Period	$	
Shop Drawings	$	
Work-as-executed drawings and O&M manuals	$	
Miscellaneous (specify)	$	

Tenderer ..... **Date** .....

GST 10%	$	_____
TOTAL TENDER AMOUNT INCLUDING GST	**$**	_____

Rates

Plumber	Per/hr	$
4th Yr Apprentice	Per/hr	$
Backhoe	Per/hr	$
100mm Down Pipes UPVC	Per/m	$
65mm Sewer suspended	Per/m	$
100mm Sewer Drains inground	Per/m	$
100mm Sewer Drains suspended	Per/m	$
50 Copper DCW	Per/m	$
25 Copper DCW	Per/m	$
32 PE-X DCW	Per/m	$
25 PE-X DCW	Per/m	$
20 PE-X DCW	Per/m	$
50 Copper NG	Per/m	$
20 Copper NG	Per/m	$
Gas Fitter	Per/hr	$
100mm Acoustic Drainage Suspended	Per/m	
Acoustic wrap to ø100 PVC	Per/m	

Tenderer ..... **Date** .....

Tenderer ..... **Date** .....

APPENDIX B – TECHNICAL DATA SCHEDULES – HYDRAULIC SERVICES

The following schedule is to be completed at time of tender submission.

SANITARY DRAINAGE- suspended

Make and Material .....

FIRE STOP COLLARS

Make .....

ISOLATION VALVES-above ground

Make .....

Type .....

HOT WATER PIPEWORK INSULATION - EXPOSED TO WEAHTER

Make .....

Material Thickness

HOT WATER PIPEWORK INSULATION - EXPOSED IN CARPARK

Make .....

Material Thickness .....

Tenderer ..... **Date** .....

HOT WATER AND WARM WATER INSULATION - CONSEALED

Make .....

.....

Material Thickness .....

SUSPENDED DRAINAGE ACOUSTIC INSULATION

Make .....

Material Thickness .....

APARTMENT HOT & COLD WATER SERVICE PIPEWORK (from outlet of isolation valves)

Make .....

Material Thickness .....

.....

HOT WATER SYSTEM CIRCULATION PUMPS

Make and Model .....

.....

.....

HOT AND COLD WATER PIPEWORK - MAINS

Make .....

Material Thickness

.....

Tenderer ..... **Date** .....

REMOTE READ-OUT – COLD WATER METERS

Make

Model

Tenderer ..... **Date** .....

NATURAL GAS PIPEWORK –ABOVE GROUND

Make

Material thickness

NATURAL GAS PIPEWORK BELOW GROUND

Make

Material Thickness

BACKFLOW VALVES

Make

Model

HOTWATER BALANCE VALVES

Make

Model

Tenderer ..... **Date** .....

INWALL TUNDISH

Make

Model

PRESSURE REDUCTION VALVE

Make

Model

Tenderer ..... **Date** .....

APPENDIX C – SANITARYWARE, TAPWARE AND FIXTURE SCHEDULE

Refer to Architectural Specification for sanitary ware, tapware and fixture schedule.

Tenderer ..... **Date** .....

LUCID
CONSULTING AUSTRALIA

PROSPECT APARTMENTS

168 PROSPECT ROAD, PROSPECT

Project No: LCE12584

Mechanical Services Specification

Tender Issue

Revision T1

SPECIFICATION ISSUE REGISTER

REVISION	DESCRIPTION	DATE ISSUED	AUTHOR	REVIEWED
P1	Preliminary Issue	26.03.2017	TC	-
T1	Tender Issue	02.06.2017	TC	HW

PROJECT DIRECTORY

BUILDER	Bert Farina Constructions 11 Indama Street Regency Park SA 5010
ARCHITECT	Studio Nine Architects 9 King William Street Kent Town SA 5067
BUILDING SERVICES	Lucid Consulting Australia Level 3/169 Pirie Street Adelaide, SA 5000
STRUCTURAL AND CIVIL CONSULTING ENGINEERS	TMK Consulting Engineers 100 Pirie Street Adelaide, SA 5000

CONTENTS

1 GENERAL 4
1.1 CROSS REFERENCES 4
1.2 PROJECT DETAILS 4
1.3 DEFINITION OF TERMS 4
1.4 DRAWINGS 5
1.5 SCOPE 5
1.6 ASSOCIATED WORKS 7
1.7 STANDARDS 8
2 CONTRACT SUBMISSIONS 10
2.1 TENDER SUBMISSIONS 10
2.2 PRE-CONSTRUCTION SUBMISSIONS 10
3 MATERIALS & WORKMANSHIP 15
3.1 UNIFORMITY AND QUALITY 15
3.2 WARRANTIES 15
3.3 INSTALLATION COORDINATION 15
3.4 PENETRATIONS 16
3.5 CONCEALED SERVICES 17
3.6 DISSIMILAR METALS 17
3.7 IDENTIFICATION 17
4 EQUIPMENT 20
4.1 EQUIPMENT PERFORMANCE 20
4.2 AIR CONDITIONING UNITS - AIR COOLED 21
4.3 FANS 28
4.4 ROOF COWLS 29
5 AIR DISTRIBUTION SYSTEMS 30
5.1 GENERAL 30
5.2 RECTANGULAR SHEETMETAL DUCTWORK 30
5.3 RECTANGULAR PVC DUCTWORK 31
5.4 CIRCULAR FLEXIBLE DUCTWORK 31
5.5 DUCT SUPPORTS 32
5.6 FLEXIBLE CONNECTIONS 32
5.7 VOLUME CONTROL DAMPERS 33
5.8 FIRE DAMPERS 33
5.9 ACCESS PANELS 34
5.10 AIR DIFFUSION 35
6 PIPEWORK SYSTEMS 37
6.1 GENERAL 37
6.2 REFRIGERATION PIPEWORK AND FITTINGS 37
6.3 PIPEWORK INSULATION 38
6.4 DRAINS & CONDENSATE DRAIN PIPEWORK 39
6.5 PIPEWORK SUPPORTS 39

7 AUTOMATIC CONTROLS 41
7.1 GENERAL 41
7.2 CONTROLS 41
8 ELECTRICAL SERVICES 42
8.1 GENERAL 42
8.2 CERTIFICATE OF COMPLIANCE 42
8.3 STANDARDS 42
8.4 TESTING AND ACCEPTANCE 43
8.5 ELECTRICAL INTERERENCE 43
8.6 BALANCING AND PHASE ROTATION 43
8.7 TESTING AND TAGGING 43
8.8 WIRING SYSTEMS 44
8.9 ISOLATING SWITCHES 46
9 NOISE AND VIBRATION 47
9.1 GENERAL 47
9.2 EARTHQUAKE FIXINGS AND SUPPORTS 47
9.3 ANTI-VIBRATION MOUNTS 49
10 TESTING AND COMMISSIONING 50
10.1 GENERAL 50
10.2 PRE-COMMISSIONING PROCEDURES 51
10.3 COMMISSIONING 52
10.4 ACCEPTANCE TESTS 53
11 SERVICE AND MAINTENANCE 56
11.1 SCOPE 56
11.2 MONTHLY MAINTENANCE 56
11.3 HALF YEARLY MAINTENANCE 56
11.4 SERVICES 57
APPENDIX A – TENDER PRICE BREAKDOWN 58
APPENDIX B – TECHNICAL DATA SCHEDULES 60
APPENDIX C – SCHEDULE OF SUBCONTRACTORS AND PERSONNEL 62
APPENDIX D – TRAINING RECORD 63
APPENDIX E – EXAMPLE COMMISSIONING SHEET 64

1 GENERAL

1.1 CROSS REFERENCES

All work covered within this specification shall be read in conjunction with the following trade packages and contracts. Should any discrepancy occur between the references the larger/greater shall be assumed and referred to the Engineer prior to proceeding with any works.

- Head Contractors Preliminaries and General Contract Conditions
- Architectural Documentation
- Electrical, Hydraulic, Fire and Vertical Transportation Services Documentation
- Structural and Civil Documentation

The above documents shall be made available on request through the head contractor.

1.2 PROJECT DETAILS

The works described within this specification pertain to the Mechanical Services installation at 168 Prospect Road, Prospect.

The works involve the provision of air conditioning and ventilation systems to the 16 apartments.

Air conditioning systems shall comprise a single, reverse cycle wall mounted type unit within the living room for all apartments.

Ventilation systems shall comprise a header box type exhaust fans to each bathroom and laundry area. Kitchens shall be equipped with ducted rangehoods, with discharge ducted to the building façade on level 1 and 2, and via the roof on level 03.

1.3 DEFINITION OF TERMS

Proprietor	-	Client or end user of the proposed building
Head Contractor	-	Building Contractor appointed to carry out the construction of the building. Mechanical Contractor shall enter contract to undertake the Mechanical Services installation with the successful Head Contractor.
Contractor	-	Installer undertaking the works.
Works	-	As described within this specification
Provide	-	Supply, install, commission and place into service
Equal Approved	-	Alternative product/method of installation which is presented to the consulting engineer and written approval is received.
Local Power Authority	-	SA Power Networks

Local Gas Authority	-	Envestra (APA Group)
Local Water Authority	-	SA Water
Local Fire Authority	-	South Australian Metropolitan Fire Services (SAMFS)

1.4 DRAWINGS

Drawings associated with and forming part of this specification are scheduled below:

Drawing No.	Drawing Title
LCE12584-M01	Ground, First Floor Air Conditioning and Ventilation Arrangement, General Notes and Drawing Index
LCE12584-M02	Second and Third Floor Air Conditioning and Ventilation Arrangement
LCE12584-M03	Roof Plan, Legend of Symbols and Details

The arrangements and details indicated on the above drawings are approximate only. Check all dimensions and building details prior to commencement of the work.

1.5 SCOPE

General Requirements

The work covered by this specification includes the following:

- The supply, installation, testing, commissioning, maintenance, service and warranty and all sundry and material items, whether mentioned in detail or not, required to complete the installation and place into working order.
- The planning, scheduling, procurement of components and installation to meet the programme, coordination and liaison with the head contractor and other trade packages.
- Full responsibility for the execution of the complete installation in accordance with the specification and drawings.
- The provision of a Mechanical Services installation that satisfies all statutory legislative, local authority, code requirements and satisfies the general details herein.
- Compliance with all relevant Occupational Health, Safety and Welfare legislation and best practice including any site specific requirements or regulations such as attendance at site inductions and adherence to the procedures covered in such inductions.

Description of the Installation

The following systems and services shall be included:

- The provision of sixteen (16x) air cooled, reverse cycle, wall mounted type air conditioning systems to serve each residential apartment. Associated air cooled condensing units located at roof level, with the exception of the single ground floor apartment which shall have the condensing unit at ground level.

- Ventilation systems to serve each residential apartment including a header box type exhaust air fan within each bathroom and laundry enclosure.

- Provision of exhaust air ductwork from the kitchen range hoods to an exhaust air grille within the façade or to roof discharge cowl on roof.

- Provision of exhaust system to serve the ground level toilet comprising exhaust air grilles, ductwork and exhaust fan.

- Provision of exhaust air system to serve the ground level refuse room, comprising exhaust air grilles, ductwork and exhaust fan.

- Preparation of workshop drawings as in following specification sections. Tender drawings shall be made available in PDF 'Bluebeam' format only. It shall be the contractors responsibility to produce full workshop drawings in CAD format.

- Air distribution systems associated with the above systems.

- Refrigeration and condensate piping systems associated with the above systems.

- Condensate drains from each wall mounted fan coil unit including common drains discharging to drain points in ground level carpark.

- Electrical installation associated with the above systems.

- Automatic controls associated with the above systems.

- Vibration isolation and noise control associated with the above systems.

- Provision of overflashing to roof penetrations and flashing angles to wall penetrations.

- All hoisting and scaffolding required for the installation of the above systems.

- Painting, identification and labelling of equipment, and air distribution systems.

- Testing and commissioning of the above systems. Make allowance for qualified commissioning technicians to undertake commissioning and supply results in accordance with this specification. Make due allowance for additional time to complete a full witness with the consultant prior to practical completion.

- Maintenance and servicing, defects liability and warranty for 12 months from date of practical completion.

- Three (3) copies of approved Operation and Maintenance Manual including hard copies of work-as-executed drawings and electronic Auto Cad Version 2012 (or later) copies on CD.

Variations to the Scope

Instructions may be issued throughout the project which may alter the scope of works. Any aspects of any such works which are not specifically mentioned in any instruction are to comply with this specification.

Any claims for any additional costs or credits for any such variations must be submitted with a complete breakdown of costs including quantities and rates for all labour, materials and equipment. Variation Claims submitted without breakdowns will be rejected.

Substitutions to the Scope

Where a substitution to the specification is proposed, the contractor shall submit each substitution, incorporating technical details and a cost breakdown, to the head contractor. The substitution shall be reviewed by the consulting engineer and the client for consideration. Unless approved by the consulting engineer and the client, the substitution will not be acceptable as an equal or approved approach to the specification.

1.6 ASSOCIATED WORKS

The following works related to the Mechanical Services installation shall be carried out under other trade packages at the direction of the head contractor unless otherwise indicated.

Coordinate all cable locations, runs / routes, terminal strip locations and ensure that information is provided to other trades to facilitate cabling and termination.

Electrical Services

- Electrical power supply incorporating weatherproof switched isolator adjacent to each air-cooled condensing unit (final termination by Mechanical Services).
- Electrical power supply incorporating a socket outlet in the ceiling space controlled by a combined light and fan switch plate, for apartment bathroom and laundry exhaust fans. Control cabling and control switch by electrical services (Final termination by Mechanical Services).
- Electrical power supply incorporating a socket outlet in the ceiling space interlocked with lighting for ground level bathroom exhaust fan. Control cabling and control switch by electrical services (Final termination by Mechanical Services).
- Electrical power supply incorporating a socket outlet in the ceiling space for outside air fans serving apartments. Control cabling and control switch by electrical services (Final termination by Mechanical Services).

Hydraulic Services

- Provision of tundishes for receipt of discharge from plant and condensate drains.

Building Related Trades

- All associated building works. The Mechanical Services trade shall set-out locations of all associated building works.

- Apartment rangehoods to be provided by Builder. Rangehoods to be provided with suitable duty to achieve 100l/s exhaust (min) at the calculated system pressure loss.
- Wall penetration for intake louvre in rear wall at Ground Floor Level.
- Provision of formed penetrations to roof, walls and ceilings for the passage of mechanical equipment. Mechanical Services trade to provide dimensioned shop drawings for the penetrations required. Roof penetrations shall be formed with upstands.
- Under cuts to doors and door grilles as nominated (by Door Contractor).
- Mechanical contractor to produce a coordinated dimensioned shop drawing with all formed slab penetrations relevant to the Mechanical, Electrical, Hydraulic and Fire Service Trades for submission to the Head Contractor. Coordinate all Head Contractors work and penetrations and accept responsibility for the accuracy of the consolidated drawings.

1.7 STANDARDS

Comply in all respects with the requirements of the following codes and regulations applicable to the works:

- Building Code of Australia
- Local Power, Water & Gas Authority Regulations
- Office of the Technical Regulator (OTR) Regulations
- Occupational Health, Welfare and Safety Regulations
- Local and State Government Acts governing the works
- SA 76 – Ministers Specification – testing and maintenance of essential safety provisions (identify as an SA only relevant clause please)

Comply in all respects with the requirements of the following Australian Standards applicable to the works (most recent revision unless previous revision is referenced in the current BCA):

AS 1055	Acoustics – Description and Measurement for environmental noise
AS 1132	Methods of tests for air filters for use in air conditioning and general ventilation
AS 1170.4	SAA Loading Code – Earthquake
AS 1259	Acoustics – sound level meters
AS 1345	Identification of the contents of piping, conduits and ducts
AS 1359 Part 51	Noise level limits rotating electrical machines general requirements
AS 1432	Copper tubes for plumbing, gas fitting and drainage applications

AS 1530	Methods of fire tests on building materials, components and structures
AS 1571	Copper seamless tubes for air conditioning and refrigeration
AS 1668 Part 1, 2 and 3	The use of mechanical ventilation and air conditioning in buildings
AS 1677	Refrigeration systems
AS 1894	The storage and handling of non-cryogenic and refrigerated liquids
AS 2625	Mechanical Vibration
AS 2670	Vibration
AS 2700	Colour standards for general purposes
AS 3000	SAA Wiring Rules
AS 4041	Pressure piping
AS 4254	Ductwork for air handling systems in buildings

2 CONTRACT SUBMISSIONS

The contractor shall prepare and submit the items in each section identified below to the consulting engineer for approval.

2.1 TENDER SUBMISSIONS

The submissions required at Tender shall incorporate, as a minimum, all information defined within the Appendices of this Specification. Any appendices not completely filled out will be rejected.

Tenderers are required to submit full manufacturer's selection details of equipment offered at time of tender submission for approval, incorporating the following as a minimum:

- Electrical full load amps, voltage and phase data
- Performance data relevant to the equipment specification clause
- Acoustic data measured in Sound Power as per the equipment specification clause
- Size and weight information including maintenance clearance

Identical equipment to that approved by the consulting engineer must be installed on site. Equipment will only be considered "equal approved" if it has been approved by the consulting engineer. Approval of equipment does not override the requirement to comply with the requirements of the specification.

Select manufacturers with local representation, technical support and expertise, proven local long-term performance and readily-available spare parts.

2.2 PRE-CONSTRUCTION SUBMISSIONS

2.2.1 SAMPLES

Submit the following sample fittings and accessories to obtain approval prior to ordering:

- Temperature sensors
- Vibration isolation mounts

Deliver the samples to the consulting engineer at least 14 days before approval is required and notify the Head Contractor of their arrival. Make due allowance to courier samples to and from the consulting engineers office for all required sample reviews (including re-submitted samples).

2.2.2 TRADE DOCUMENTATION AND INSTALLATION COORDINATION

The Mechanical Services Contractor shall take the lead role in the shop drawings process. Produce a combined services (Mechanical, Electrical, Communications, Hydraulic and Fire Services as a minimum) set of working drawings outlining the trade coordination and builder's work drawings for all formed structural penetrations (roof, floor, walls, etc.).

The drawings shall be submitted to the Managing/Head Contractor, prior to concrete placement or equipment order/manufacture/installation onsite.

All building services related trades shall submit workshop drawings to the Mechanical contractor to develop the fully coordinated workshop and Head Contractor's work drawings. The Mechanical contractor will be responsible for providing the appropriate deadlines to each trade for their submission of drawings to the mechanical contractor.

Obtain all available up-to-date CAD drawings from all other trades and overlay to ensure that all services are fully coordinated.

All trades shall make the necessary arrangements with all services trades and the head contractor to undertake coordination sessions and changes to their respective documents to accommodate the coordination set of drawings.

The final coordinated set of drawings shall be submitted to the consulting engineers and architects (base building and fit-out) for review and approval before proceeding with any manufacture of equipment/materials and installation.

2.2.3 WORKSHOP DRAWINGS

Prepare and submit for approval before commencing manufacture or installation, 1 copy of shop drawings from which the contract works shall be built. Further copies shall be required upon review of the preliminary issue of workshop drawings.

Shop drawings shall all be on the same size drawings sheets and shall be of a scale not less than 1:100 and larger where necessary.

Shop drawings shall cover the following parts of the work.

- All wall, ceiling and roof penetrations, location of ceiling access panels including full dimensions.
- Plant, ductwork and pipework layouts including manufacturer's equipment details.
- Major equipment support details including details of loads imposed on the building structure.
- Reflected ceiling plans showing all air outlets, lights, fire detectors and sprinklers.
- Location of other building engineering services for coordination purposes.
- Electrical and automatic control schematics including BMS points list and MSSB layout.

Examination of shop drawings shall not remove from the Contractor the responsibility for the correctness of the dimensions on such drawings nor compliance with Statutory Regulations or the requirements of the tender documentation.

The Mechanical Services Contractor shall take the lead role in the shop drawings process and produce a combined services formed slab and pre-cast wall penetration drawing for review and use by the concrete trade contractor.

Submit shop drawings with due account for the construction programme. Allow for 5 working days for the return of such drawings. Complete shop drawings ordering of equipment and accept responsibility for dimensions and configuration of equipment ordered to suit the spatial restrictions of the project.

2.2.4 CALCULATIONS

Submit the following engineering calculations based on the equipment as shown on the workshop drawings:

- Airside Static Calculations

All the above information shall be submitted for review prior to any order being placed on equipment.

2.2.5 AUTHORITIES, PERMITS, FEES, CERTIFICATES AND APPROVALS

Make applications, obtain all permits, and arrange testing, as necessary for the installation and placing into operation of the works where required by any Authority including:

- Local power authority
- Local water/sewer authority
- Workplace Services

Provide all associated documentation required for the applications and pay all associated fees.

2.2.6 OPERATING AND MAINTENANCE INSTRUCTIONS

General

The Contractor shall instruct the Proprietor's representative in the correct practice, routine adjustment and maintenance of the installation before it has reached practical completion.

Instructions shall continue as required during the period of operation preceding the date of issue of the Certificate of Practical Completion during which time the Contractor shall be responsible for operation supervision and correcting faults.

Operating and Maintenance Manuals

Within 30 days of reaching Practical Completion hand over three (3) copies of an Installation Manual.

Initially one (1) copy shall be prepared and submitted to the Consulting Engineer for approval. Make due allowance to courier manuals to and from the consulting engineers office for all required reviews (all draft and final reviews).

The manuals shall contain the following as a minimum:

- Index
- General Description of Plant and systems

- Plant Operation Instructions which provides a description of all control strategies and functions, with instructions for starting, stopping re-setting and adjusting controls.
- Schedule of Technical Data
- List of Equipment Suppliers
- Equipment Suppliers Literature
- Routine and Preventative Maintenance Instructions
- 'As-Installed' Drawings (Mechanical, Head Contractor's Works and Electrical Switchboard and Wiring Diagrams)
- Copy of completed training record (refer Appendix D)
- USB with the full PDF copy of Operating and Maintenance manual (including CAD 'As-Installed' drawings)

The manual shall be professionally prepared and bound in a vinyl hard-back folder with insert sleeves on the front to an approved format.

In addition, the project title and "Mechanical Services" shall be inserted vertically along the spine insert sleeve of the folder.

Operating Instruction Summary

Provide a brief summary of plant operating instructions including project specific features and control procedures on a single laminated card to be handed to the client's representative. Submit a draft of the Operating Instruction summary with the Installation Manual.

Apartment Owner Information

In addition to the Installation Manual provided for the builder owner and/or facilities management, provide an abbreviated Information Manual for each apartment owner.

Initially one copy shall be prepared and submitted to the Consulting Engineer for approval.

The Apartment Owner Information Manual shall contain the following documents:

- General Description of Plant and systems
- Original copy of the Manufacturer's Literature
- Maintenance Instructions (Routine and Preventative)
- List of Equipment Suppliers

The manual shall be professionally prepared and bound in a vinyl hard-back folder with insert sleeves on the front to an approved format.

2.2.7 USER TRAINING

Carry out training on systems as nominated within this specification with user groups and other parties as nominated by the Superintendent. Provide a program for user training for approval by the Superintendent and Building Services Consulting Engineer.

The contractor shall confirm instruction of Proprietor's representative by completing training record (refer Appendix D) and incorporating into Operating and Maintenance manual.

2.2.8 WORK-AS-EXECUTED DRAWINGS

Before the date of practical completion "as-installed" drawings shall be provided with the installation manuals. These drawings are to be prepared on AutoCAD computer aided drafting system version 2012 or later. Hard copies of the work-as-executed drawings along with copies of the AutoCAD Drawings are to be included on CD within the Operation and Maintenance Instructions. The work-as-executed drawings must indicate the full installation within the area of the works as it exists at the completion of the project including any design modifications which occurred during the project and any existing equipment.

3 MATERIALS & WORKMANSHIP

3.1 UNIFORMITY AND QUALITY

Obtain approval for and maintain uniformity of the manufacturer and type of all materials and equipment. Use only new, current manufacture, first quality materials and equipment.

Comply with the manufacturer's recommendations in respect to installation techniques and the requirements for associated materials, access clearances, equipment, components and devices.

Ensure compatibility of materials and equipment with the installed environment in respect of ambient temperatures, utilities supplies and vibration.

Support all equipment including pipework, cabling and the like, independently of other services and/or non-structural building elements in accordance with Section 9, Noise and Vibration.

3.2 WARRANTIES

Warranties shall extend for a minimum of 12 months.

All equipment and workmanship to be provided with a warranty.

Warranty to commence at date of practical completion, not the date of installation.

3.3 INSTALLATION COORDINATION

Check on site at regular intervals the building working dimensions, tolerances and the setting out of the associated works. Immediately report any discrepancy.

General

The positions of equipment shown on Drawings accompanying the Specification are for Tender purposes and are diagrammatic only. Check on site for positions and obtain approval and verification of all locations with the Principal and mounting heights prior to first fixing.

When any relocating is required to conform to the above, undertake such relocation without additional costs to the Principal. Allow relocation of accessories and equipment a distance of 3m before and during first fix without variation to the contract.

Verify locations of all equipment, including automatic controls to ensure:-

- Co-ordination with final furniture arrangements and interior design;
- Co-ordination with other trades construction workshop drawings;
- The work of any other trade does not interfere with the mechanical installation;
- Equipment is not obstructed by door swings and tracks, furniture or equipment;
- Conformity with any pattern formed by ceilings, panels, tiles, beams and the like;

- Full compliance with relevant Authorities and Australian Standards.

Anomalies

Promptly report any anomalies, for consideration and instructions. Work proceeding without obtaining approval, and subsequently rejected by the Superintendent shall be made good at nil additional expense to the Principal.

Co-ordination

Ensure all equipment has been coordinated with other trades and reviewed by the consulting engineer and architect before placing orders and before commencement of the relevant trade construction workshop drawings.

3.4 PENETRATIONS

Provide treatment to the penetrations as follows. Refer to architectural drawings for indication of all fire walls, floors ceilings, and the like, for allowance required to fire rated penetrations throughout:-

Major External Penetrations

Install weatherproof overflashings to upstand and complete with appropriate silicone sealant to prevent water ingress through penetration. Provide trimmer beams or other reinforcement necessary to support equipment, ducts, pipes, electrical and controls conduits and flues passing through the penetration.

On completion the Mechanical Services Contractor shall test all penetrations for leaks to the satisfaction of the Architect.

Minor External Penetrations

Utilise "Dektite" or “Rooftite” seal or equal approved and silicon sealant. Utilise a single seal for each pipe / conduit where not concealed under flashings. Utilise a multiple seal where seal is protected under sheetmetal flashing, not exceeding three (3) services through the Seal. Appropriately size all seals, silicone around the top of each seal and install clamps.

On completion the Mechanical Services Contractor shall test all penetrations for leaks to the satisfaction of the Architect.

Exposed Penetrations

In addition to the above, flash pipework and ductwork penetrations where exposed to view with sheet metal escutcheon plates. Paint sheet metal to the architects approved colour

Protection of Penetrations

All floor and wall penetrations shall be protected to ensure no personnel can fall through the penetration at all times.

Temporarily seal all ductwork penetrations with sheet metal blanking plates.

Temporarily seal open ends of pipes with fitted covers of pressed steel or UPVC. Rags, paper or wood plugs are not acceptable.

3.5 CONCEALED SERVICES

Conceal all services in areas other than plant or utility areas. Install services as follows:

Cavity walls, hollow block and dry walls – install services concealed within cavity.

Single leaf brickwork, concrete – surface mounted conduit or "mini-duct" and seek approval prior to installation.

Do not chase walls or floors without prior approval from structural engineer.

3.6 DISSIMILAR METALS

Provide complete material separation between components of dissimilar metal as follows:

Pipework

Where clips, brackets, supports or the like are of dissimilar metal to the associated pipework, completely insulate the piping at all fixing points with at least four layers of 50mm wide black polyethylene tape wrapped around the pipe prior to fixing in position.

Roofing & Structure

Where brackets, stands, supports or the like for equipment or ductwork are of dissimilar metal to the supporting roof sheet or structure, provide complete separation with waffle pad or approved equal. Waffle pad shall extend no less than 25 mm outside the area of contact in all directions.

3.7 IDENTIFICATION

Designation labels

Provide engraved traffolyte labels with equipment designation (e.g. FCU 1-2, ACC 1-2, etc.) to the following items

- Air-conditioning and ventilation equipment

Labels to be engraved traffolyte with 10mm Arial font type black lettering on white background.

For outdoor use, utilise UV rated traffolyte.

Round or bevel the edges of labels exceeding 1.5 mm thickness.

Fix each label by not less than two chrome plated screws. Where adjacent to terminations, locate the label so that the installed wiring does not mask the label.

Isolating Switches

Provide colour coded IPA studs to all isolating switches and power outlets. Studs shall not affect the integrity of the isolating switch.

Provide labelling to all fire protection systems in accordance with the requirements of AS16681.1 Clauses 4.12.4 Isolation Switches and 4.13.4 Notices and Labels.

Pipework & Fittings

Provide bands and lettering at all pipe connections to equipment, pipe junctions and at approximately 7500mm intervals. Provide arrows indicating direction of flow adjacent the identification bands.

Use the following identification:

Service	Code
Refrigerant	Refrigerant

Provide identification tags to all critical valves within the plant room, indicating the 'normally open', normally closed' and the like.

Electrical supply and Refrigerant Charge labels

Provide an engraved traffolyte label adjacent each item of Mechanical Services equipment with a connected power and/or controls circuit. Provide label in a location concealed from general view in occupied spaces, but obvious to maintenance personnel accessing the equipment for maintenance purposes, and not further than 1m from the item of equipment.

Labels to be engraved traffolyte with 5mm Arial font type white lettering on black background.

For outdoor use, utilise UV rated traffolyte.

Round or bevel the edges of labels exceeding 1.5 mm thickness.

Fix each label by not less than two chrome plated screws. Where adjacent to terminations, locate the label so that the installed wiring does not mask the label.

Include the following information as a minimum:

- Equipment designations
- All power cable connections/cicuits and source location
- All control cable connections/circuits and source location
- All equipment connected to and operating in conjunction with the associated power/controls source.
- Refrigerant charge for connected system (where applicable)

Refer to the example label as follows:

EQUIPMENT DESIGNATIONS
Indoor Unit: FCU 1-2
Outdoor Unit: ACC 1-2

CONNECTED POWER/CONTROLS CIRCUITS:

DB-1	Room 100
ACC 1-2	Roof platform
Fan	OAF 1-2
Temp sensor	Room 100
Control panel	Room 100
Lighting relay	N/A

REFRIGERANT:

Type	R410a
Charge	18.5 kg

CAUTION! MORE THAN ONE ELECTRICAL SUPPLY EXISTS!

4 EQUIPMENT

4.1 EQUIPMENT PERFORMANCE

General

The Contractor shall be responsible for complying fully with this Specification and for ensuring that good trade practice is observed and that all work is completed in a tradesman-like manner.

In particular, the capacities and outputs of the various items of installed equipment shall be not less than those specified and the Contractor shall balance air quantities and make all necessary adjustments to the plant to satisfy the Consulting Engineer that the installation meets the requirements of this Specification.

Use equipment which operates within the required noise and vibration limits. Prevent the transmission of vibration from rotating or reciprocating equipment to other building elements using static and dynamic balancing, and anti-vibration mounting supports and hangers.

Select equipment to suit the equipment arrangements, configurations and spatial restrictions as indicated on the drawings such as refrigerant pipe runs and routes, flue configurations, horizontal (side) or vertical (top) discharge arrangements for air conditioning and evaporative cooling equipment and the like.

Select equipment to comply with the Building Code of Australia – Section J (Energy Provisions), MEPS rating scheme and Australian Standard 1359.5 (Motor Efficiency).

Equipment Compliance

The Contractor shall be fully responsible for providing plant complying with all items in the following specification clauses and achieve the all performance specified below. The Contractor shall guarantee the performance of all the systems installed under this contract.

Continuous Operation

All plant selected and installed shall be capable of continuous reliable operation within the following extremes:

Maximum Temperature:	46.0°C dry bulb/28.0°C wet bulb Full Solar Load
Minimum Temperature:	0.0°C dry bulb
Electricity Supply:	415 V, +4%, -8%, 50 Hz + 1 Hz three phase earthed neutral generally in accordance with local power authority rules and conditions of supply. Voltage drop within the air conditioning installation shall not exceed 3%.

Minimum Performance Requirements

Air conditioning system capacities have been calculated to achieve the minimum performance requirement specified below:

External Ambient conditions

Summer:	Design day of maximum external ambient temperature 38.0°C dry bulb/21.0°C wet bulb Full Solar Load
Winter:	Ambient temperature 5.0 degrees C dry bulb

Internal conditions

Summer:	Maximum 23.5°C dry bulb/50% RH.
Winter:	Minimum 21.0°C dry bulb.
	Note: Conditions can only be guaranteed to be maintained when all doors and windows are closed

4.2 AIR CONDITIONING UNITS - AIR COOLED

Supply and install air cooled reverse cycle air conditioning units complying with the following performance and construction criteria.

General

- Factory assembled and tested of Fujitsu, Mitsubishi or Daikin Manufacture or equal approved equivalent.
- Incorporate compressor capacity control through inverter technology or digital scroll technology.
- Systems capable of achieving refrigerant piping length and level difference as indicated on the drawings (without necessity for oil traps).
- Connect and run all refrigerant pipes and electrical wiring to present a neat and workmanlike appearance.

Outdoor Unit

Compressors:

- Hermetic type operating on Refrigerant 410a.
- Scroll compressors (DC or Digital) complete with internal discharge muffler.
- Supported on casing base by neoprene double deflection or spring type vibration isolation mounts.
- Motors suitable for direct on line starting or incorporating soft starters.
- Thermal overload incorporating thermostats located directly in the motor windings connected to automatic re-set lout out relays.

- Compressors, safety controls and electrical components shall be housed in an insulated serviceable compartment with access panel separated from condenser airflow.

Condenser Air Fans:

- Propeller direct drive type.
- Condenser air discharge orientation as shown on the drawings.
- Guard mesh to fan discharges.
- Fan motor drive totally enclosed fan cooled type, rated to IP54 (minimum).
- Electric motors in accordance with minimum efficiency rating, contained in this section shall be high temperature with Class F insulation and of TEFC construction.

Coils and refrigerant circuits:

- Direct expansion aluminium fin copper tube type.
- Corrosion protection to condenser coils incorporating epoxy coating or passivated treatment.
- Rifled bore type with capillaries arranged to ensure even distribution of liquid refrigerant.
- Maximum face velocity 2.75 m/s evaporator coils and maximum fin spacing 514 fins/m.
- Electronic or thermostatic type expansion valves.
- Incorporate filter/drier to each compressor.
- Incorporate additional refrigeration charge to system where the pipework lengths to the air conditioning system exceed the maximum allowable length for the refrigeration change provided as standard.

Electrical:

- Incorporate crankcase heaters served by separately fused sub-circuits.
- Main power entering shall be protected by HRC fuses and HRC fuses shall also protect the control circuit primary and secondary.
- All packaged electrical and safety controls to be factory fitted and tested. Operating controls on each compressor / circuit / motor including shall include the following as a minimum:
    - Start delay timers
    - Low refrigerant head pressure switch
    - High refrigerant head pressure switch
    - Current overload
    - Thermal overload
    - HP Control
    - Compressor motor temps auto-reset
    - Compressor current overload, auto-reset

- Supply fan overload, auto-reset
- Outdoor fan overload, auto-reset
- Automatic defrost operation
- Control fuse
- Sump heater
- Start delay timers on all compressor circuit

- Incorporating automatic defrost operation utilising hot gas, and ensure that supply air fan is disabled to prevent over cooling of the space.
- Incorporate crankcase heaters served by separately fused sub-circuits.
- The electrical panel incorporated in the outdoor unit shall be fully internally wired and housed within weatherproof area and must conform to relative Australian Standards and relevant state electrical authorities.
- Incorporate independent lock out of each refrigeration circuit.
- Mount all electrical components within a separate segregated weatherproof compartment.
- Label all components.
- Provide wiring diagram, complete with protective finish and schedule of fan and compressor motor over load settings, fixed permanently within the electrical compartment.

Indoor Units

General:

- Indoor evaporator unit configuration shall be of wall mounted type as scheduled below.
- All wall mounted type indoor units shall of maximum height 300mm.
- Incorporate multiple indoor units to outdoor units where scheduled below.

Casing:

- Complete with airtight, gasketted access panels to facilitate access to all major components.
- Internally insulated casing with aluminium foil faced closed cell foam insulation glued to all internal surfaces, with insulation manufactured and composed without the use of ozone depleting substances.
- Incorporate corrosion resistant, 1 piece drip tray under the coil sections with 20mm drain connection.
- Fabricate all brackets and bracing from galvanised steel and affix using stainless steel screws.

- Where fan coil units are installed in ceiling spaces incorporate an additional galvanised steel 1 piece drip tray complete with drain connection to the underside of each unit.

Fans - supply air:

- Centrifugal type to suit unit configuration incorporating lubricated and sealed for life, self-aligning ball type bearings.
- Motor power capacity sufficient to supply 110% of design air quantity against the corresponding increase in system resistance with the air filters operating at half of their dust holding capacity.
- Direct drive with multiple (minimum 3) fan speed settings adjustable via dip switch or wiring tappings.
- Fan motor drive totally enclosed fan cooled type, rated to IP54 (minimum), in accordance with minimum efficiency rating.
- Statically and dynamically balanced.
- Maximum fan discharge velocity 8 m/s.

Electrical/Controls:

- Wire each fan coil unit from the respective condensing unit and incorporate an isolating switch on the fan coil unit.
- Mount all electrical components within a separate segregated compartment.
- Label all components.
- Provide wiring diagram, complete with protective finish and schedule of fan and compressor motor over load settings, fixed permanently within the electrical compartment.
- All electrical cables shall be crimp pin terminated and all wiring shall be independently colour coded. The unit shall incorporate an independent earth bar which shall earth all electrical components.
- Overloads, relays and contactors shall be installed for each motor circuit. The wiring throughout the unit shall be 2.5mm square power and 1.00mm square control run through PVC cable duct throughout the unit.
- Indoor units shall be complete with dew proof heater, air sweep function, auto restart after power failure, heating mode indoor fan auto speed control and compressor restart time delay.
- Each unit shall be provided with the following minimum control functions:
    - OFF/ON control function.
    - Auto Swing louvre with shut-off function.
    - Automatic heat/cool changeover or manual selection.
    - Automatic or manual fan speed modulation.

- Self-diagnosing facility
- Seven day programmable time clock.

- Provide wiring diagram, complete with protective finish and schedule of fan and compressor motor over load settings, fixed permanently within the electrical compartment.

Performance criteria:

Unit Designation	**ACC/FCU-01**	**ACC/FCU-02**	**ACC/FCU-03**
Unit Configuration	Wall Mounted	Wall Mounted	Wall Mounted
Area Served	Apartment 01	Apartment 02	Apartment 03
Supply Air - L/s	300	300	300
Return Air - L/s	300	300	300
Outside Air - L/s	-	-	-
Total Cooling Capacity - kW	5.0	5.5	5.0
Sensible Cooling Capacity - kW	4.5	5.0	4.5
Entering Air Temp Cooling - °Cdb	23.5	23.5	23.5
Entering Air Temp Cooling - °Cwb	17.5	17.5	17.5
Heating Capacity - kW	3.0	3.5	3.0
Entering Air Temp Heating - °Cdb	19.5	19.5	19.5
Electrical Amps/Phase/Volts	20/1/240	20/1/240	20/1/240
Condenser Coil Air On Cooling – ºCdb	38.0	38.0	38.0
Condenser Coil Air On Heating – ºCdb	5.0	5.0	5.0

Unit Designation	**ACC/FCU-04**	**ACC/FCU-05**	**ACC/FCU-06**
Unit Configuration	Wall Mounted	Wall Mounted	Wall Mounted
Area Served	Apartment 04	Apartment 05	Apartment 06
Supply Air - L/s	300	300	300
Return Air - L/s	300	300	300
Outside Air - L/s	-	-	-
Total Cooling Capacity - kW	5.5	5.5	5.0
Sensible Cooling Capacity - kW	5.0	5.0	4.5
Entering Air Temp Cooling - °Cdb	23.5	23.5	23.5
Entering Air Temp Cooling - °Cwb	17.5	17.5	17.5
Heating Capacity - kW	2.5	3.5	3.0
Entering Air Temp Heating - °Cdb	19.5	19.5	19.5
Electrical Amps/Phase/Volts	20/1/240	20/1/240	20/1/240

Condenser Coil Air On Cooling – ºCdb	38.0	38.0	38.0
Condenser Coil Air On Heating – ºCdb	5.0	5.0	5.0

Unit Designation	**ACC/FCU-07**	**ACC/FCU-08**	**ACC/FCU-09**
Unit Configuration	Wall Mounted	Wall Mounted	Wall Mounted
Area Served	Apartment 07	Apartment 08	Apartment 09
Supply Air - L/s	300	260	300
Return Air - L/s	300	260	300
Outside Air - L/s	-	-	-
Total Cooling Capacity - kW	4.5	6.0	6.0
Sensible Cooling Capacity - kW	4.0	5.5	5.5
Entering Air Temp Cooling - °Cdb	23.5	23.5	23.5
Entering Air Temp Cooling - °Cwb	17.5	17.5	17.5
Heating Capacity - kW	3.5	3.5	3.5
Entering Air Temp Heating - °Cdb	19.5	19.5	19.5
Electrical Amps/Phase/Volts	20/1/240	20/1/240	20/1/240
Condenser Coil Air On Cooling – ºCdb	38.0	38.0	38.0
Condenser Coil Air On Heating – ºCdb	5.0	5.0	5.0

Unit Desingation	**ACC/FCU-10**	**ACC/FCU-11**	**ACC/FCU-12**
Unit Configuration	Wall Mounted	Wall Mounted	Wall Mounted
Area Served	Apartment 10	Apartment 11	Apartment 12
Supply Air - L/s	300	300	300
Return Air - L/s	300	300	300
Outside Air - L/s	-	-	-
Total Cooling Capacity - kW	5.0	4.5	5.0
Sensible Cooling Capacity - kW	4.5	4.0	4.4
Entering Air Temp Cooling - °Cdb	23.5	23.5	23.5
Entering Air Temp Cooling - °Cwb	17.5	17.5	17.5
Heating Capacity - kW	3.5	3.5	3.5
Entering Air Temp Heating - °Cdb	19.5	19.5	19.5
Electrical Amps/Phase/Volts	18/1/240	18/1/240	18/1/240
Condenser Coil Air On Cooling – ºCdb	38.0	38.0	38.0
Condenser Coil Air On Heating – ºCdb	5.0	5.0	5.0

Unit Designation	**ACC/FCU-13**	**ACC/FCU-14**	**ACC/FCU-15**
Unit Configuration	Wall Mounted	Wall Mounted	Wall Mounted
Area Served	Apartment 13	Apartment 14	Apartment 15
Supply Air - L/s	260	260	260
Return Air - L/s	260	260	260
Outside Air - L/s	-	-	-
Total Cooling Capacity - kW	5.0	4.5	5.0
Sensible Cooling Capacity - kW	4.5	4.0	4.5
Entering Air Temp Cooling - °Cdb	23.5	23.5	23.5
Entering Air Temp Cooling - °Cwb	17.5	17.5	17.5
Heating Capacity - kW	3.5	3.5	3.5
Entering Air Temp Heating - °Cdb	19.5	19.5	19.5
Electrical Amps/Phase/Volts	20/1/240	20/1/240	20/1/240
Condenser Coil Air On Cooling – ºCdb	38.0	38.0	38.0
Condenser Coil Air On Heating – ºCdb	5.0	5.0	5.0

Unit Designation	**ACC/FCU-16**
Unit Configuration	Wall Mounted
Area Served	Apartment 16
Supply Air - L/s	360
Return Air - L/s	360
Outside Air - L/s	-
Total Cooling Capacity - kW	7.0
Sensible Cooling Capacity - kW	6.5
Entering Air Temp Cooling - °Cdb	23.5
Entering Air Temp Cooling - °Cwb	17.5
Heating Capacity - kW	4.5
Entering Air Temp Heating - °Cdb	19.5
Electrical Amps/Phase/Volts	25/1/240
Condenser Coil Air On Cooling – ºCdb	38.0
Condenser Coil Air On Heating – ºCdb	5.0

Notes

- Tenderers are required to submit full manufacturer's selection details of equipment offered at time of tender submission.
- Minimum unit capacities specified above shall take into account the system refrigeration pipe length and fan motor gains de-rating factors to obtain required cooling capacity.
- Design and select refrigeration systems and condensers such that the air conditioning units continue to operate satisfactorily at ambient conditions 5°C above and 5°C below the condenser coil air on cooling and heating conditions, respectively, without exceeding the manufacturer's recommended safety control limits

4.3 FANS

General

Select fans which have quiet operation and maximum static efficiency and which deliver the required air quantity against the resistance of the systems installed.

- Statically and dynamically balance rotating parts after assembly at the manufacturer's works.
- Fan selection, blade pitch angle and motor kW shall include sufficient allowance adjustment for a 10% increase in design air quantity against the corresponding system pressure increase.
- Motors shall be squirrel-cage, induction type and suitable for continuous running in ambient temperatures of up to and including 60°C and shall be complete with ball or roller bearings lubricated and sealed for life.
- Determination of the fan sound power shall be in accordance with British Standard 848 (1966) "Methods of Testing Fans: Part 2 Fan Noise Testing".
- Provision of Internal Thermal Protection. Provide resets where applicable for fans in accordance with AS/NZS60335-2-80:2004
- Isolate rotating parts from the unit casings with proprietary resilient mountings.
- Refer to performance schedule for additional sensors and speed controllers to control fans.
- Miscellaneous Fans such as bathroom exhaust fans, domestic rangehoods, ceiling mounted fans, require backdraft dampers in compliance with the Building Code of Australia, Part J3.5.
- Vertical discharge fans shall have maglocks fitted to backdraft dampers to prevent opening when system is not in operation.

Header Box Fans

- Provide factory assembled and tested in quantity production fans, similar to Fantech Ultimate series or approved equal.

- Incorporate a proprietary plastic injection moulded louvre-faced type grille for the fan fascia.
- Incorporate proprietary backdraft damper.
- Incorporate proprietary potentiometer speed-controllers.
- Access to speed controller shall be via removable grille.

Performance Criteria

Fan Designation	**TEF/GEF-X**	**TEF-G1**	**GEF-REFUSE**
Area Served	Typical Apartment Bathroom/Laundry	Carpark Toilet	Refuse Room
Fan Type	Headerbox	Headerbox	Duct Mounted
Capacity – L/s	50	50	150
Estimated External Static Pressure – Pa	60	60	80
Minimum fan diameter – mm	150	150	200
Maximum Speed – rps	16	16	35
Electrical Supply – Amps/Phase/Volts	1/1/240	1/1/240	1.5/1/240
Maximum Noise Level dB(A) @ 3m	37	37	40
Speed Control	Potentiometer	Potentiometer	Potentiometer
Quantity Allowance (No.)	32	1	1

4.4 ROOF COWLS

Provide factory assembled and tested in quantity production roof mounted relief air cowls, suitable for mounting on roof, similar to Fantech MRV/RV series or approved equal. The roof mounted cowls shall incorporate the following performance and construction criteria:

- Components may be manufactured from galvanised steel, GRP or polypropylene.
- Cowl shall incorporate a compact base fitted with a weathering skirt and a hinged weatherproof and bird-proof cowl.

Performance Criteria

Fan Designation	**RC APT X-1**	**RC APT X-2**
Location	Roof	Roof
Area Served	Apartment Kitchen	Apartment Bathrooms/Laundry
Capacity – L/s	To suit rangehood	100L/s
Internal Connection Dimensions – W x D	350x350	350x350
Maximum Pressure Loss - Pa	15	15

5 AIR DISTRIBUTION SYSTEMS

5.1 GENERAL

This section of the Specification covers the general materials and construction standards for the supply and installation of the air distribution systems including ductwork, plenums, dampers, air diffusion equipment and all associated fittings.

The tender drawings indicate the general arrangement in which the various systems are to be installed, however, it should be noted that referenced drawings do not necessarily indicate all off-sets and transitions required for the necessary detailed co-ordination between trades and associated services and the building structure.

All air distribution systems including ductwork, acoustic and thermal insulation and fire dampers shall be constructed in accordance with the Australian Standard 1668 Parts 1, 2 and 3 and all applicable statutory requirements.

Duct dimensions indicated on the drawings are in millimetres and are clear internal sizes, the first dimension being the side shown in that view. Where ductwork is internally lined, increase sheetmetal dimensions accordingly.

5.2 RECTANGULAR SHEETMETAL DUCTWORK

Construction:

Manufacture in accordance with S.M.A.C.N.A. standards from galvanised steel sheet conforming with AS 1397 grade GCZ 300 and with Pittsburgh lock longitudinal seams as follows, all dimensions being in mm:

Duct Maximum Side (mm):	Material Thickness (mm):	Transverse Joints (mm):	Bracing – All 4 sides (mm):
To 200	0.6	Drive Slip/Cleat	Nil
Over 200 to 600	0.8	Drive Slip/Cleat	Nil
Over 600 to 1000	0.8	Proprietary Flanges or 25 x 25 x 3 angle	Duct beaded or 25 x 25 x 1.6 angle
Over 1000	1.0	Proprietary Flanges or 40 x 40 x 3 angle	Duct beaded or 40 x 40 x 1.6 angle

- Flanged Joints – Provide soft jointing material e.g. 'Prestik' between flanged joints, with bolts or clips at centres not greater than 150mm.
- Crossbreaking – Cross break all sides exceeding 300mm in width, except where duct is acoustically treated internally.
- Proprietary fan coil unit ductwork sections, fibreglass type, shall not be provided.

Duct Fittings

- Utilise radius bends where possible. Square bends when used shall include double section turning vanes, except for applications with grease laden air such as kitchen exhaust.

- Limit angle of diverging or converging transitions or tapers to 15°. Where this is not possible, provide internal splitters to achieve this result.

- Provide splitters and dampers at all branches and at registers and grilles to allow full adjustability of the air distribution system. Ensure all are readily accessible for adjustment after installation and that final settings are prominently marked.

5.3 RECTANGULAR PVC DUCTWORK

- Apartment toilet/laundry and rangehood exhaust ductwork shall be proprietary rectangular plastic ductwork of Air Systems or FanTech manufacture or approved equivalent.

- Plastic duct systems shall be compliant with AS1530.3 (1999) Building Standard Specification and AS4254 (2002).

- Plastic duct systems shall be provided complete with proprietary bends, spacers and rectangular to circular flexible duct connection pieces for fan connections.

5.4 CIRCULAR FLEXIBLE DUCTWORK

General

- Construct in accordance with Australian Standard 4254.

- Flexible ductwork shall be sized based on a maximum velocity of 3.0 m/s.

- The inner duct shall be factory wrapped in insulation and sheathed with an aluminium foil laminate outer vapour barrier.

Construction and Insulation

- Fabric reinforced aluminium foil laminate or similarly durable material. Do not use unreinforced plastic materials.

Joints

- Use full 3m lengths for connections to registers where possible.

- Fasten inner core to duct and register spigots with tape, then with mechanical bands,

- Separately tape / seal outer sheath with tape.

- Utilise 50mm wide adhesive tape fully complying with AS 4245.

Hangers and Supports

- Support ductwork with rot and fire proof webbing at all changes in direction at not more than 2000mm intervals.

- Supports to ensure that duct is clear of the ceiling and free of kinks, sufficiently wide.

5.5 DUCT SUPPORTS

General

- Manufacture in accordance with S.M.A.C.N.A, AS4254 and AS1170.4 standards as a minimum.
- In additional to above, support all ductwork from threaded rods with angle bases as a minimum. Spacing shall be in accordance with above standard. Steel straphangers will not be considered as an equal alternative to angle based mounting for equipment.
- Substitutions to the above will subject to mechanical engineer's approval.
- Fix supports to the underside of duct.
- Where duct supports are used to support other services, provide adequately increased support ratings, utilising a proprietary support system, such as "Unistrut" certified for the combined weight.

Connection to structure

- Fix hangers to solid structural members, underside of floor slabs, roof beams and the like.
- Provide adequate allowance for expansion and contraction.
- Fix supports to the building structure through the webs, not flanges of beams, purlins and the like.
- For fixing to steel and timber structure, M10 cadmium plated mild steel bolts shall be used.
- For fixing to masonry structures, expanding type plugs with M10 steel bolts or threaded drop rods of the sizes specified shall be used. Plugs shall be of the wedge action type designed to expand at the base.
- Supports shall be provided adjacent to flexible connections, branch connections, tee connections, bends and the like.

Spacing of duct supports

- Horizontal ducting - 1500mm maximum centres
- Vertical ducting - 2400mm maximum centres

5.6 FLEXIBLE CONNECTIONS

Provide flexible connections at locations shown on the details for each fan, air conditioning and air handling systems.

Construction: Neoprene glass coated fabric having a density of not less than 1kg/M^2 for normal applications at less than 90° C, similar to "wavebar" or approved equivalent.

5.7 VOLUME CONTROL DAMPERS

General

Dampers shall be free of rattles, fluttering or slack movement.

- Capable of adjustment over the desired range without excessive self-generated noise or the need for special tools.
- Blades shall not have sharp edges and shall be sufficiently rigid to eliminate movement when locked.
- Sizes shall be as per duct size unless shown otherwise on the drawings.

Butterfly Dampers – Flexible Branch Duct Take-Offs

- Round single blade, double folded type.
- Butterfly dampers shall be constructed of minimum 0.6 mm thickness zinc coated steel.
- Blade securely fastened to rod, pivoted in bronze or nylon bushes fixed to the spigot.
- Lockable type quadrant. The quadrant lock shall be clearly marked to indicate the "open" and "shut" positions of the damper.

5.8 FIRE DAMPERS

General

- Install fire dampers in all duct and air outlet penetrations through fire rated barriers in accordance with Australian Standard 1668 - Part 1 - Fire Precautions in Buildings with Air Handling Systems.
- Test and certify dampers to the requirements of the Statutory Authorities.

Fusible Link Type

- Install strictly in accordance with manufacturer's recommendations Construct fire dampers in accordance with Australian Standard 1682 - Fire Dampers.
- Provide access panels in ducts sufficiently sized and arranged to enable access for inspection and re-setting.

Intumescent Type

- Provide intumescent fire dampers of "Lorient" manufacture "LVH" Series or equal approved.
- Construct from heavy gauge galvanised steel casing. Incorporate evenly spaced, fixed parallel aerodynamic intumescent slats with 20mm pitch.
- Provide for operation in accordance with Australian/New Zealand Standard 1668.1 - Fire precautions in buildings with air handling systems.

- Test in accordance with Australian Standard 1530.4 - Fire resistance tests of elements of building construction.
- Install in accordance with Australian Standard 1682.2 - Fire dampers – Installation and manufacturer's recommendations.
- Size dampers to provide for a maximum pressure drop of 20 Pa at 5 m/s air flow.

Multi-Blade Type

- Provide multi-blade fire dampers of "Bullock" manufacture "4800" Series or equal approved.
- Install strictly in accordance with manufacturer's recommendations Construct fire dampers in accordance with Australian Standard 1682 - Fire Dampers.
- Provide access panels in ducts sufficiently sized and arranged to enable access for inspection and re-setting.
- Construct from heavy gauge galvanised steel casing, engineered body with any exposed welds to be coated with cold zinc primer paint to prevent rusting.
- Damper expansion gap shall be maintained incorporating metal expansion gap sealant system complying with AS1682.1 as a minimum.
- Fusible links shall operate at the greater of 68.0°C or the requirements satisfying the AS1682.1 rating.
- Incorporate flange channels where required to allow construction to be securely fixed to adjoining ductwork.
- Size dampers to provide for a maximum pressure drop of 20 Pa at 5 m/s air flow.

5.9 ACCESS PANELS

General

Provide access panels in ducts and plenums adjacent to each fire damper, modulating damper, air filter and in kitchen exhaust ducts at each change of direction and at not less than 3000mm intervals in horizontal runs, and in all similar locations where access is required for maintenance purposes.

Coordinate ceiling access panels required for mechanical equipment maintenance and commissioning with the Building Related trade and all Services Trades.

- Utilise proprietary access panels with purpose built frames fabricated from galvanised sheetmetal.
- Incorporate hinged access panels where possible.
- Access panels to incorporate the equivalent standard of insulation with the surrounding ductwork.

- Incorporate high quality proprietary heavy duty hinges and latches and sealing gaskets to the frame and panel. All hardware to be either galvanised or stainless steel. Do not utilise piano hinges or latches with rivets acting as the shaft.

- Construct access panels to withstand system pressures and ensure panels are completely air and watertight.

- Where possible, locate access panels in ductwork carrying moisture and kitchen exhaust ductwork in the side of the ducts.

- Size access panels to suit the maintenance purposes envisaged.

5.10 AIR DIFFUSION

General

All air diffusers, air registers, louvres, exhaust air grilles, door relief grilles and all other such fittings shall be of an approved type and as scheduled in the following clauses of this section of the specification and as shown on the drawings.

- Provide N.A.T.A., A.D.C. or equal approved certified performance data for all air diffusion equipment to be installed. Performance data for similar but not identical equipment will not be accepted.

- All outlets shall be selected for efficient air distribution and low noise levels.

- Check neck velocities, horizontal and vertical flow patterns and noise levels prior to ordering equipment. Outlets with poor distribution and excessive noise levels shall not be used.

- Supply air outlets for air conditioning equipment are to be sized on the basis of a terminal velocity of 0.3 m/s in the occupied zone.

- Approval shall be obtained for each type of outlet, grille and register proposed for use. Samples shall be submitted for this purpose prior to manufacture.

- All internal parts of outlet, such as straightening vanes and volume controllers shall be finished matt black.

- Unless otherwise specified aluminium outlets shall be powdercoat finish, to architect's colour selection.

- Internal duct surfaces visible through any air outlet or grille shall be painted matt black.

- Outlets shall be free of rattles, provide rubber packing or sealing strips as required to eliminate noise.

- Provide acoustically lined cushion head boxes to all outlets, lined on all surfaces.

- Provide volume control dampers to all outlets as indicated on the drawings.

Weather Proof Louvre

- Aluminium construction, powder coat finish.
- Fixed core, fixed horizontal blades supported and braced by means of concealed stiffeners and bars.
- Fix blades at 45° to the direction of air flow with 30mm pitch up to 900mm high otherwise 100mm pitch.
- Fully stormproof and outward draining, flash and seal to building openings.
- Install 13mm x 13mm x 1.6mm diameter removable birdscreen to inside face of all grilles.
- 30 Pa (max) pressure drop at 2.0 m/s face velocity.
- 50% (min) free area.

Exhaust Air Diffusers – Curved Blade Type

- Curved louvre face single direction blow type.
- Aluminium construction, powder coat finish.
- Cores to be readily removable for cleaning.
- Internal baffle to separate kitchen and toilet/laundry exhaust air flows.

6 PIPEWORK SYSTEMS

6.1 GENERAL

This section of the Specification covers the general materials and construction standards for the supply and installation of the various pipework systems required for the installation.

The tender drawings indicate the general arrangement in which the various systems are to be installed, however, it should be noted that referenced drawings do not necessarily indicate all off-sets and transitions required for the necessary detailed co-ordination between trades and associated services and the building structure.

Install pipework to achieve a neat and workmanlike appearance, correct grade and alignment, satisfactory clearances, and all necessary provisions for correct and efficient operation and maintenance.

Connections to any item of equipment shall be designed to enable removal of the item with a minimum of disturbance to the associated pipework.

6.2 REFRIGERATION PIPEWORK AND FITTINGS

General

Supply and install all refrigerant pipework, joints and associated fittings in accordance with the following:

- Copper pipework in accordance with Australian Standard 1677, Australian Standard 1571/122-0 (Nominal size up to 20mm), Australian Standard 1571/122-H (Nominal size, over 20mm).
- Tube wall thickness in accordance with Australian Standard 1432 Type B minimum and selected to suit the operating pressures and temperatures of the associated refrigerant.
- Copper alloy fittings and valves shall be dezincification-resistant to Australian Standard 1585 Clause 6.3.
- Utilise proprietary fittings for all joints, bends, reductions, tees and the like. Utilise elbows with minimum centreline radius 1.45 tube diameters to AS 1585, Table 1B. Wherever possible make reductions at elbows, tees, line devices or equipment connections using reducing fittings, otherwise use reducing bushes or reducing couplings.
- All refrigerant pipework and fitting to be installed in accordance with the associated equipment manufacturer's installation guidelines. It is the responsibility of the mechanical services contractor to review the installation guidelines and ensure compliance is achieved.

Joints

- Utilise Brazed joints wherever possible unless equipment is supplied from factory with flared compression joint fittings.
- Utilise Brazing Alloy in accordance with Australian Standard 1167.1 Table 2 B4, with15% minimum silver content.

- For Jointing Dissimilar Metals utilise Brazing Alloy in accordance with Australian Standard 1167.1 Table 1 A10 or an alloy with an equivalent silver content (minimum 34%).

- Produce flared compression joints utilising full bore refrigerant flare fittings to SAE J533b.

6.3 PIPEWORK INSULATION

Refrigeration

- The insulating material shall be commercially available slip-on type of the non-rigid form, similar to 'Armaflex FR'.

- Insulate all sections of the piping systems including flanges, valves and fitting with compliance to the minimum R – value requirements of the BCA Volume One, Specification J5.4, Insulating Piping, Vessels, Heat Exchangers and Tanks. The R – value of preformed pipe insulation shall be calculated in accordance with AS/NZS 4859.1: 2002.

- Use only insulation materials and systems that comply with Specification C1.10 Fire Hazard Properties – General, of the Building Code of Australia Volume One.

- Insulate all sections of the piping systems including flanges, valves and fittings utilizing sectional Elastomeric nitrile – rubber foam in tubular or sheet form, with high resistance to water vapour to create a water – vapour barrier.

- Thermal conductivity of ≤ 0.036 W/(m·K), when measured at 23 ±1^{0}C as per AS/NZS 4859.1: 2002.

- Thoroughly clean pipework prior to the application of the insulation.

- Minimum insulation thickness shall be provided to satisfy the R-Value with respect to installation location and system capacity in accordance with the BCA.

- Select insulation to suit the exact pipe diameter and firmly apply the insulation to the pipework ensuring all joints are butted together with contact adhesive and no gaps or air spaces are left. Accurately shape insulation to closely fit all bends.

- Insulate refrigeration suction and liquid lines for all air conditioning system over their entire length between the condensing unit and the fan coil evaporator. Glue ends of insulation to condensing unit and fan coil unit casing.

- Complete the vapour seal around all bends, joints and fittings utilising proprietary sealing compound in accordance with the manufacturer's recommendations. Complete the vapour seal to all longitudinal and circumferential joints with a pressure sensitive adhesive tape.

- Provide galvanised sheetmetal capping to all external pipework insulation.

- Provide rubber or neoprene sleeves or grommets to brackets at support points to prevent damage of the insulation.

- Thoroughly clean the pipework prior to the application of the insulation.

- Refer to Manufacturers Application Guide for further recommendations.

6.4 DRAINS & CONDENSATE DRAIN PIPEWORK

Provide condensate drains, but not limited to, to the following equipment:

- Fan Coil Units
- Condensing Units

Condensate drain should be provided in accordance with the following:

- Drain pipework shall be Copper construction.
- Minimum 20mm diameter pipework shall be provided to a single unit, unless indicated larger on the drawings.
- Common condensate drains serving more than three items of equipment shall be minimum 40mm diameter unless indicated larger on the drawings. Common condensate drains shall not serve more than six items of equipment.
- All drains shall run to sewer or stormwater – discharge over the drain points as nominated on the drawings maintaining an air gap between the drain discharge and the tundish, cone or the like.
- Where a drain connection is not available for air-cooled condensing units, provide additional drip trays or approved means of drainage collection prior to discharge to sewer or stormwater.
- Comply with local water authority and EPA regulations.
- Incorporate a removable connection at the point of connection to equipment such as a section of clear plastic hose secured by hose clamps, to enable removal and cleaning.
- Insulate the first 1500mm length of drain line downstream of equipment mounted within the ceiling space.
- Incorporate P-Traps to all equipment which operates at a pressure lower than atmosphere (draw through type fan coil units and packaged air conditioning units).

6.5 PIPEWORK SUPPORTS

Support all pipework and associated equipment to prevent deflection, movement and undue stresses on the piping systems and building structure under all operating conditions in accordance with the following:-

- Select the supports and associated expansion allowances to suit the combined loads of the pipework, valves, fittings, insulation, fluid and reactions due to thermal expansion/contraction and movement of the building structure.
- Utilise proprietary support system such as “Unistrut” or “Ezystrut” constructed completely from galvanised steel.
- Isolate all pipework from dissimilar metal bracket materials with rubber grommets.

- Install non-compressible insulating ferrules at the support points of insulated pipework and maintain the vapour seal as detailed in the pipework insulation sections above.

- Install and support pipework to achieve a neat and workmanlike appearance and parallel to building lines wherever possible.

- Install supports at intervals in accordance with the support system manufacturers recommendations, and not less than 2000mm

  Connect supports to the building structure in accordance with the support system manufacturer's recommendations, utilising threaded rod, suitable masonry anchors for concrete or proprietary clamps for structural steel members.

- Incorporate allowance for pipe movement and expansion, including spring mounts to pipework mounted in vertical riser shafts.

7 AUTOMATIC CONTROLS

7.1 GENERAL

Supply and install all automatic controls necessary to achieve the specified control functions and for the safe and satisfactory operation of the mechanical services systems described in this specification. Include all ancillary equipment as necessary to provide a complete operating system designed for safe, correct and efficient operation of the plant.

The installation, setting and putting into operation of automatic controls shall be carried out by personnel trained and experienced in this field.

The automatic controls shall be commercial quality, of approved manufacture, proven performance and reliability and compatible with the equipment to which they are connected. Controls shall be of the electronic type.

7.2 CONTROLS

Air Conditioning Units - Air Cooled Reverse Cycle

The air conditioning units shall be controlled by the manufacturer’s proprietary control system complete with a 7 day timeclock. The timeclock shall also include battery back-up.

Provide wireless manufacturer's standard backlit LCD controllers, complete with optional wall mounting bracket.

Each fan coil unit shall be controlled by its associated Liquid Crystal Display controller incorporating the following as a minimum:

- ON-OFF control function.
- Individual temperature setting and mode adjustment (AUTO/HEAT/COOL).
- Fan speed selection including AUTO mode.

Apartment Bathroom, Toilet and Laundry Exhaust Fan

Exhaust fans shall be controlled via a combined lighting and fan switch plate in each bathroom/toilet/laundry. Control panel by electrical trade. Connect to controlled socket outlet provided by electrical services contractor.

Ground Level Toilet Exhaust Fan

The toilet exhaust air fan shall be linked with the lighting and operate whenever the lighting within the space is activated, complete with run-on timer for continued fan operation for 20 minutes (adjustable).

8 ELECTRICAL SERVICES

8.1 GENERAL

The work includes but is not limited to the detailed design, manufacture, supply, installation, testing and maintenance of electrical works associated with the mechanical services installation.

Where ratings, sizes, loads, dimensions and the like have been provided, they are to be taken as the minimum values. The Contractor shall undertake their own assessment to confirm all components of the proposed installation, and shall incorporate the greater value within the installation.

The Mechanical Services Contractor shall confirm all equipment electrical loads to the Electrical Contractor prior to ordering of electrical sub-mains, breakers, isolators and the like.

8.2 CERTIFICATE OF COMPLIANCE

Certify on completion of each component or stage that the works comply with the requirements of AS/NZS 3000, the Electricity Distributor Regulations and any other applicable rules or regulations.

Provide a separate Certificate of Compliance for each stage of the work including temporary supplies.

The Certificate shall be in a form acceptable to the Office of Energy Policy and completed in accordance with their requirements. Issue copies to the Superintendents Proprietor and the local power authority.

8.3 STANDARDS

Refer to, but not limited to, the following referenced documents for the Electrical Installation for works includes under this trade package:

AS/NZS CISPR Set: Electromagnetic Compatibility

AS/NZS 1668.1: The use of ventilation and air conditioning in buildings – Fire and smoke control in multi-compartment buildings

AS 1939: Degrees of protection for enclosures

AS/NZS 3000: Wiring Rules

AS/NZS: 3008: Electrical installations – selection of cables – Cables for alternating voltages up to and including 0.6/1 kV

AS/NZS 3080: Telecommunications installations – Generic cabling for commercial premises

AS/NZS 3111: Approval and test specification- Miniature overcurrent circuit-breakers

AS/NZS 3947.4.3: Low voltage switchgear and control gear

AS 60044.1: Instrument Transformers

AS 60947 Set: Low voltage switchgear and controlgear

AS/NZS 61000 Set: Electromagnetic Compatibility

8.4 TESTING AND ACCEPTANCE

Test Certificates

Supply electrical Certificates of Compliance, dated and signed by a responsible person in duplicate to the Superintendent.

Site Tests

Tests must include but not be limited to the following:

- Insulation resistance using 1,000 volt Insulation and Continuity tester between each conductor and all others in cable, conduit or switchgear and between conductors and earth.
- Earth resistance tests in accordance with AS/NZS 3000.
- Verification of polarity and phase rotation.
- Functional tests of all switchgear, controls and systems including safety devices.
- Testing in accordance with AS/NZS 3760

8.5 ELECTRICAL INTERERENCE

Generally in accordance with AS/NZS CISPR Set. Design and use electrical equipment which will not cause interference with electronic and electrical equipment within the vicinity. In the event that the inherent characteristics of equipment make interference possible, fit effective suppressors to eliminate the interference.

Maintain electrical disturbances within the limits set out in Australian Standard 2279 – Disturbances in mains supply networks. Comply with Australian Standard 4252 – Electromagnetic compatibility – Generic immunity standard.

Maintain radio and television interference level within the limits set out in Australian/New Zealand Standard 1044 – Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.

8.6 BALANCING AND PHASE ROTATION

Balancing and phase rotation shall be in accordance with AS/NZS 3000. Balance each section of the installation evenly over all phases and ensure that phase rotation is correct throughout.

8.7 TESTING AND TAGGING

All Electrical equipment and accessories are to be tested and tagged in accordance with AS/NZS 3760.

Provide tags on the flex cable (if fixed) or on the chassis (if flex cable is removable).

Provide a schedule of equipment that has been tested and tagged under this contract in the Operating and Maintenance Manual.

8.8 WIRING SYSTEMS

Cables & Enclosures

- All cabling shall be installed in accordance with the manufacturers requirements, and this specification. Wherever there exists a discrepancy between the two documents the lesser specification shall be disregarded.
- Cabling shall be rated to a minimum of 90°C using PVC/PVC V-90 cables.

Cable Selection

- Standards: Select cables in accordance with AS/NZS 3000 and AS/NZS 3008.1.
- Ratings: Use AS/NZS 3008.1 for the determination of current ratings, voltage drop and cable size.
- Voltage Drop: The maximum voltage drop to each final sub-circuit are not to exceed 5% unless specified otherwise.
- Conductors: Unless otherwise specified, use multi-stranded copper conductors. Aluminium cabling will not be accepted.
- Minimum Sub-Circuit size: The following minimum cable sizes shall be provided:
  - 20 Amp circuit – 4mm2
  - 16 Amp circuit – 2.5mm2
  - Control circuit – 1.5mm2
- The contractor shall undertake all calculations necessary to ensure cables are installed in accordance with regulatory standards and requirements, based on final equipment selections, loads and length of cabling.
- Sub-Circuit cable types: Unless otherwise specified use cabling with V-90 (PVC) insulation and PVC sheath, or R-HF-110 (Elastomer) insulation and HFS-110-TP (Elastomer) sheath for fire and life safety services, unless specified otherwise.

Cable Installation

- Installation shall be in accordance with AS/NZS 3000 and AS/NZS 3008.
- Manufacturers' recommendations: Unless otherwise specified, install, terminate and joint cables in accordance with manufacturer’s recommendations.
- Terminations: Terminate each circular multicore cable, and each single core TPS cable of greater cross section than 35mm2, using a nonferrous gland at each end of each cable. Provide non-ferrous gland plates for all single core cables.

- Handling cables: Handle cables so as to avoid damage to insulation and serving or sheathing. All damaged cabling shall be replaced at no cost to the project.

- Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables for their entire route length without intermediate straight-through joints. Locate and carry out approved joints as directed.

- Installation: Install and adequately support fixed wiring as specified throughout the installation. All multi-phase circuits with single conductors shall be installed in trefoil configuration, strictly in accordance with the requirements of AS 3008. All power and control cabling shall be installed on cable trays, catenaries and fixed structure where specifically requested within this specification. Where it is not specifically stated, refer to the Consulting Engineer for approval of appropriate installation method.

- Conductors & Identification: For fixed wiring colour the conductor insulation as follows:
  - Active conductors in single phase circuits: RED.
  - Active conductors in polyphase circuits: A PHASE – RED, B PHASE – WHITE, C PHASE – BLUE
  - Neutral conductors - BLACK
  - Earth conductors - GREEN with YELLOW stripe
  - Control cables (red phase) – RED
  - Other conductors: To AS 3000 clause 3.2.
  - Sheathing: White for single phase and orange for 3-phase.

- Balancing: The Contractor is to ensure that all phases are balanced in accordance with regulatory requirements, and ensure that phase rotation is correct.

- Tagging: Identify multicore cables and trefoil groups at each end and at crowded intermediate points by means of stamped, non-ferrous tags, clipped around each cable, or trefoil group.

Conduits

- Galvanised steel where required to meet AS 3013 classification, where subject to high temperatures and where exposed to sunlight. Paint to approval.

- Rigid PVC generally otherwise.

- HDPE/HFT (or any UV stabilised alternative), ultra-violet resistant when exposed to sunlight.

- Corrugated Plastic Conduit: May be used where embedded in concrete and to effect changes in direction of surface runs of rigid PVC conduit and for final connections to equipment. Use with manufacturer's approved accessories.

Draw Cords: Install polypropylene draw cords in all spare conduits and in all conduits including submains conduits which have spare capacity which may be used in future.

Cable Ducts

- Fabrication: Provide cable ducts of sheet steel manufacture unless shown otherwise.
- Size: Ensure that the size of cable ducts comply with AS/NZS 3000 requirements. Adequately size for the installation of 30% additional cables.
- Installation: All ducts shall be installed parallel or perpendicular to the building structure.
- Support: Provide substantial supports comprising plain or angle brackets of galvanised steel angle, Unistrut or similar, fixed to walls or floors or suspended from structure where applicable. Provide corrosion resistant spacers between duct and surface where fixed direct to a wall.
- Steel Ducts shall be in provided accordance with the following:
  - Construction: Galvabond or Zincanneal (where painted) sheet steel of thickness to prevent deformation.
  - Lids: Provide unless specified otherwise. Ensure duct lids are installed to maintain earth continuity. Provide 10 mm to 15 mm return edge for fastening and stiffening purposes.
  - Fixings: Fasten lids at ends and at maximum 1500 mm intervals between with galvanised steel gutter bolts and captive nuts.
  - Retaining: Hold lids by retaining chains or nylon cords properly anchored and approx. 300 long.
  - Cable Installation: Provide vertical runs with an approved means of supporting the cable at intervals of 1000 mm maximum, or as recommended by the manufacturer

8.9 ISOLATING SWITCHES

Minimum rating: 415V, 20A minimum, or to exceed the connected load. All isolators shall be of heavy duty type suitable for inductive loads. IP Rating shall 56 minimum, fully complying with AS 3000.

Where isolators are nominated as weatherproof they shall be of “Clipsal 56” Series (or equal approved) high impact polycarbonate with locking provisions. Clipsal “Weathershield WHB IP66” Series (or equal approved) is acceptable in general external areas except in plant rooms, roofs or for specialist requirements.

Enclose the isolating switches to suit their operating environment. Label each isolating switch with the item of plant served with Traffolyte labelling.

Carry out all final connections to all equipment fitted with isolating switches.

Mechanisms: Isolating switches are to be provided with a rotating toggle with external locking facilities both in the ‘on’ and ‘off’ position.

The mechanism is to be rated in excess of the connected equipment.

Provide upstands and associated flashings as required for isolators. Do not mount isolators directly to equipment.

Colour: To the Consulting Engineers approval.

Location: Check the location of the isolator in respect to the connected plant and locate as close as practicable and within 600 mm.

9 NOISE AND VIBRATION

9.1 GENERAL

Attention shall be paid to the prevention of noise and vibration in all equipment and the contractor shall be responsible for the correction of such objectionable noise and vibration as may occur to the satisfaction of the Mechanical Services Consulting Engineer.

Provide anti-vibration mounts under all equipment. Select and install mounts to suit the weight and type of equipment proposed in accordance with mount suppliers recommendations.

Select and install equipment to operate within the required vibration limits. Prevent the transmission of vibration from rotating or reciprocating equipment to other building elements by suitable means including, where appropriate, static and dynamic balancing, rubber or spring isolation mounting supports, inertia blocks, pipework vibration isolation and the like.

Set and adjust isolation mounting supports so that they give the required static deflections with adequate clearance for free movement.

9.2 EARTHQUAKE FIXINGS AND SUPPORTS

All plant, equipment and piping systems, shall comply with the requirements of Australian Standard 1170.4 - SAA Loading Code – Earthquake, AS2670 – Vibration, AS2625 Mechanical Vibration, ISO1940:2003 – Mechanical Vibration.

Where greater incorporate the Design, Selection and Installation with requirements of ASHRAE Handbook 2011, Applications Chapter 48.

For further information regarding earthquake restraining, refer to following:-

- Gripple Seismic Installation Manual
- Tyco flow control, 2002,unistrut seismic bracing systems
- Fema e-74, January 2011, reducing the risks of non-structural earthquake damage - a practical guide.
- S.M.A.C.N.A seismic restraint manual, guidelines for mechanical systems, 1998, S.M.A.C.N.A, sheet metal and air conditioning contractors' national association.

Provide restraints and supports designed and certified by a structural engineer, to all plant, equipment, tanks pipework, isolation mounts and ductwork in accordance with Australian Standard 1170.4-2007 Section 8, incorporating the following:-

Criteria	Unit	Factor
Importance Level	I	2
Annual Probability of Exceedance	yr	1:500
Soil Classification		De
Hazard Factor	Z	0.1

Criteria	Unit	Factor
Probability Factor	Kp	1.0
Structural Classification	EDC	2

All restraints and supports shall be issued to the structural engineer to review the adequacy of the structure to support the services loads, including seismic forces. Proof of formal review and approval by structural engineer shall be provided as part of the shop drawing review process.

Where internal expertise is not available to the contractor, formal engagement of a registered structural engineer shall be sought for design of earthquake restraints. Cost of engagement shall be included in Tender pricing and listed as a separate item when applicable.

The following ductwork and piping do not require seismic bracing:

- Piping less than 32mm internal diameter in plant rooms.
- All other piping less than 64mm internal diameter
- All electrical conduit less than 64mm internal diameter
- All rectangular air-handling ductwork less than 0.40 m2 in cross sectional area
- All ducts and piping suspended by individual hangers 300mm or less in length from the top of the pipe to the bottom of the support for the hanger

All ductwork to be supported in accordance with AS 4254-2002.

Transverse bracing for duct sections to be at 6.00m maximum centres and at section ends.

Longitudinal bracing for duct sections to be at 12.00m maximum centres and at section ends.

Transverse bracing on adjacent runs may be considered the longitudinal bracing for the adjacent section.

Spacing of the bracing may need to be reduced for example:

- Brace both sides of piping, conduit or ductwork at flexible connections
- Brace to avoid collision between piping, conduit or ductwork and other non-structural components
- Brace within 600mm of changes in direction, whether it be horizontal or vertical changes
- Brace where components penetrate floors or ceilings
- Brace in both directions at the top of all risers where risers exceed 900mm

The spacing of bracing along a run of piping, conduit or ductwork should not vary greatly in order to ensure uniform deflection and loading.

Each unit of equipment connected to a run of piping, conduit or ductwork shall be individually and independently braced. Thermal expansion and contraction forces, where present, must be considered in the layout of transverse and longitudinal braces. Flexibility should be provided where pipes pass through seismic or expansion joints or connect to equipment with vibration isolators.

Bracing of pipework shall be at every second support but not exceeding the spacing given for ducts.

Services braced in accordance with AS 1170.1-2007 section 8 shall have a minimum of 50mm clearance from all ceiling hangers and the ceiling grid.

Do not core through, cut through or otherwise damage steel reinforcement in concrete slabs, beams or columns when installing seismic bracing.

9.3 ANTI-VIBRATION MOUNTS

Provide anti-vibration and acoustic mounts under all equipment. Select and install mounts to suit the weight and type of equipment proposed in accordance with mount supplier's recommendations.

Select and install equipment to operate within the required vibration limits under normal operating conditions. Prevent the transmission of vibration from rotating or reciprocating equipment to other building elements by suitable means including, where appropriate, static and dynamic balancing, rubber or spring isolation mounting supports, inertia blocks, pipework vibration isolation and the like.

Mounting details as follows (refer to below table for static deflection requirements):

- Flexible connections between all solid supported ductwork and fans.
- Spring isolation hangers for ducted fans and all ductwork not isolated from equipment by flexible connections.

All components associated with vibration isolation mounts to be either hot dipped galvanised after manufacture or stainless steel.

Ensure equipment bases are sufficiently rigid to avoid distortion or deflection at the support/mounting point. Provide additional reinforcement or large washers as required to satisfy this requirement. Refer to *Workmanship and Materials* for Equipment Bases information.

10 TESTING AND COMMISSIONING

10.1 GENERAL

On completion of the work, commission the entire installation and put it into operation.

Provide proper facilities and instruments to carry out such tests as may be necessary to satisfy the Engineer, Independent Commissioning Agent and the Client that the installation meets the requirements of this Specification. Calibrate all test instruments at an approved N.A.T.A. certified laboratory prior to carrying out the tests.

All commissioning must be undertaken by a NEBB certified commissioning technician. Submit NEBB Certification number within tender schedules.

Commissioning Information

Provide and setup commissioning information in a lever arch folder complete with dividers in the following format:

- Introduction (quick description of the purpose of the document and the general systems covered by the document, and references, i.e. CIBSE code A).
- Commissioning programme up until the end of DLP.
- Commissioning method statement.
- Pre-commissioning checklists (with check boxes and date column).
- Commissioning Results (see below).
- Commissioning instrumentation and calibration certificates (if applicable).
- All off-site pre-commissioning certificates.

Test records & Commissioning results

All test results shall be properly recorded on approved test log sheets. Proposed log sheets (blank pro-formas) shall be submitted for review prior to commencement of commissioning. Test log sheets shall contain the following information as a minimum:

- Equipment item designation (e.g. FCU 1-2).
- Manufacturer, model and serial number of equipment.
- Test information for each individual item of equipment shall be recorded on a separate sheet. Nominate ‘specified’ vs. ‘actual’ results.
- Item(s) of equipment used for each test (e.g. “Flowhood” “Anemometer”, (make/model, serial number, date last calibrated).
- Control settings including field code settings, temperature set points, high and low head pressure switch settings and overload settings as applicable.

- Evidence of controls calibration such as control set point versus measured temperature.
- Programmed time schedule settings.
- Velocity reading, dimensions, area, factor for all grille air flow readings tested using any equipment other than a flowhood.
- All results shall be entered onto log sheets at the time of testing.
- A copy of all test results shall be forwarded to the Engineer for approval immediately after testing. These initial results may be handwritten to avoid transcription errors.
- A typed copy of all test sheets and calibration certificates shall be enclosed in the Operating and Maintenance Manuals.

10.2 PRE-COMMISSIONING PROCEDURES

Carry out the following works prior to the commencement of the commissioning of the systems:

- Prepare commissioning information folder as detailed above.
- Check the building fabric is complete (i.e. windows, doors, ceiling installed as per normal operating conditions).
- Check the electrical supply is live.
- Visually check ductwork for air tightness.
- Clean all ductwork and remove internal manufacturer's identification stickers.
- Slug dose with chemicals, pressure, and leak test piping systems.
- Ensure all controls are in their appropriate setting and in 'automatic' mode.
- Ensure, as required, that doors, seals, door hardware, ceiling tiles etc. are in place to avoid leakage.
- Clean and flush out all water systems including piping systems and connected equipment. Use non foaming detergent compatible with final selected water treatment to flush out the system, followed by a second flushing using clean water. Remove and clean out all strainers
- Drain down water storage tanks, clean out and flush with disinfectant, refill and check aerobic bacteria count.
- Pressure and leak test air distribution systems.
- Carry out point to point damper checks.
- Review and coordinate interfaces with other trade.

- Clean out plantrooms, conditioners and plenums and operate all air handling systems with temporary filter media.

- Submit for approval, manufacturer's test certificates, performance curves and tables for all plant, equipment and electrical components. Mount test certificates for pressure vessels in glazed frames adjacent the equipment.

- Submit for approval the controls functional specification.

10.3 COMMISSIONING

Carry out all adjustments necessary for the safe, reliable and satisfactory operation of the plant prior to the Practical Completion.

Practical completion will be certified only after the plant has been inspected and approved and the requirements of this section of the specification are fulfilled.

Undertake commissioning in strict accordance with CIBSE Commissioning Codes or ASHRAE Commissioning Guideline 1-1996 including but not limited to the following:

Plant and equipment

Check the operation of the plant and equipment including direction of rotation of motors, noise and vibration levels, operating temperatures, pressures and flows

Check and prove all operating and safety controls

Check and prove performance characteristics at full and part load.

Controls

Program all control inputs, time schedules, timer settings and field code settings as applicable to achieve the specified control strategies and to ensure stable operation and to meet manufacturer's recommendations. Calibrate all sensors. Record all settings and calibration results on test log sheets.

Carry out "point to point" testing for each control device and external monitoring device to demonstrate complete, correct control functionality and submit written evidence in tabular format.

Air Systems

All air quantities shall be measured and all adjustments made to obtain the specified performances.

Commission air systems utilising the following calibrated equipment:

Supply air outlets:

- Utilise "Flowhood" with appropriately sized hood, in accordance with manufacturer's recommendations.

Exhaust air grilles:

- Utilise "Flowhood" with appropriately sized hood, in accordance with manufacturer's recommendations wherever possible.
- If flowhood cannot be used due to configuration/space constraints then utilise a "Velgrid" in accordance with manufacturer's recommendations (including area factors).

The total supply air quantity shall correspond to within 0% to plus 10% of the air quantities shown on the drawings. The fans shall run at their lowest practicable speed while maintaining the specified quantities.

The air quantities through air outlets, and exhaust grilles shall correspond within -0 to +5% of the air quantities shown on the drawings.

Allow for all changes to fan motor drives necessary to obtain the required performance at no cost extra to the Contract.

Ensure ductwork mounted static pressure sensors are located 1 equivalent diameters upstream of flow measurement points where possible.

Subsequent to occupation provide fine tuning of the air balance based on temperature measurements within the space. Ensure no undue drafts are present.

Refrigeration Systems

Check and prove operation of expansion devices. Monitor moisture indicators and check and record all operating and safety pressure settings.

All vacuum pipework shall undergo a vacuum test equivalent to a minimum of 300 Microns maintained for a period of twelve (12) hours. If there is any pressure rise during the vacuum tests, the pipework shall be checked for leaks and after repairs have been made the test shall be repeated. If a section of pipework fails a required test, repair the fault and retest.

Tolerance on pressure readings: +5%.

Electrical systems

Progressively and finally test the complete installation to ensure it is mechanically and electrically safe and operates correctly under normal, emergency and fault conditions:

- Check all terminations, clamps and fixings.
- Check phase identifications match throughout the installation.
- Check for excessive heating at all joints.

10.4 ACCEPTANCE TESTS

Acceptance Tests

Acceptance tests shall commence only when the preliminary test results demonstrate that the plant is ready for test.

Consulting Engineer Witnessing

Make due allowance (time and cost) in the commissioning phase of the project for final consultant witnessing of all plant in operation. Coordinate the required consultant witnessing, for all plant, within the builder's construction programme.

The mechanical trade shall be responsible for notifying the consulting engineer to attend site and witness the mechanical services installation. A minimum of three (3) working days' notice must be provided to the consulting engineer.

Final witnessing must only be arranged once the installation is complete, the final commissioning results have been issued to the consultant and consultant comments have been reviewed and rectified.

When the installation is complete, commission the plant by putting it into working order and operating it to prove all control methodologies outlined within this specification are achieved.

Make the adjustments necessary (prior to consultant witnessing) to achieve the required performance under continuous operating service conditions, including balancing, setting the controls, checking the operation of overload and safety devices, and correcting malfunctions.

Record and submit the results to the consulting engineer prior to arranging final consultant witnessing. One (1) full working day (minimum) will be required for the consulting engineer to review the results prior to arranging the final witnessing inspection.

Controls

Demonstrate all control functions as requested and to the satisfaction of the Mechanical Services consulting engineer including control strategies, interlocks, field code settings, set points, calibration, timeclock settings/schedules, timer settings, run and fault indication and safety settings.

Electrical Requirements

Progressively test all components of the installation to ensure compliance with Statutory and Australian Standards requirements, and Manufacturer's recommendations. Check operation under normal, emergency and fault conditions.

Submit records of all tests, and provide all necessary forms and documentation required by current Statutory regulations.

Motor-Driven Appliances

Test each appliance for operation to name-plate rating. Adjust thermal overloads for actual load during maximum ambient conditions. Measure running amps for all phases, speeds of motors and driven plant (where belt drives are used), supply voltages.

Concealed Work

Do not cover or conceal underground or enclosed work until it has to be inspected and tested, in sections where necessary, to the approval of the consulting engineer and the relevant authority. Leave pipe joints exposed to enable observation during the tests.

On Completion

Check pipe joints and the like. Rectify if damaged, and retest.

Rejection: Pipework which fails a required test, or which vibrates or is noisy because of insufficient support or loose fixings, is liable to rejection.

Handover

Requirement: The Principal shall accept handover of the plant when the acceptance tests demonstrate that the required performance has been achieved and the consulting engineers has undertaken witnessing of all mechanical systems.

Remedial Work

If a tested item fails to meet the performance requirements before Practical Completion, remedial or replacement work during the Defects Liability Period, if permitted by the Client, may be subject to restricted access conditions.

Completion

Commissioning: After satisfactory completion, leave the service in full operational condition.

Warranty period will commence on the date of commissioning acceptance.

11 SERVICE AND MAINTENANCE

11.1 SCOPE

Maintain and service the complete installation for a period of 12 months from the date of Practical Completion. Routine maintenance visits shall be scheduled on a monthly basis as organised through the head contractor.

Maintain all equipment included in this contract in perfect operation during the term of the Guarantee and Maintenance Period and provide emergency service on a 24 hour call out basis.

11.2 MONTHLY MAINTENANCE

At each maintenance visit not less than the following functions shall be carried out in addition to the manufacturer's recommended maintenance activities.

- Inspect and clean as necessary all fans, etc.
- Inspect and replace as necessary all filters.
- Check all bearings for correct operation.
- Check all anti-vibration supports for deterioration.
- Check all flexible duct connections for air tightness.
- Check all drains and clean as necessary.
- Prove correct operation of all safety controls.
- Repair or replace all defective items.
- Check operation of fire mode control.

11.3 HALF YEARLY MAINTENANCE

In addition to the Monthly Maintenance requirements and at intervals not exceeding 6 months the following minimum functions shall be carried out:

- Inspect and clean as necessary all fans, etc.
- Clean and adjust all switchgear, contactors, and starters.
- Prove operation of all thermal overloads.
- Check calibration of all thermal controls.
- Check all safety controls.

Provide all consumable necessary for the proper maintenance and servicing, including grease, oil, refrigerant, refrigeration filter/dryers, etc. Replace all components worn during the maintenance period including belt drives, fuses, globes, etc.

11.4 SERVICES

General

The Contractor shall undertake to provide a comprehensive breakdown of service whereby a qualified mechanic attends the plant promptly after a breakdown is reported and carries out immediate remedial work.

Where the Contractor fails to attend the plant within eight (8) working hours of notification of breakdown and where remedial work is interrupted during normal working hours for purposes other than obtaining spare parts from the nearest source, the Proprietor reserves the right to order such action as may reasonably expedite completion of remedial work at the Sub-Contractors expense.

Service Reports

During each service visit complete a report in the form of a check list which shall indicate the readings of all gauges, the condition of all items, any remedial work carried out. Arrange to have Service reports countersigned by the Proprietor's representative, prior to leaving site.

Final payment of retentions monies will only be certified pursuant to receipt of 12 Service Reports which indicate that the Maintenance and Service requirements have been regularly and satisfactorily completed.

APPENDIX A – TENDER PRICE BREAKDOWN

This schedule is required to be filled out at time of Tender Submission. The amounts indicated in the total Tender price including administration costs and profit for sections of the work are as follows:

SECTION COSTS

NO.	ITEM	AMOUNT TENDERED
1.	**Air Conditioning & Mechanical Services Equipment**	
	Air Conditioning Units – Split Inverter type systems	$
	Fans	$
	Ductwork	$
	Air Diffusion Equipment	$
	Refrigeration Pipework	$
	Electrical (Equipment)	$
	Automatic Controls (Equipment)	$
	Earthquake Restraining and Fixing	$
	Other (specify)	$
2.	**Air Conditioning & Mechanical Services Installation/Labour**	
	Labour General (ductwork, equipment, plant, etc.)	$
	Electrical	$
	Automatic Controls	$
	Pipework	$
	Commissioning	$
	Other (specify)	$
3.	**Air Conditioning & Mechanical Services General**	
	Engineering Calculations	$
	Manuals	$
	For Approval/Workshop Drawings (Revit/CAD)	$
	As-Installed Drawings	$
	User Training	$
	Defects Liability/Comprehensive Maintenance	$
	SUB TOTAL	**$**
	PLUS 10% GST	$
	TOTAL	**$**

Tenderer ..... **Date** .....

4.	**Ongoing preventative maintenance costs (post 12 month DLP)**		
	2 year contract	$	
	3 year contract	$	
	5 year contract	$	
5.	**Trade Rates**		
	Tradesman	$	/hour
	4th Year Apprentice	$	/hour
	Draftsman - AutoCAD	$	/hour
	Draftsman - Revit	$	/hour
	Engineer - Calculations	$	/hour
	Electrical	$	/hour
	Automatic Controls	$	/hour
	Pipework	$	/hour
	Commissioning	$	/hour

Tenderer ..... **Date** .....

APPENDIX B – TECHNICAL DATA SCHEDULES

This schedule is required to be filled out at time of Tender Submission. All plant and equipment is to be in accordance with the Specification. In addition to information requested below, provide at time of tender all manufacturer's selection print-outs indicating compliance with the performance criteria specified at the nominated conditions.

Air Cooled DX

Unit Designation	**ACC/FCU-01**	**ACC/FCU-02**	**ACC/FCU-03**
Indoor Unit Model			
Outdoor Unit Model			
Manufacturer			

Unit Designation	**ACC/FCU-04**	**ACC/FCU-05**	**ACC/FCU-06**
Indoor Unit Model			
Outdoor Unit Model			
Manufacturer			

Unit Designation	**ACC/FCU-07**	**ACC/FCU-08**	**ACC/FCU-09**
Indoor Unit Model			
Outdoor Unit Model			
Manufacturer			

Unit Designation	**ACC/FCU-10**	**ACC/FCU-11**	**ACC/FCU-12**
Indoor Unit Model			
Outdoor Unit Model			
Manufacturer			

Unit Designation	**ACC/FCU-13**	**ACC/FCU-14**	**ACC/FCU-15**
Indoor Unit Model			
Outdoor Unit Model			
Manufacturer			

Tenderer ..... **Date** .....

Unit Designation	**ACC/FCU-16**
Indoor Unit Model	
Outdoor Unit Model	
Manufacturer	

Fans

Unit Designation	**TEF/GEF-XX**	**GEF-G1**	**GEF-REFUSE**
Fan Type			
Manufacturer			
Model			

Air Diffusion Equipment

Weatherproof Louvre

Manufacturer

Type

Exhaust Air Grille - Curved Blade Type

Manufacturer

Type

Automatic Controls

Individual Controller

Manufacturer

Type/Model

Sensors

Manufacturer

Type/Model

Tenderer ..... **Date** .....

APPENDIX C – SCHEDULE OF SUBCONTRACTORS AND PERSONNEL

Subcontractors

Electrical .....

Automatic Controls .....

Ductwork Manufacture .....

Ductwork Installation .....

Pipework .....

Commissioning .....

Personnel

Project Manager .....

Years' Experience with Company / Industry ..... / .....

Site Manager/Foreman .....

Years' Experience with Company / Industry ..... / .....

Commissioning Technician

Years' Experience with Company .....

NEBB Certification No. .....

Tenderer ..... **Date** .....

APPENDIX D – TRAINING RECORD

System Designation	System Type	Scheduling Training	On/Off Training	Fan Speed/Temperature Set-Point Adjustment
e.g.: FCU/ACC-1	e.g.: Ducted	e.g.: Complete	e.g.: Complete	e.g.: N/A

Proprietor's Representative

Position .....

Name .....

Signature .....

Date .....

Mechanical Contractor's Representative:

Position .....

Name .....

Signature .....

Date .....

Tenderer ..... **Date** .....

APPENDIX E – EXAMPLE COMMISSIONING SHEET

Direct Expansion Air Conditioning Test Report

Project Name:		
Project No:	**Date:**	**Sheet: of**

System Designation:	**Applicable Drawing:**	**Area Served:**
FCU Make		
FCU Model No.		
Design Outside Air	**L/s**	
Design Supply Air	**L/s**	
Fan Drive Section		
1. Motor Details - Power - Voltage	kW V	Speed: High/Medium/Low Nameplate Amps: .....A
2. Measured Data - Running Amps - O/Load Set point - O/Load Set point	A	W B

Grille	**Type**	**Area Factor**	**Size**			**Design**		**Prelim Readings**		**Final**	
			MM	**x**	**MM**	**VEL**	**L/s**	**1**	**2**	**L/s**	**Insp.**
					TOTAL SUPPLY AIR:						

Tested By:	**Witnessed By:**	**Test Apparatus:** **Model:**	**Date of Last Calibration:**

Tenderer ..... **Date** .....

Fan Test Report

Project Name:		
Project No:	**Date:**	**Sheet of**

System Designation:	**Applicable Drawing:**	**Area Served:**
1. Fan Make		
2. Fan Model No.		
3. Fan Type		
4. Design Duty	L/s	
5. Fan Details - Impeller-Diameter	mm	
6. Motor Details - Power - Speed - Voltage - Nameplate FLA	 kW rps V A	
7. Measured Data - Air Flow Rate - Running Amps - O/Load Range - O/Load Setpoint	 L/s R:	

Grille	**Type**	**Area Factor**	**Size**			**Design**		**Prelim Readings**		**Final**	
			MM	**x**	**MM**	**Area**	**L/s**	**1**	**2**	**L/s**	**Insp.**
					TOTAL SUPPLY AIR:						

Tested By:	**Witnessed By:**	**Test Apparatus:** **Model:**	**Date of Last Calibration:**

Note: Amend schedule to suit services on project. Alter to suit project requirements.

Tenderer ..... **Date** .....

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

CONSTRUCTION REPORT AND FOOTING RECOMMENDATIONS (CR1)

Agent:	STUDIO NINE ARCHITECTS	**Job Number:**	1702160
Owner:	MICHAEL CALABRO	**Date:**	05/07/2017
Project:	PROPOSED RESIDENTIAL APARTMENTS	**Order No:**	
Project Location:	168 PROSPECT ROAD, PROSPECT		

This is a Construction Report giving specific recommendations for the above mentioned building. This report must be read in conjunction with all listed attachments. This report is valid for a period of 24 months, based on current standards, regulations, etc.

ATTACHMENTS: CRC, CR2, CR2-1 (2 pages), CR2-2, CR4, CR5, CR5-1, CR6, CR9, CD1, CD3, CD5, CRS, CRG, SDN, CSIRO BTF 18 Bulletin - Owner's copy only.

FOOTING TYPE:

1. Reinforced concrete raft and strip footings founded at a minimum of 200 mm into natural ground
2. Reinforced concrete pad footings entirely founded into natural ground

FOOTING DETAILS (*Unless noted otherwise*):

Designation		**Width x Depth**	**Reinforcement**	**Hangers / Ligatures**
Major External:	E			
Major Internal:	M		REFER TO A1 DRAWINGS	
Minor:	m			

RECOMMENDED SITE INSPECTIONS:

1. After excavation for the footing beams and piers, prior to placement of the damp proof membrane.
2. After preparation of the reinforcement prior to pouring of any concrete.
3. As otherwise required by the engineer, or required by the client / contractor.

NOTE: 1. These inspections will incur additional fees.
2. We require 24 hours notice when booking inspections.

ADDITIONAL NOTES / REQUIREMENTS:

1. This is a Class H1-D site, with a Y_s value of approximately 45 mm. Refer to sheet CR5-1 for corner reinforcement and lagging requirements.
2. Flexible connections for sewer and stormwater pipes are required on this site.
3. The design gust wind speed for this site has been calculated to be in the order of 40 m/s (ultimate limit state).

For and on behalf of
TMK Consulting Engineers

TONY GARREFFA
Senior Associate / Team Leader

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

1. GENERAL

1.1 This is a Construction Report giving specific recommendations for the aforementioned building. This report must be read in conjunction with all listed attachments. Changes to the design or construction must not be made without further written advice from the Engineer.

The Owner and or his / her Agent[1] will comply and procure compliance in all respects and at all times with all terms, conditions and recommendations contained in, or attached to, this Construction Report.

1.1.1 List of Possible Attachments.

CRC	- Conditions for Use of the Footing Construction Report
CR2	- Surface Soil Borehole Log
CR2-1	- Surface Borehole Location Plan
CR2-2	- Surface Soil Borehole Log Explanatory Notes
CR3	- Footing Layout Plan
CRL	- Level Plan
CRD	- Drainage Plan
CR4	- Typical Footing Details - Grillage Raft
CR5	- Typical Footing Details - Strip
CR5-1	- Typical Footing Details - Corner Reinforcement and Service Penetration
CR6	- Typical Footing Details - Steps
CR9	- Typical Footing Details – Cut and Fill Sites
CD1	- Control Joint Details in Masonry Walls & Construction Details between New & Existing Buildings
CD2	- Standard Articulation Details for Existing Walling
CD3	- Typical Details for Perimeter Paving
CD4	- Domestic-Sealed Drainage System (Pressurized)
CD5	- Flexible Service Connection Details for Class H, E Sites
CD6-1	- Reinforced Brick Arch 2. "Hesbia" Lintel
CD7	- Stormwater Soakage Pit Detail
CD8	- Earthquake Connection Detail Roof to Solid Masonry Wall
CD9	- Gravel Filled Soakage Pit Detail
CRS	- Specifications for Footings
CRG	- General Notes
SD1	- Structural Details
SDN	- General Construction Notes
FC1	- Footing Calculations
SC1	- Structural Calculations
SW1	- Stormwater Calculations
RC1	- Retaining Wall Details and Calculations
RW1	- Retaining Wall Details
RWN	- Retaining Wall Notes
R1	- Retaining Wall Details
SRW	- Sleeper Retaining Wall Details and Calculations
PT1	- Dynamic Cone Penetrometer Test
RT1	- Roof Tiedown Details
SPS	- Swimming Pool Specifications
SPG	- Swimming Pool General Notes
A1	- Appendix A, B, etc.

1.2 The details in this report contain advice designed to minimize distress to the building. It is an important document and should be kept in a safe place. It is essential that this report be supplied to subsequent owner / Agents so that they are aware of the consequences of making changes to the building, garden and adjacent areas. Without this information, they may institute changes to site management that could jeopardize the long term serviceability of the building. In addition the Owner / Agent's attention is drawn to the CSIRO BTF 18 Information Sheet entitled “Foundation Maintenance and Footing Performance: A Homeowners Guide", attached.

[1] *Agent refers to architect, builder, project manager, contractor, supervisor or any other such person that has authority to act on the Owner's behalf.*

1.3 This Construction Report has been prepared at the request of the Owner / Agent. It is a condition of the use of this report that the Owner / Agent accepts the basis on which the footing design has been prepared (refer to Clause 2) and that the Owner / Agent ensures that the Engineer is advised with sufficient notice of the time to attend each of the recommended site inspections (refer to Clause 4).

1.3.1 It is essential that the Owner / Agent reads the entire Footing Construction Report carefully as it contains important information, relating not only to the construction of the footings, but also to the obligations, liabilities and requirements for site management.

1.3.2 If the Owner / Agent requires a different type of footing to that recommended, or stiffer footings to reduce expected movement, our office must be notified prior to the commencement of construction, and advice will be provided accordingly.

1.3.3 If there are any aspects of the report that are not understood, the Owner / Agent should contact the Engineer.

1.4 The Engineer may (and the Owner hereby authorizes the Engineer to):

1.4.1 Issue instructions (including an instruction to cease construction) on behalf of the Owner to any person engaged in the construction of the building, or any part thereof, to ensure that the construction of the building is in accordance with this Construction Report and any modification thereof. If any modification as aforesaid may be likely to result in additional construction costs exceeding $3,500.00 (plus GST) the Engineer may issue an instruction to cease construction in order to obtain the approval of the Owner for such modification.

1.4.2 Make such modifications to the Construction Report as the Engineer may deem necessary during the course of construction.

1.5 The Owner shall be responsible for, and indemnify the Engineer against, all and any costs and charges and all claims and demands made for any additional costs incurred by reason of any act, requirement or instruction of the Engineer made or given pursuant to Clause 1.4.

1.6 The Engineer shall not be liable for any defect in or damage to the building arising from footing inadequacy or movement of the building, including its footing, caused by or contributed to by any breach of the terms, conditions and recommendations committed, permitted or allowed by the Owner / Agent.

1.7 Where more than one person is named as the Owner, all these terms, conditions and recommendations shall bind all such persons jointly and each such person severally, and any instruction or information given to the Engineer by any one such person shall be deemed to be given by all other such persons.

1.8 For the purposes of these conditions any builder or supervisor (and any of their respective servants or agents) engaged in the construction of the building shall be deemed to be an agent of the Owner.

2. FOOTING PERFORMANCE

2.1 The following information represents the basis on which the Construction Report has been prepared.

2.1.1 It is important for the Owner to understand that reactive clays move because of moisture changes. Even relatively stable clays will move significantly if subjected to extreme moisture changes, for example, too much or too little garden watering. It is neither possible nor economical to design for extreme changes in soil moisture conditions. The Owner is the person responsible for maintaining acceptably uniform moisture conditions on the site.

2.1.2 Generally, the footings specified in an engineered system will be reasonably economical to construct, will fully comply with all relevant building codes and industry practice and will provide acceptable levels of performance into the future.

2.1.3 The Owner should appreciate that it is impossible to design a footing system that will totally prevent structural movement, unless of course there is no limit on expenditure. Some minor aesthetic (non-structural) cracking, whilst undesirable, will occur in almost all buildings.

2.1.4 Any movement, damage, cracking, collapse or other condition which reduces the safety, aesthetics or serviceability of the structure is usually referred to as “distress”. Engineered footings are designed to reduce the risk of foundation (ie, soil or rock) movements causing distress to the structure and are not designed to completely eliminate all cracking or other distress.

2.1.5 Limits on the expected performance of engineered footings are set out in Tables C1 and C2 of AS 2870, reproduced below. While occasional Category 2 behaviour may occur, Category 0 and 1 should be the limit for most situations.

2.1.6 Masonry exhibiting crack widths of more than 5 mm (Category 3) usually perform well in practice. In most cases, the cracking of the structure only presents an aesthetic problem.

2.1.7 The generally accepted probability of Category 3 damage occurring is of the order of 5%. This equates to the probability that 1 in 20 buildings will experience a crack of 5 mm width sometime during their design life and is a community-based level of risk adopted in AS 2870. If the Owner desires a lower risk of distress, this can be achieved but at increased expense. The Owner must specifically request a lower risk design, if desired.

2.1.8 The risk of distress is affected by various environment factors. The risk levels adopted in AS 2870 are based on normal site and environmental conditions. Abnormal conditions such as leaking water or sewer pipes or a departure from the site management regime described in this report will increase the risk of significant distress occurring during the life of the building. Many of these abnormal conditions are directly under the control of the Owner.

2.1.9 Just as it is impossible to design an immovable footing system, it is almost impossible to provide remedial measures that will prevent further movements if distress does occur. Therefore, extreme remedial measures should not be undertaken for minor problems.

2.2 Ideally, the planting of trees should be avoided on reactive clay sites in order to protect the structure from possible damage. However, this is not always practicable. Therefore the planting of trees must be carried out strictly in accordance with recommendations set out elsewhere in this report.

In the case where one or more trees already exist in the vicinity of the proposed structure, the engineering design of the footings takes account of their anticipated effects by allowing for greater soil movements than would be expected if the tree or trees were not present.

The Owner should understand that, because the effects of trees and their roots on a structure cannot be predicted precisely due to the complex geometry of tree roots and the variability inherent in the soil material, some level of structural movement must be expected due to the presence of trees.

2.4 When additions are made to an existing building, special considerations will apply. The footings of the existing building and the footings of the addition are always separate structures. Even though some connection may be made between the footings, the footings will move differentially, meaning that cracking may occur at the junction of the two footings and control joints will open and / or close. The presence of the addition should not be expected to stabilize any pre-existing movements in the existing building.

2.5 The attachment of floor surfacing to concrete slabs that have not fully dried can cause problems due to moisture reactions with glues or normal concrete shrinkage. Drying times vary and up to 6 months may be required. Concrete shrinks as it dries resulting in some cracking, often of the order of 1 mm width. This has little effect on structural performance of the slab but could affect some brittle floor coverings if installed too soon (Refer to CRS Clause 3.8).

TABLE C1 (AS 2870): CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

DESCRIPTION OF TYPICAL DAMAGE AND REQUIRED REPAIR	APPROXIMATE CRACK WIDTH LIMIT (see Note 3)	DAMAGE CATEGORY
Hairline cracks.	< 0.1 mm	0
Fine cracks which do not need repair.	< 1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	< 5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weather tightness often impaired.	5 mm to 15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably with some loss of bearing in beams. Service pipes disrupted.	15 mm to 25 mm but also depends on number of cracks	4

TABLE C2 (AS 2870): CLASSIFICATION OF DAMAGE WITH REFERENCE TO CONCRETE FLOORS

DESCRIPTION OF TYPICAL DAMAGE	APPROXIMATE CRACK WIDTH LIMIT IN FLOOR	CHANGE IN OFFSET FROM A 3 m STRAIGHT EDGE CENTERED OVER DEFECT (see Note 6)	DAMAGE CATEGORY
Hairline cracks, insignificant movement of slab from level.	< 0.3 mm	< 8 mm	0
Fine but noticeable cracks. Slab reasonably level.	< 1.0 mm	< 10 mm	1
Distinct cracks. Slabs noticeably curved or changed in level.	< 2.0 mm	< 15 mm	2
Wide cracks. Obvious curvature or change in level.	2 mm to 4 mm	15 mm to 25 mm	3
Gaps in slab. Disturbing curvature or change in level.	4 mm to 10 mm	> 25 mm	4

NOTES:

1. Crack width is the main factor by which damage to walls is categorized. The width may be supplemented by other factors, including serviceability, in assessing category of damage.
2. In assessing the degree of damage, account shall be taken of the location in the building or structure where it occurs, and also of the function of the building or structure.
3. Where the cracking occurs in easily repaired plasterboard or similar clad-framed partitions, the crack width limits may be increased by 50% for each damage category.
4. Local deviation of slope, from the horizontal or vertical, or more than 1/100 will normally be clearly visible. Overall deviations in excess of 1/150 are undesirable.
5. Account should be taken of the past history of damage in order to assess whether it is stable or likely to increase.
6. The straight edge is centered over the defect, usually, and supported at its ends by equal height spacers. The change in offset is then measured relative to the straight edge.

3. SOIL BOREHOLE LOGS

3.1 The soil profiles as indicated by the test bores, form the basis of the footing recommendations. The soil profile is only particular to the test location and the soil samples obtained may not disclose all the soil variations on the site.

3.2 Assessment of subsurface soils apart from the determination of the 'soil heave' value, is excluded from our scope.

3.3 It is not economically possible or practical to determine every subsurface feature on a site. Because of this any variations or discrepancies in soil type, colour, or horizon depth, as compared to the test bores shall be referred to the Engineer immediately. One must not place sole reliance on the surface soil borehole logs as a means of being an absolute representation of all sub-surface features existing on the site. Nor can the density and difficulty of excavation be estimated by interpretation of the surface soil borehole logs.

3.4 The footings have been selected on the basis of the recognized characteristics of the soil profile. Unless otherwise stated, these characteristics have been visually assessed and related to known performance of the soils under normally-expected conditions of site development and use. It has been assumed that aspects of site drainage, paving and landscaping which are described in the report have been, or will be, implemented. Where any or all of these aspects do not form part of the building contract, it is a mandatory requirement that they be carried out within a period of 4 months from date of completion of the building provided always that adequate temporary stormwater drainage is installed.

4. SITE INSPECTIONS

4.1 General

Inspections specifically exclude particular architectural details, the checking of levels, layout dimensions, squareness and relationship to site boundaries.

4.1.1 The Owner / Agent shall ensure that the Engineer is advised at least 1 full working day in advance of the time to attend each of the inspections, and shall ensure that construction of the building is not allowed to proceed beyond any stage at which an inspection is required, unless the Engineer has approved the work at that stage.

4.1.2 The Owner / Agent shall ensure that any work request given by the Engineer is undertaken.

4.1.3 Site inspections have not been included in the initial design fees, and hence will incur additional fees.

The inspections listed below are strongly recommended. It is stressed that incorrect construction, detected at a later stage, may result in increased costs for remedial work.

4.2 Stages for Inspections

4.2.1 Prior to the commencement of earthworks to determine the impact of such works on adjacent structures.

4.2.2 Upon completion of primary earthworks, where the depth of excavation and/or filling exceeds 600 mm. Alternatively, this inspection may be carried out at the same time as Clause 4.2.3 provided the Owner / Agent accepts the consequences of any changes to the footing construction that may be required as a result of the primary earthworks. The inspection shall be limited to a visual assessment of the earthworks and any approval shall be conditional upon the Owner / Agent completing the final earthworks to the correct levels and slopes at a later stage. Where the Engineer considers that additional testing or investigation is required as a result of the earthworks, work shall not proceed until the additional services have been completed. Any such additional testing, investigation and reporting shall incur additional fees.

4.2.3 After completion of excavation for footings and prior to the placement of any vapour barrier (if required) or reinforcement. Where footing construction is staged, an inspection must be carried out at each stage.

4.2.4 After placement of the reinforcement prior to pouring any concrete. It shall remain the Owner / Agent's responsibility to ensure that the correct cover to reinforcement, concrete quality and quality of workmanship are maintained, vapour barriers are not punctured, and that the concrete is finished to the correct levels.

4.2.5 After completion of excavation for main sewers to ensure that the trenches, as constructed, do not affect the footing as designed. Checking sewers for compliance with the requirements of statutory authorities is excluded. This inspection is only required when the depth of any sewer trench exceeds the distance from the trench to the building. This does not apply to trenches up to 1000 mm deep running perpendicular to the building.

4.2.6 After completion of brickwork or similar to ensure that the articulation joints have been placed at the specified locations. Checking construction details which are not visible is excluded and no responsibility is taken for any problem arising from such.

4.2.7 Upon completion of the installation of paving, stormwater drains, pipes and structures. The checking of sections which are not visible is excluded and no responsibility is taken for any problem arising from such sections. Maintenance of ground slopes to ensure continued proper drainage will be required subsequent to the inspection, and shall remain the Owner / Agent's responsibility. If inspection Clause 4.2.6 has not been carried out, any control joints will be checked at this stage. The work must have been completed, and inspected, within 4 months of the date of practical completion.

5. TERMS OF ENGAGEMENT

All work will be carried out in accordance with TMK's 'Terms and Conditions of Engagement for Consulting Services'.

STS TECHNICAL SERVICES
Soil Sampling and Logging * Engineering Level Surveys
Percolation Tests * Environmental Soil Sampling * Ground Water Wells
STS Technical Services, 8 Duncan Road, Dry Creek SA 5094
Telephone 08 8262 9580 - Facsimile 08 8262 9579
email: stssa@stssa.com.au ABN 68 007 952 203

SURFACE BOREHOLE LOG	DATE: 01/03/2017 JOB NO: 1702160 STS REF:	CR2 1 OF 1
DATE DRILLED: 28/02/2017	TO BE READ IN CONJUNCTION WITH CR2-1 & CR2-2	
SITE: 168 PROSPECT ROAD PROSPECT		

DEPTH IN METRES			VISUAL ASSESSMENT OF PROPERTIES						
BORE 1	BORE 2	BORE 3	COLOUR	CONSISTENCY, TEXTURE & STRUCTURE	SOIL DESCRIPTION	U.S.C.	M.C.	BEARING	EST lps (AVE)
0.00 - 0.30	0.00 - 0.30	0.00 - 0.30	Brown	Loose, Granular	Clayey SAND with Thin Roots VLP	SC	B	M	0.005
0.30 - 0.80	0.30 - 0.60	0.30 - 0.70	Red Brown	Friable, Granular	Sandy CLAY LMP	CL	B	M	0.015
0.80 - 1.90	0.60 - 1.00	0.70 - 1.60	Cream Brown	Loose - Friable, Granular	Highly Calcareous Silty, Sandy Clayey Limey LP	CL-GC	B/N	M*	0.010
1.90 - 2.40	1.00 - 1.50	1.60 - 2.25	Cream Brown	Friable, Granular	Sandy CLAY, Limey LMP	CL	N/A	M	0.015
2.40 - 3.10	1.50 - 2.20	2.25 - 2.50	Cream Brown	Firm, Granular	Sandy CLAY, Limey with Calcrete Nodules MP	CL-GC	A	M*	0.020
3.10 - 3.60	2.20 - 3.00	2.50 - 3.20	Red Brown	Hard, Granular	Sandy CLAY HP	CH	B/N	M	0.035
3.60 - 4.40	3.00 - 4.20	3.20 - 4.40	Red, Grey, Brown	Stiff, Granular	Sandy CLAY HP	CH	B	M	0.045
4.40 - 5.00	4.20 - 5.00	4.40 - 5.00	Khaki Brown	Very Stiff Granular Blocky	CLAY VHP	CH	B	M	0.060

REMARKS	CLASSIFICATION: H1-D	TYPE: BS	CLASSIFIER: TMK

1 The classification nominated on this borehole log relates to the site soil profile at the time of testing. It does not allow for future earthworks and does not incorporate any possible effects from trees, either existing or future.
2 The calcareous clay soils present within the soil profile may lose strength upon wetting. Adequate site drainage is essential.
3 The soil profile possesses a HIGH potential of surface movement (swelling and shrinking due to soil moisture variations).

REFERENCES USED:

SOIL MAPS: Soil Association Map of the Adelaide Region

NEARBY BORELOGS:

SAMPLE METHOD: Driven push tube using high pressure hydraulic hand-held hammer

Drilled & Logged By: STS Technical Services **Checked By:** VENKY

K:\2017\02\1702160\Issue\Ready for Issue\1702160_CR2.PDF

JOB NO: 1702160

TAT:

DATE: 28/2

DUE DATE:

TECHNICAL SERVICES

Soil Sampling and Logging *Engineering Level Surveys
Percolation Tests * Environmental Soil Sampling * Groundwater Wells

AGENT: Studio Nine Architects

OWNER:

SOIL / PERCOLATION / PENETROMETER:

PLANS: YES / NO

SITE LOCATION: 168 Prospect Road
Prospect

NO. & DEPTH OF BORES REQUESTED: 3-5m

CR2-1

DRILLER'S NOTES

Drillers Initials: TB & CJ Date Drilled: 28/2 Tick and /or make notes

GROUND SURFACE	Surface Moisture Content	✓ Dry	☐ Moist	☐ Wet	
Show location on	Surface Vegetation	✓ Grass	✓ Trees	✓ Gravel	
Plan if relevant	Surface Cracks	☐ Yes	✓ No		
	Surface Soil Strength	☐ Soft	☐ Loose	✓ Firm	☐ Hard

UNUSUAL FEATURES	Heap / even Filling	☐ Yes	✓ No
	Rock Outcrops	☐ Yes	✓ No
	Pits / Cellar / Underground Tank	☐ Yes	✓ No
	Excavations	☐ Yes	✓ No
	Drainage Channels	☐ Yes	✓ No
	Trees	✓ Yes	☐ No
	Cracks in existing Structures	☐ Yes	✓ No
	Other (Specify)	☐ Yes	✓ No

SLOPE (Show on Plan) Level ..... Fall Approx. .5m

WATER TABLE Water Struck ☐ Yes ✓ No

Depth of Water Table on Completion of Drilling

Bore No	1	2	3	4	5	6	7	8	9	10	11	12
Depth												

BOREHOLE INFORMATION

		1	2	3	4	5	6	7	8	9	10	11	12
Overall Resistance	Low												
	Medium	✓	✓	✓									
	High												
Bottom Resistance	Low												
	Medium	✓	✓	✓									
	High												
Depth Drilled (in meters)		5	5	5									
Core Recovery	100%	✓	✓	x									
	Stretched	500	750										
	Core Loss			250									

Auger

Comment:

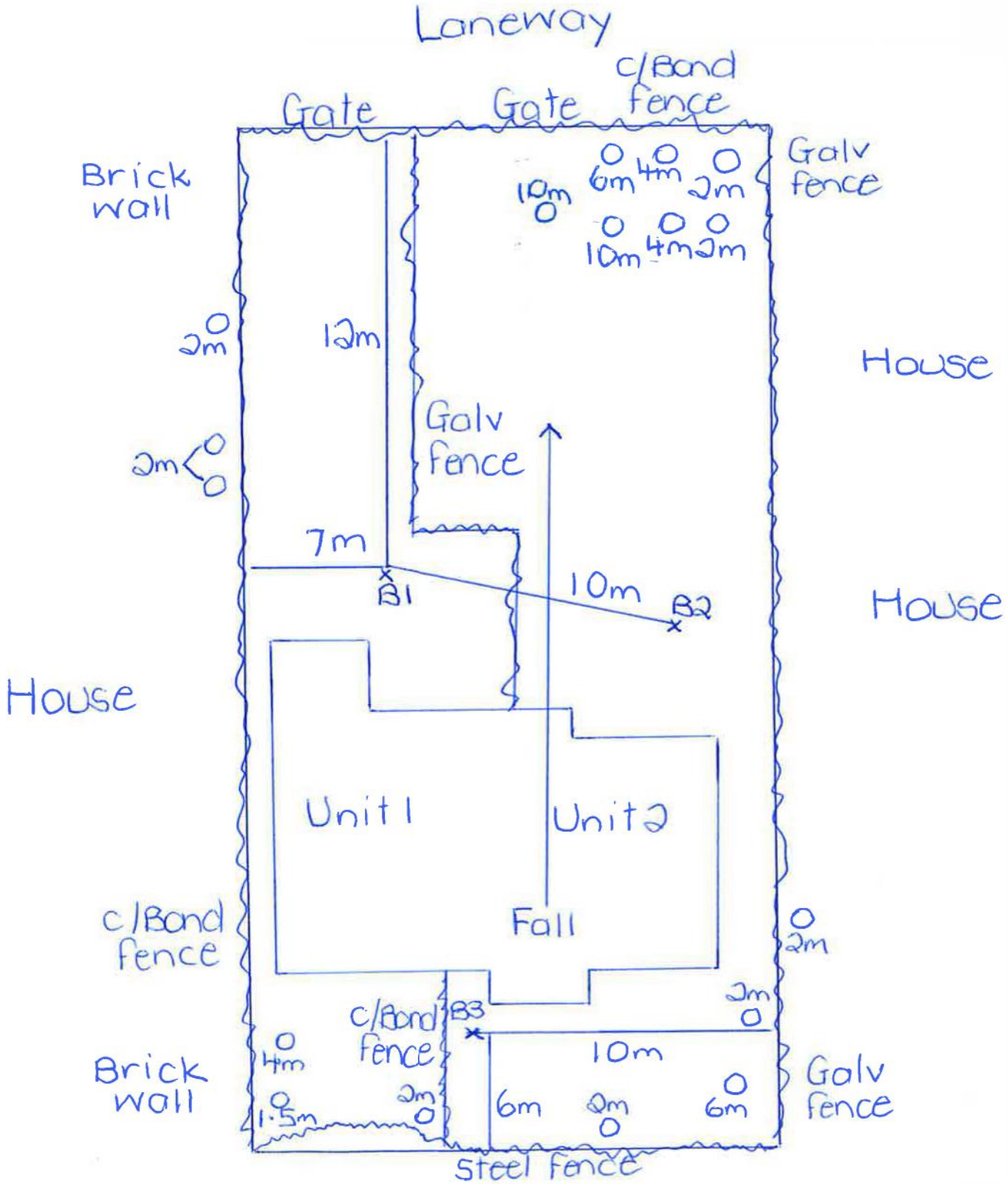
B3: Only 250mm sample from 5m pipe

STS Technical Services, 8 Duncan Road, Dry Creek S.A. 5094
Tel: 08 8262 9580 / 08 8262 4755 Fax: 08 8262 9579
Email: stssa@stssa.com.au Web: www.stssa.com.au

REF NO: 1702160

TECHNICAL SERVICES

Soil Sampling and Logging *Engineering Level Surveys
Percolation Tests *Environmental Soil Sampling *Ground Water Wells



STS Technical Services, 8 Duncan Road, Dry Creek, S.A. 5094
Tel: 08 8262 9580 / 08 8262 4755 Fax: 08 8262 9579
Email: stssa@stssa.com.au Web: www.stssa.com.au

STS
8 Duncan Road Dry Creek SA 5094

Tel: 08 8262 4755 · Fax: 08 8262 9579
Email: sts_soils@stssa.com.au

SURFACE SOIL BOREHOLE LOG EXPLANATORY NOTES (CR2-2)

1. GENERAL

The surface soil borehole log is based on visual-tactile logging of the drilled core. The soil characteristics are generally estimated, however samples from 1 in 50 sites are subjected to shrink-swell tests conducted by a NATA accredited laboratory to verify estimated values.

One must not place sole reliance on the surface soil borehole logs as a means of being an absolute representation of all sub-surface features existing on the site. Nor can the density and difficulty of excavation be estimated by interpretation of the surface soil borehole log.

The soil borehole logs are usually based upon 40 mm diameter continuous core samples in one or more locations on the site in accordance with AS 2870 *Residential slabs and footings*. It is not possible by this means to detect all subsurface features which may exist and the Owner is advised to seek information from Local Council, Department of Health and other statutory Authorities regarding any unnatural features (e.g. wells, mineshafts, filled areas etc) land use (e.g. toxic waste, waste disposal etc), or other features typical to the area (e.g. landslip, springs etc).

This office uses not only the borehole log information but may take into account such matters as the known geology of the area taken from published soil maps, the known performance of existing structures in the general area and engineering judgment to make an assessment of soil classification for design purposes.

2. UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines.
	GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.
	GC	Clayey gravels, gravel-sand-clay mixtures.
Clean sands	SW	Well graded sands and gravelly sands, little or no fines.
	SP	Poorly graded sands and gravelly sands, little or no fines.
Sands with Fines	SM	Silty sands, sand-silt mixtures.
	SC	Clayey sands, sand-clay mixtures.
Silts and Clays (Liquid Limit <50%)	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.
	CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays.
	OL	Organic silts and organic silty clays of low plasticity.
Silts and Clays (Liquid Limit >50%)	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.
	CH	Inorganic clays or high plasticity, fat clays.
	OH	Organic clays of medium to high plasticity.
Highly Organic Soils	Pt	Peat, muck, and other highly organic soils.

3. MOISTURE CONTENT relative to the Plastic Limit (PL) of the soil for cohesive soils or relative to the optimum moisture content of the soil (OMC) for cohesionless soils, i.e. non plastic.

WB	Well below
B	Below
N	Near
A	Above
WA	Well above

4. BEARING STRENGTH

The descriptive term used relates to the in-situ strength at the time of logging.

It must be noted that site works and changes in soil moisture may significantly affect the bearing strength. It must also be noted that as the soils are disturbed in the drilling and sampling process the bearing strength in-situ may be different from that logged.

Term	Description	Allowable Bearing Capacity (kPa)
VL	Very low (loose granular material or soft, possibly collapsing soil)	< 50
L	Low (firm)	50 to 100
M	Medium (stiff)	100 to 200
H	High (very stiff to hard)	> 200

5. SITE CLASSIFICATION BASED ON SITE REACTIVITY

Class	Foundation	Character
A	Most sand and rock sites with little or no ground movement from moisture changes	Stable
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes	Reactive
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes	
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes	
A	Sand	Controlled Fill
A to P	Material other than sand	
P	Mine subsidence Uncontrolled fill Landslip Soft Collapsing soils	Problem

Note: For sites with deep seated moisture changes characteristic of dry climates and corresponding to a design depth of suction change equal to or greater than 4 m, the classification shall be M-D, H1-D, H2-D, H2-D or E-D as appropriate. For example, M represents a moderately reactive site with shallow moisture changes and M-D represents a moderately reactive site with deep moisture changes.

6. PLASTICITY

NP Non plastic.
VLP Very low plasticity.
LP Low plasticity.
MP Medium plasticity.
HP High plasticity.
VHP Very high plasticity.

7. REACTIVITY

The reactivity of the soil is defined as the potential for undergoing changes in volume with changes in the soil moisture content.

The reactivity is measured in terms of Shrinkage Index (I_{ps}).

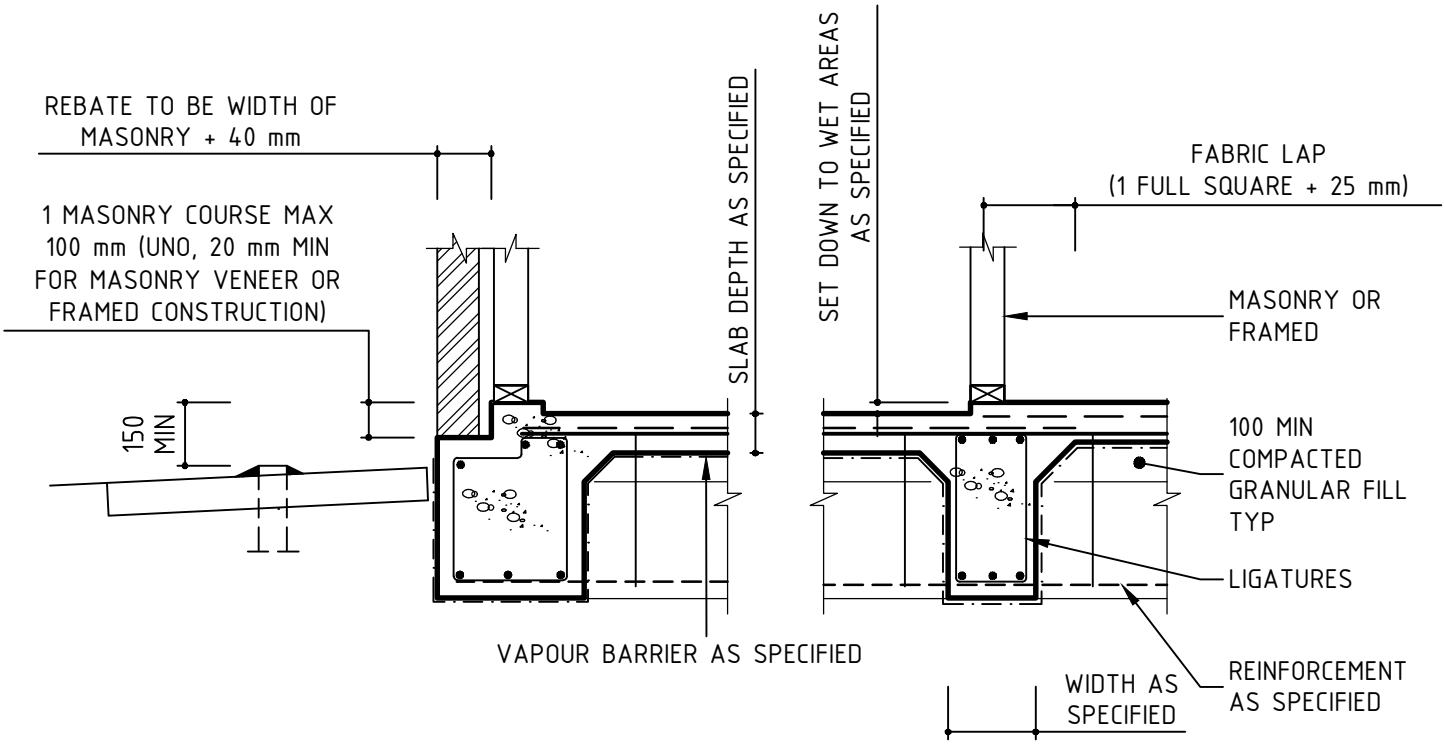
Term	Description	Shrinkage Index (I_{ps})
VL	Very low	0.5% or less
L	Low	1%
M	Medium	2%
H	High	3% to 4%
VH	Very high	4.5% or greater

Characteristic surface movement (y_s) mm	Site classification in accordance with Table 2.3 AS2870-2011
$0 < y_s \leq 20$	S
$20 < y_s \leq 40$	M
$40 < y_s \leq 60$	H1
$60 < y_s \leq 75$	H2
$y_s > 75$	E

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

RAFT FOOTING DETAIL (CR4)

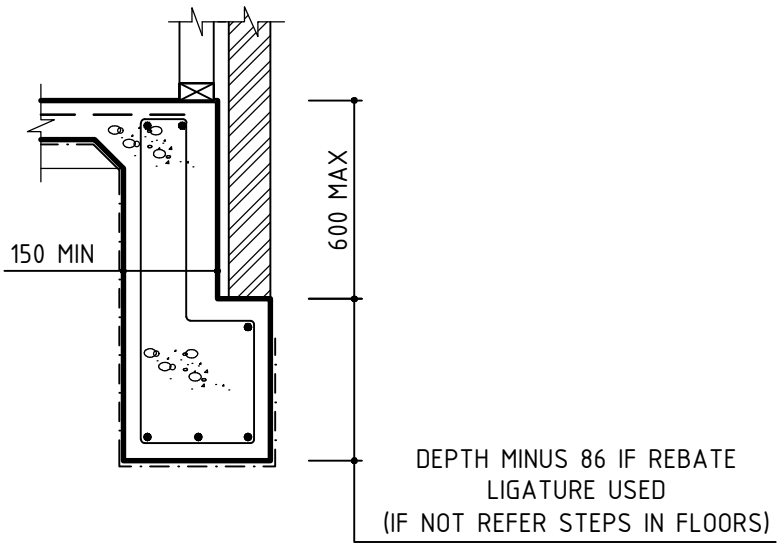
NOT TO SCALE



TYPE E TYPE M

NOTES:

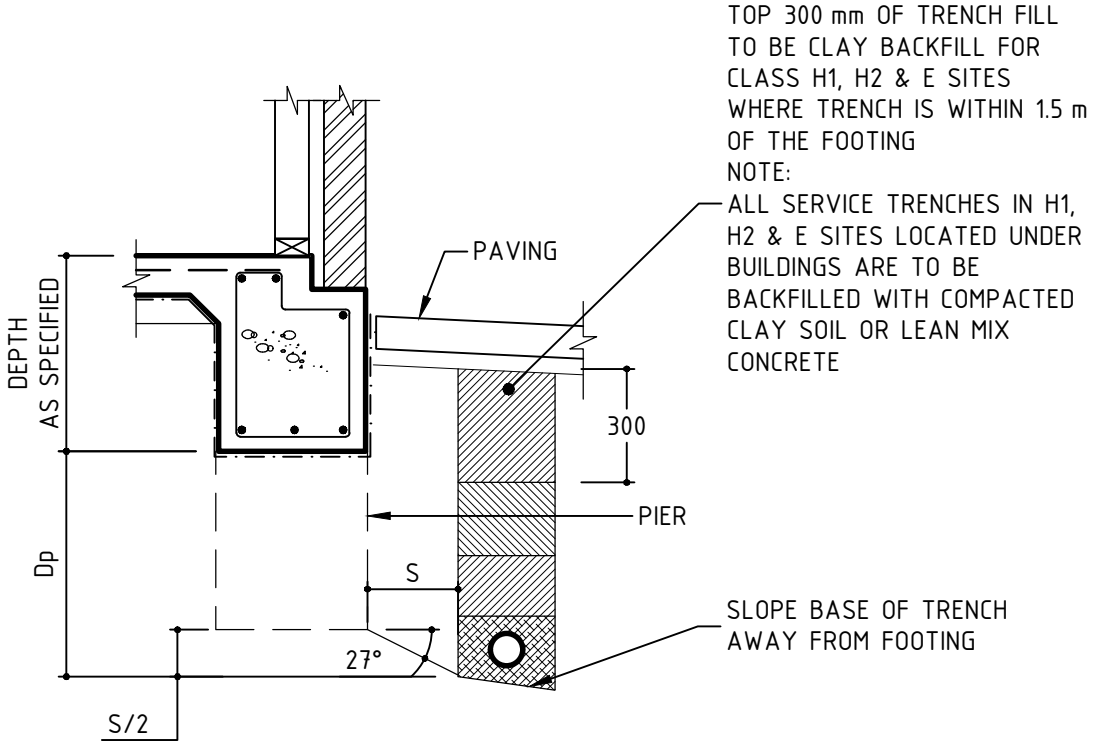
1. WHEN DEPTH OF FOOTING BEAM EXCEEDS 800 mm CARRY VAPOUR BARRIER DOWN SIDES ONLY



DEEP EDGE REBATE

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

NOT TO SCALE



FOOTING REQUIREMENTS ADJACENT TO PIPE TRENCHES

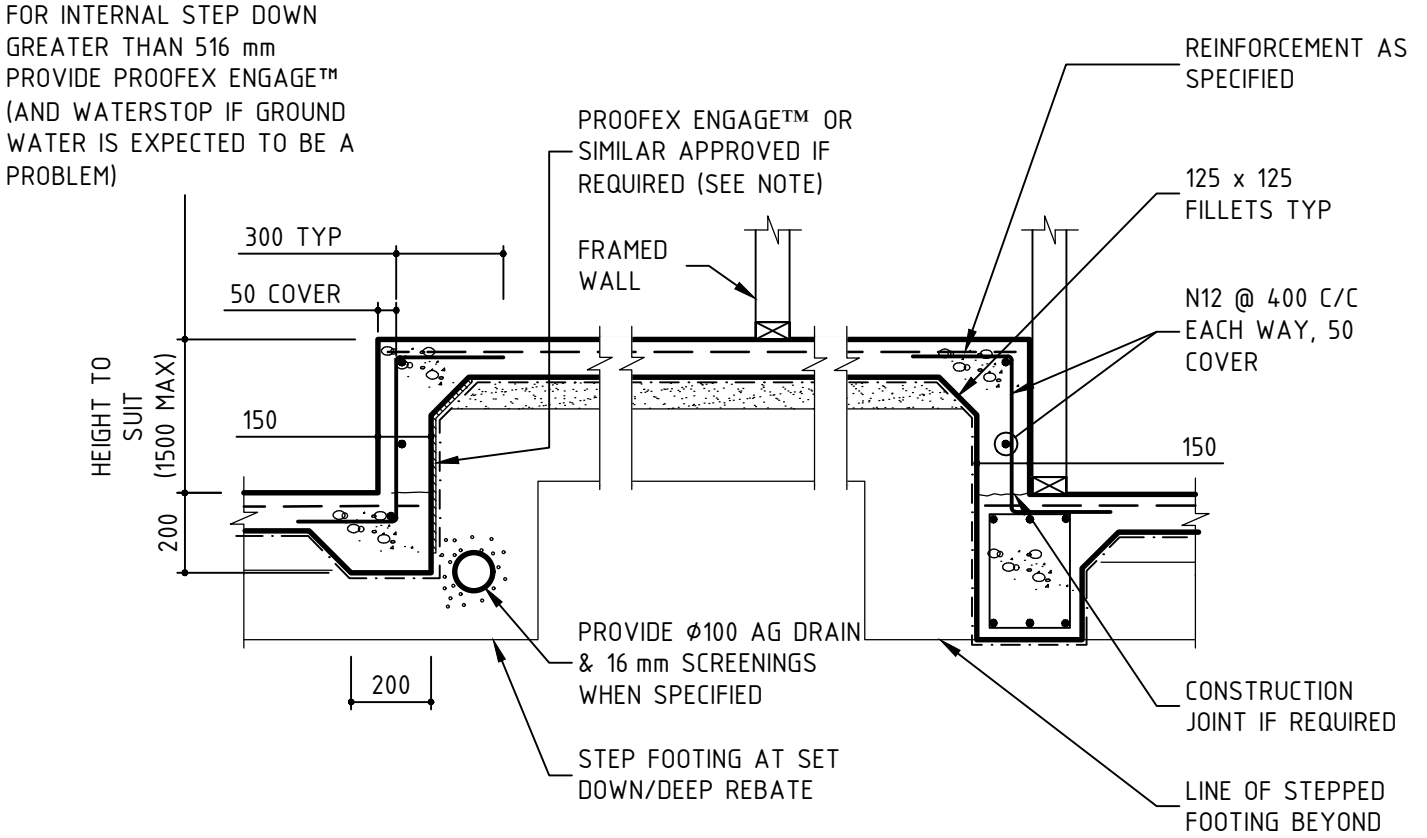
NOTES:

1. WHEN THE DEPTH Dp IS GREATER THAN THE DISTANCE S/2, PROVIDE A MINIMUM OF 1000 LONG UNREINFORCED CONCRETE PIERS THE SAME WIDTH AS THE FOOTING BEAM AT MAXIMUM 3000 C/C TO THE DEPTH SHOWN
2. THE LIGATURE SPACING IN THE FOOTING BEAMS MUST BE REDUCED TO 300 C/C WHEN PROVIDING PIERS
3. ALTERNATIVELY: BACKFILL THE TRENCH WITH A GRANULAR MATERIAL (NON CLAY) IN LAYERS NOT EXCEEDING 150 mm EACH LAYER IS TO BE COMPACTED TO A DENSITY OF 95% IN ACCORDANCE WITH AS 1289 5.2.1 MODIFIED COMPACTION

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

RAFT FOOTING DETAILS (CR4)

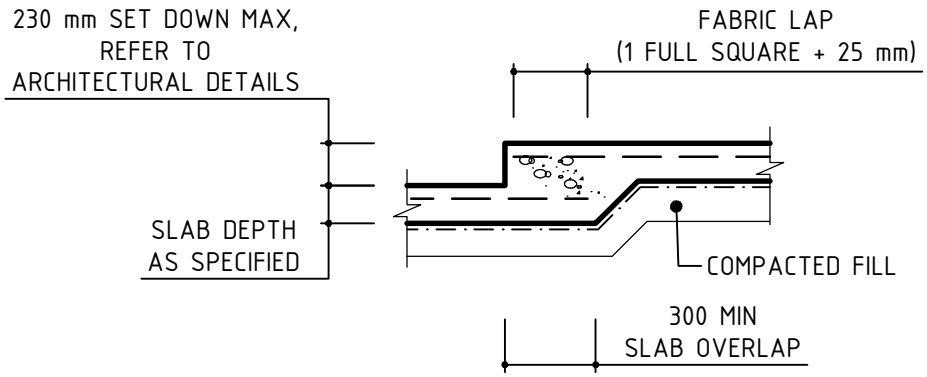
NOT TO SCALE



STEPS IN FLOORS (GREATER THAN 230 mm)

NOTES:

1. WHEN DEPTH OF FOOTING BEAM EXCEEDS 800 mm CARRY VAPOUR BARRIER DOWN SIDES ONLY

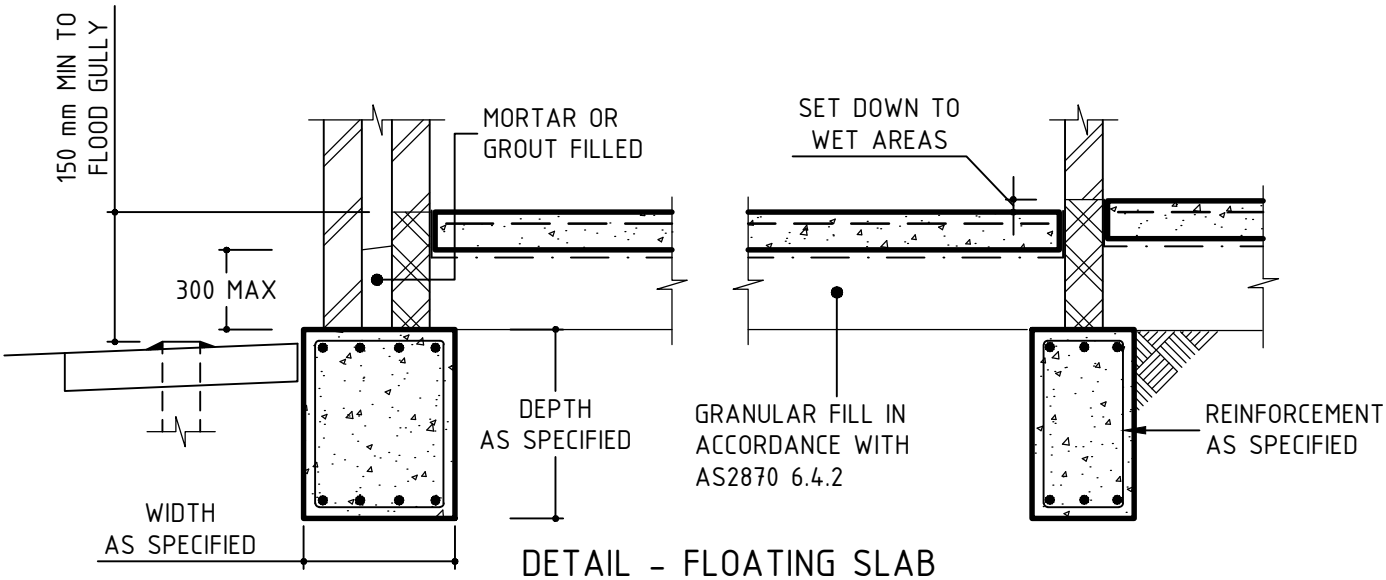


STEPS IN FLOORS (LESS THAN 230 mm)

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

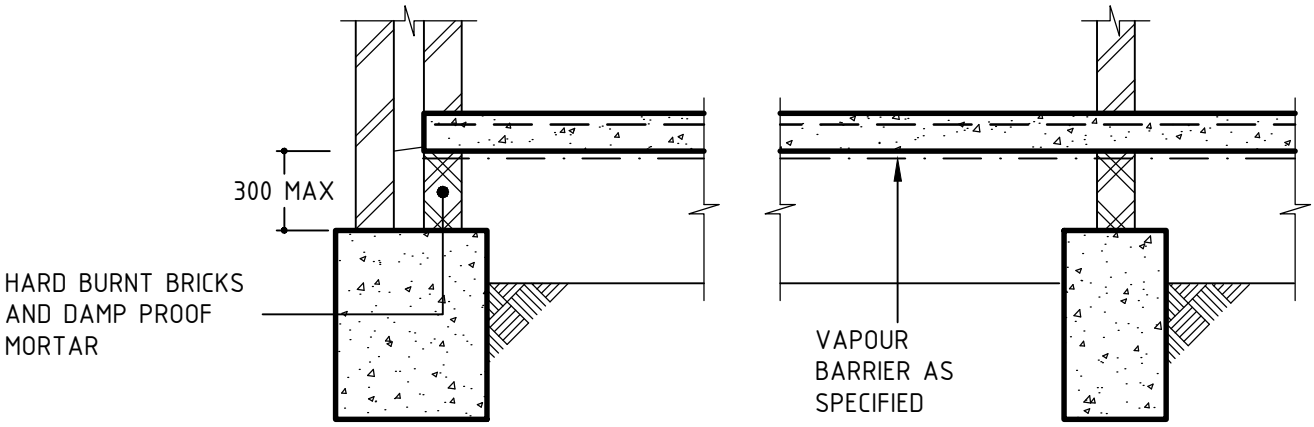
STRIP FOOTING DETAILS (CR5)

NOT TO SCALE



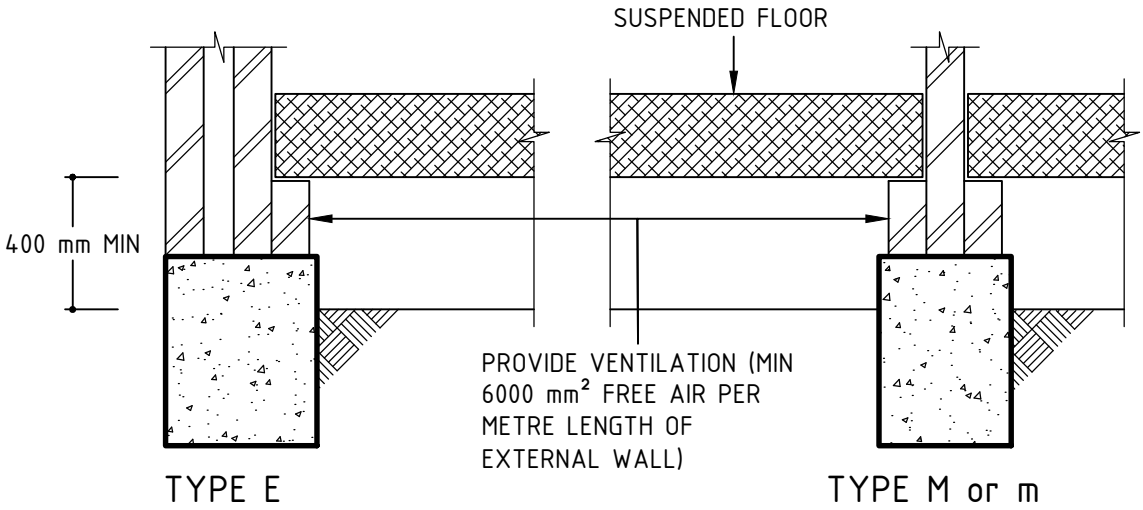
DETAIL - FLOATING SLAB

(CLASS A & S SITES ONLY)



DETAIL - SLAB POURED AFTER BRICK BUILD UP

(CLASS A & S SITES ONLY)

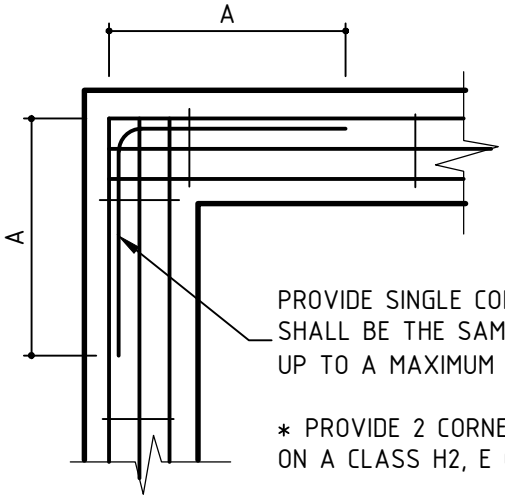


DETAIL - SUSPENDED FLOOR

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

CORNER REINFORCEMENT AND SERVICE PIPE PENETRATION FOOTING DETAIL (CR5-1)

NOT TO SCALE

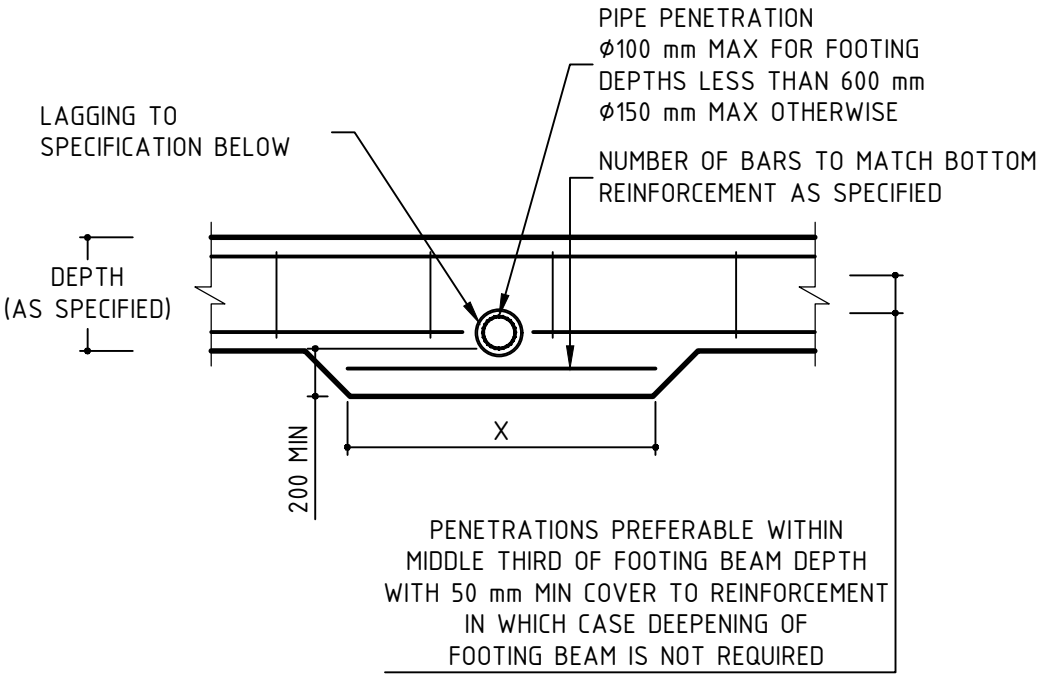


CORNER BAR LAP LENGTHS	
MAIN FOOTING REINF SIZE	DIMENSION A, mm
N12, N16, N20	500 MIN
N24, N28, N32	1000 MIN

PROVIDE SINGLE CORNER BAR TOP AND BOTTOM* (LAP BAR SIZE SHALL BE THE SAME AS THE MAIN REINFORCEMENT IN THE FOOTING UP TO A MAXIMUM OF N24)

* PROVIDE 2 CORNER BARS TOP AND BOTTOM FOR STRIP FOOTINGS ON A CLASS H2, E OR P SITE

ADDITIONAL CORNER REINFORCEMENT



LAP BAR IN DEEPENED FOOTING	
LAP BAR LENGTH X, mm	MAIN (& LAP) BAR REINF SIZE
1200	N12
1700	N16
2200	N20
3100	N24

SERVICE PIPE LAGGING	
SITE SOIL CLASSIFICATION	CLOSED CELL POLYETHYLENE LAGGING THICKNESS, mm
S	20**
M, H1	20
H2, E, P	40

** NEED NOT BE CLOSED CELL

FOOTING SERVICE PIPE PENETRATION DETAIL

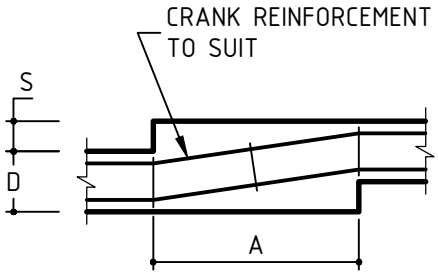
NOTE:
FOOTING PENETRATIONS NOT COVERED BY THE ABOVE ARE NOT PERMITTED WITHOUT SPECIFIC ADVICE & APPROVAL FROM THIS OFFICE

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

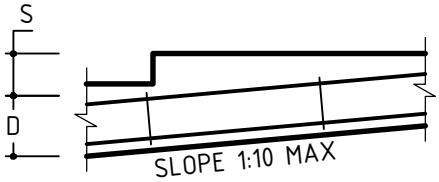
STEP FOOTING DETAILS (CR6)

NOT TO SCALE

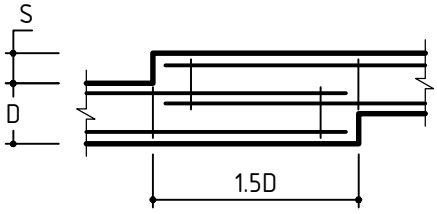
STEP LENGTH	
MAX STEP HEIGHT S, mm	DIMENSION A, mm
100 (1 COURSE)	600
200 (2 COURSES)	1200



OPTION 1

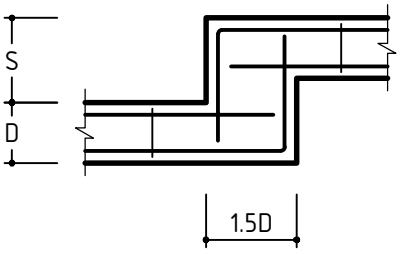


OPTION 2

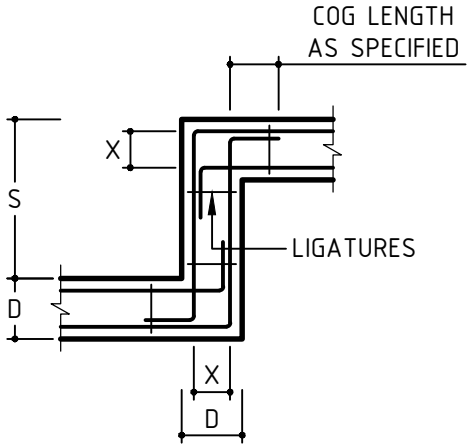


OPTION 3

STEP 'S' FOR 2 MASONRY COURSES (200 mm OR LESS)



STEP 'S' GREATER THAN 200, AND LESS THAN '2D'



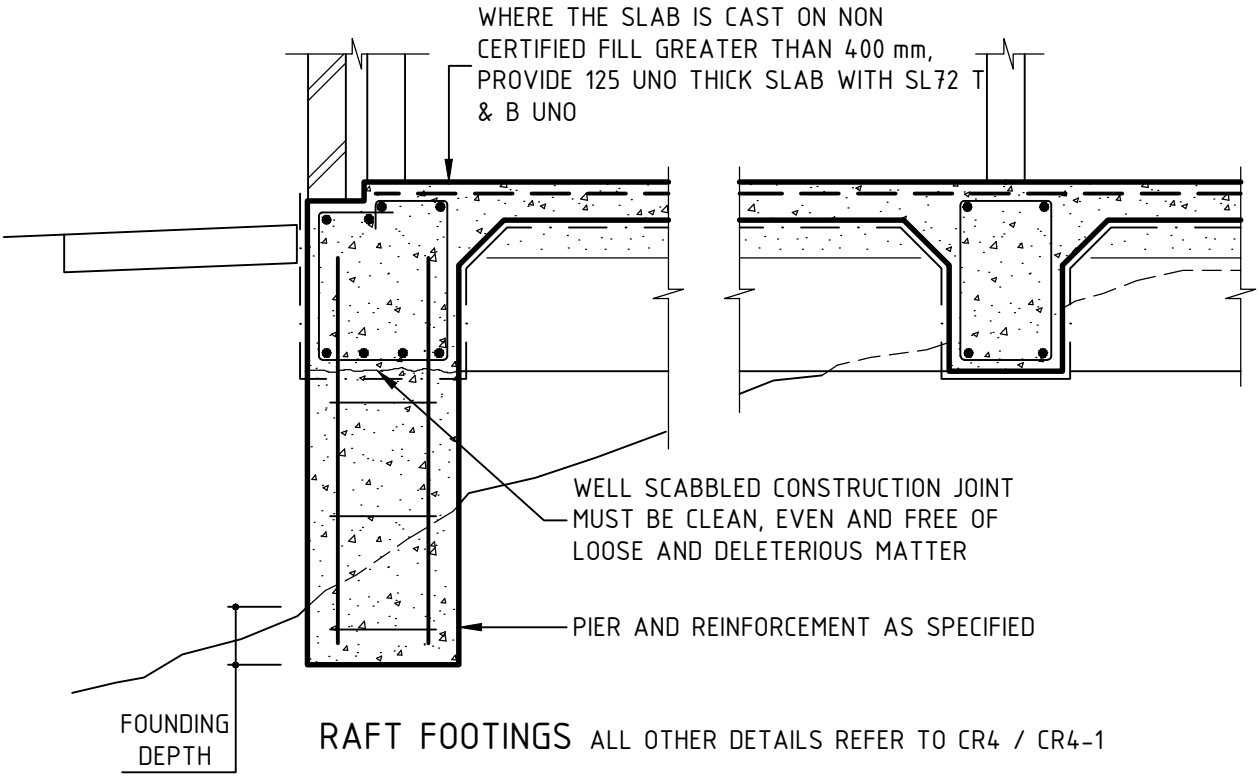
STEP 'S' GREATER THAN '2D' (DROP PIER)

COGS MAY BE OMITTED IF 'X' IS GREATER THAN OR EQUAL TO SPECIFIED COG LENGTH

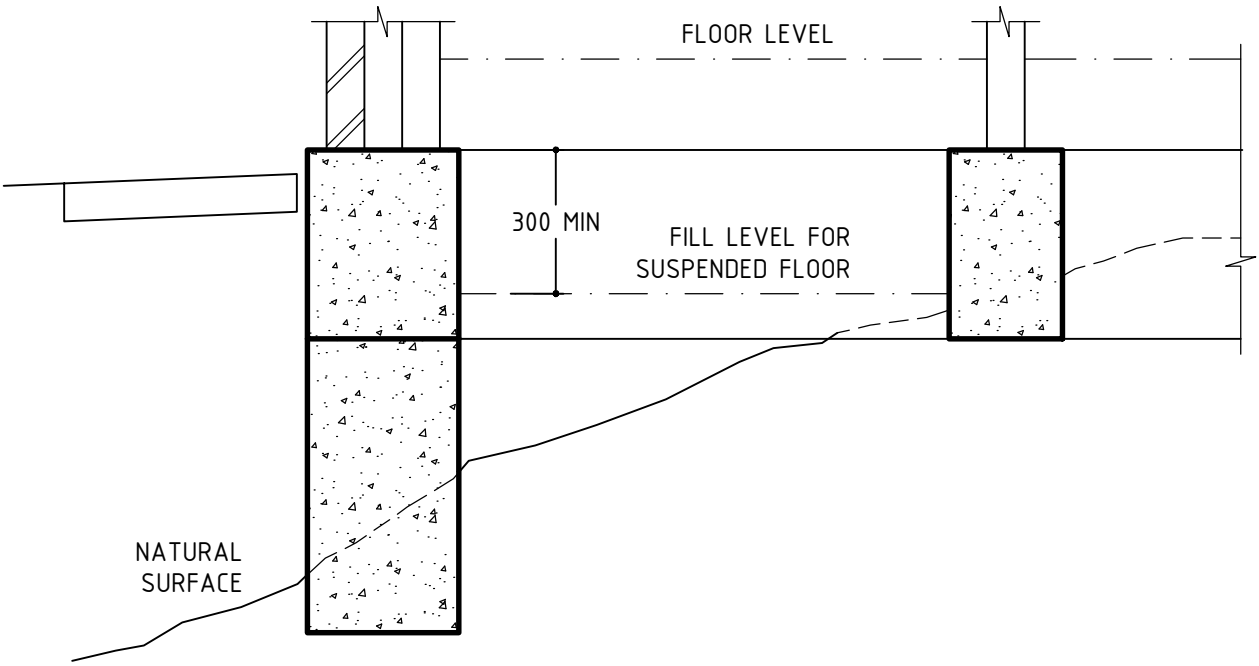
TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

CUT AND FILL SITES FOOTING DETAIL (CR9)

NOT TO SCALE



RAFT FOOTINGS ALL OTHER DETAILS REFER TO CR4 / CR4-1



STRIP FOOTINGS ALL OTHER DETAILS REFER TO CR5

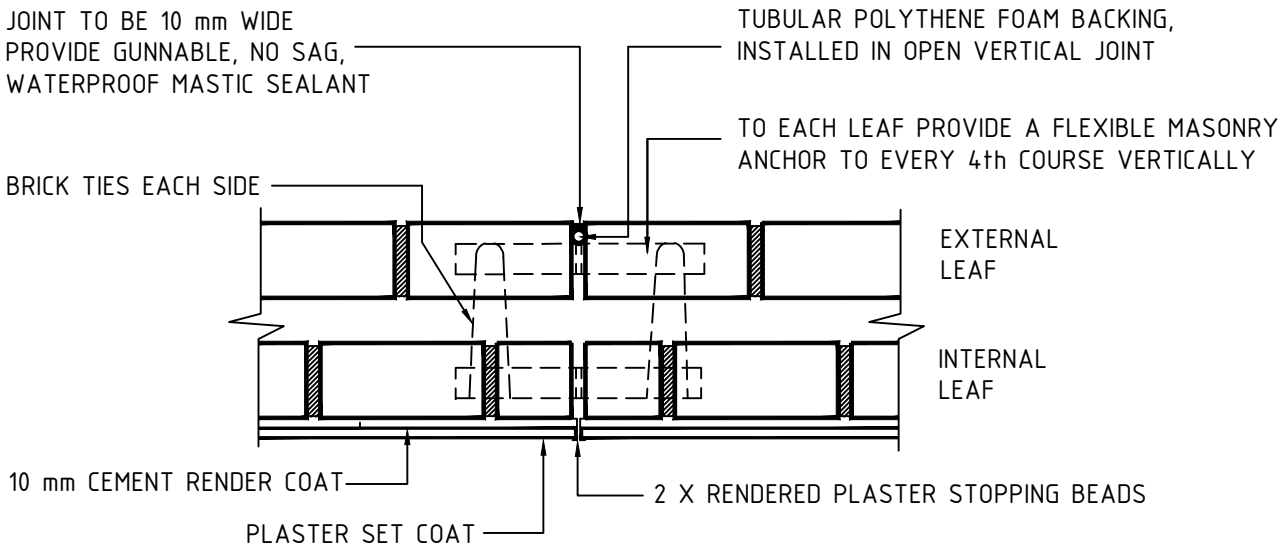
NOTES:

1. TRENCHED / BORED PIERS GREATER THAN 1000 DEEP BELOW FOOTING LEVEL TO BE POURED AT LEAST 24 HOURS PRIOR TO MAIN POUR.
2. TRENCHED / BORED PIERS GREATER THAN 1.0 m DEEP TO BE REINFORCED WITH 6-N12 VERTICAL BARS (UNO).
3. LIGATURE SPACING TO BE REDUCED TO 300 C/C BETWEEN PIERS (UNO).

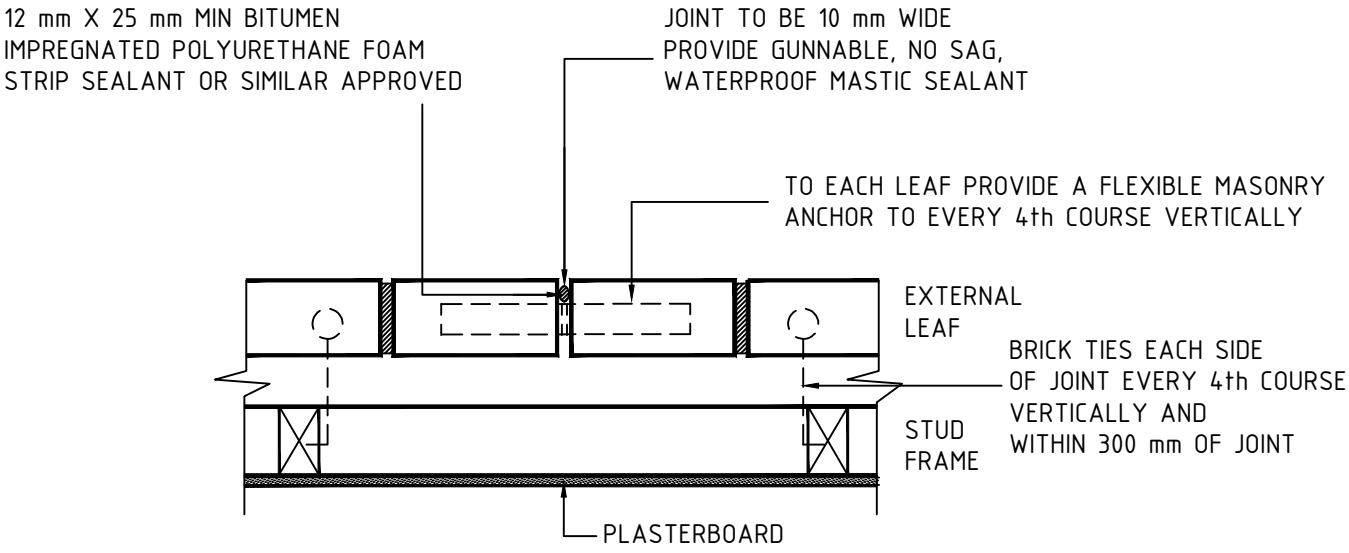
TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

CONTROL JOINT DETAIL IN WALLING (CD1)

NOT TO SCALE



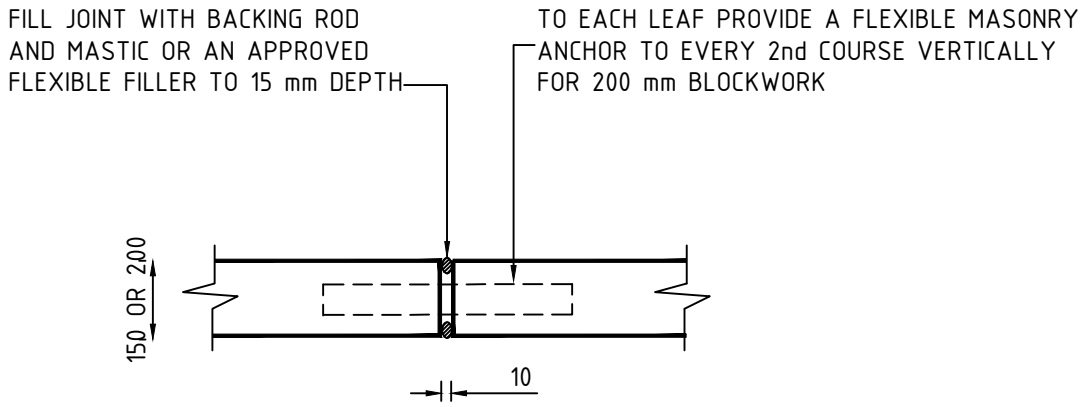
DETAIL 1: CAVITY SOLID MASONRY CONSTRUCTION



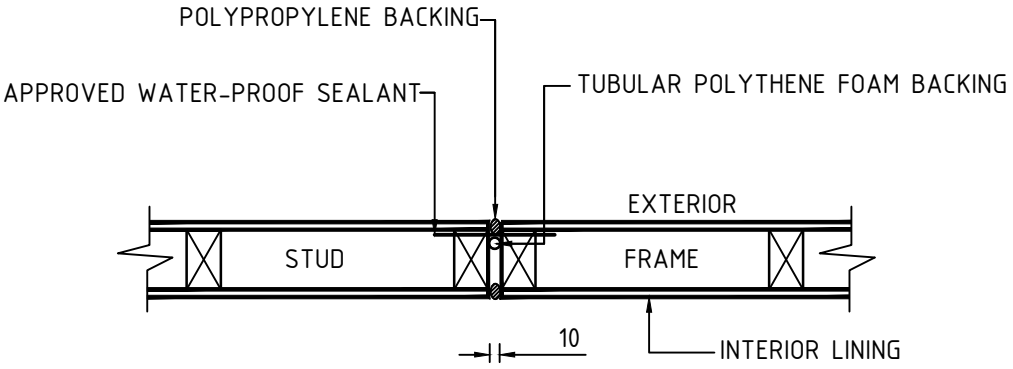
DETAIL 2: MASONRY VENEER CONSTRUCTION

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

NOT TO SCALE



DETAIL 3: CONTROL JOINT DETAIL IN AAC BLOCK WALL

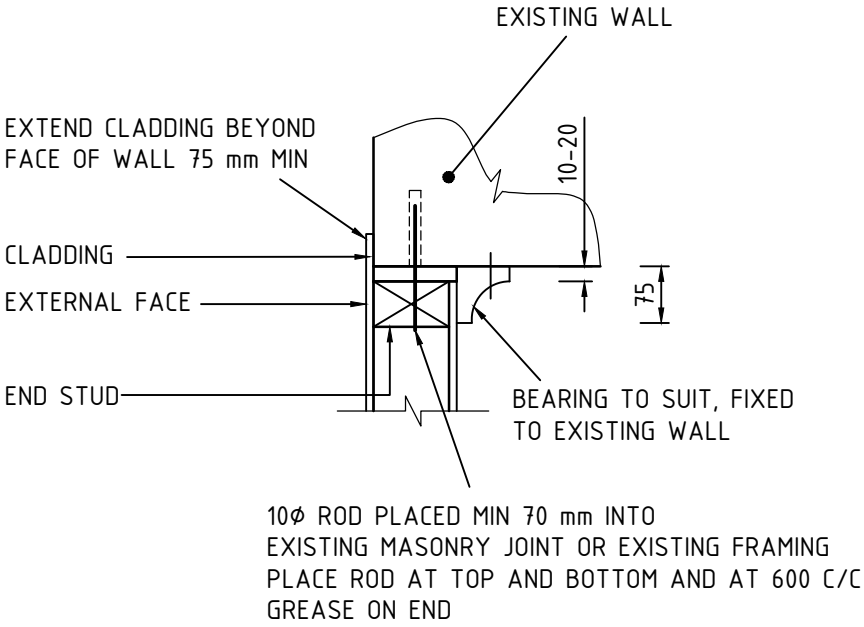


JOINT FILLERS / SEALANTS SHALL ACHIEVE THE REQUIRED FIRE RESISTANCE LEVEL

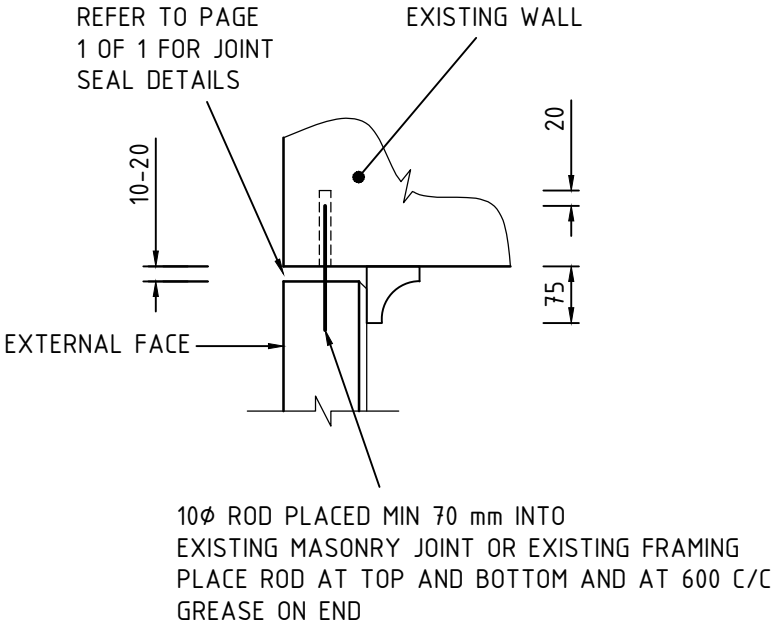
DETAIL 4: LIGHT FRAMED WALL CONSTRUCTION

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

NOT TO SCALE



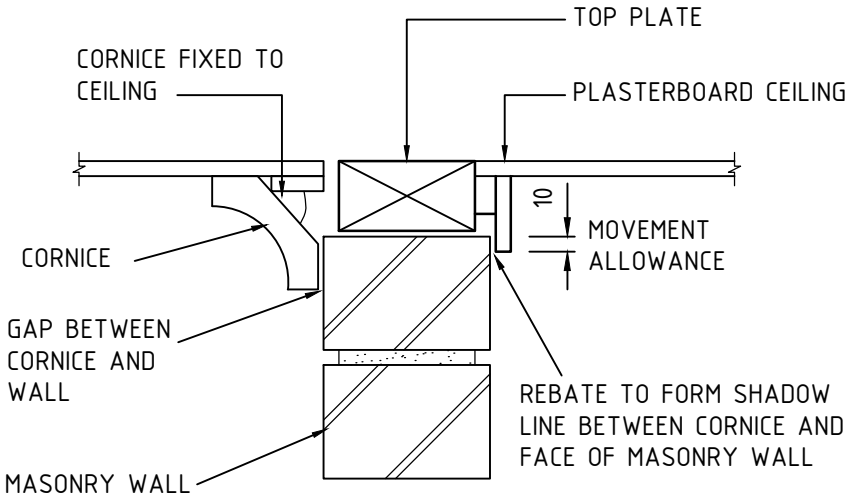
DETAIL 5: LIGHT FRAMING DETAIL

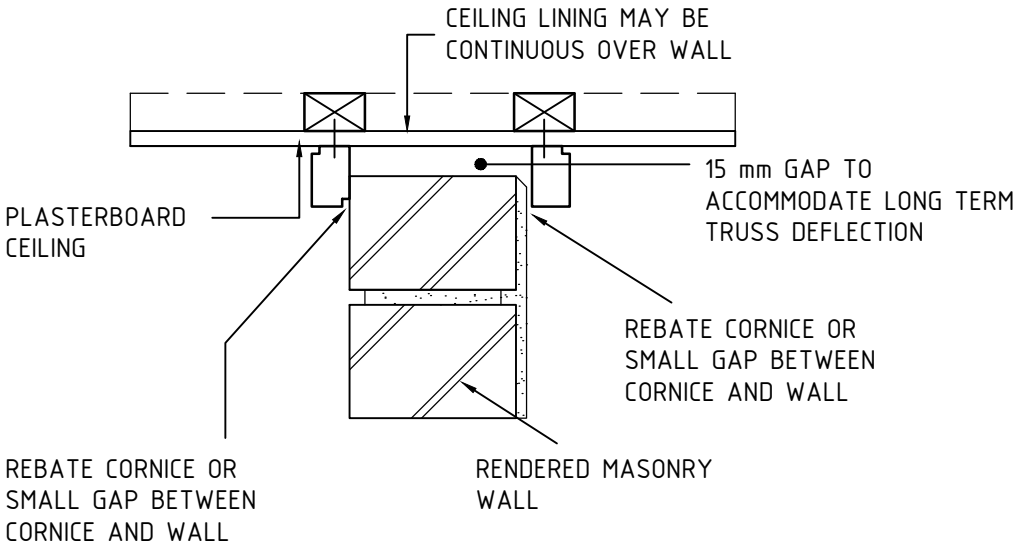


DETAIL 6: MASONRY WALLING DETAIL

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

NOT TO SCALE

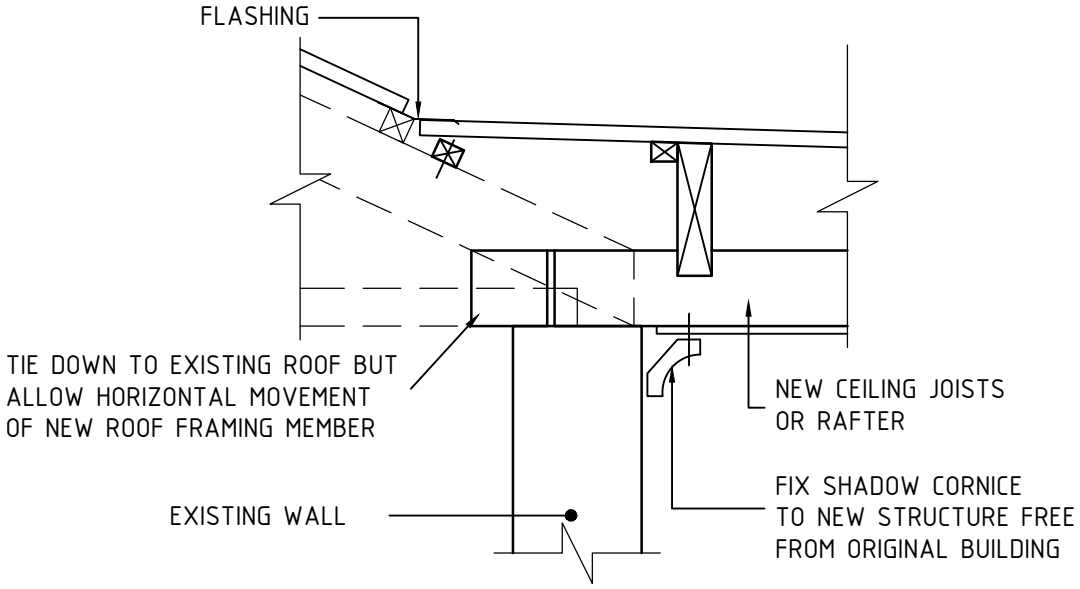




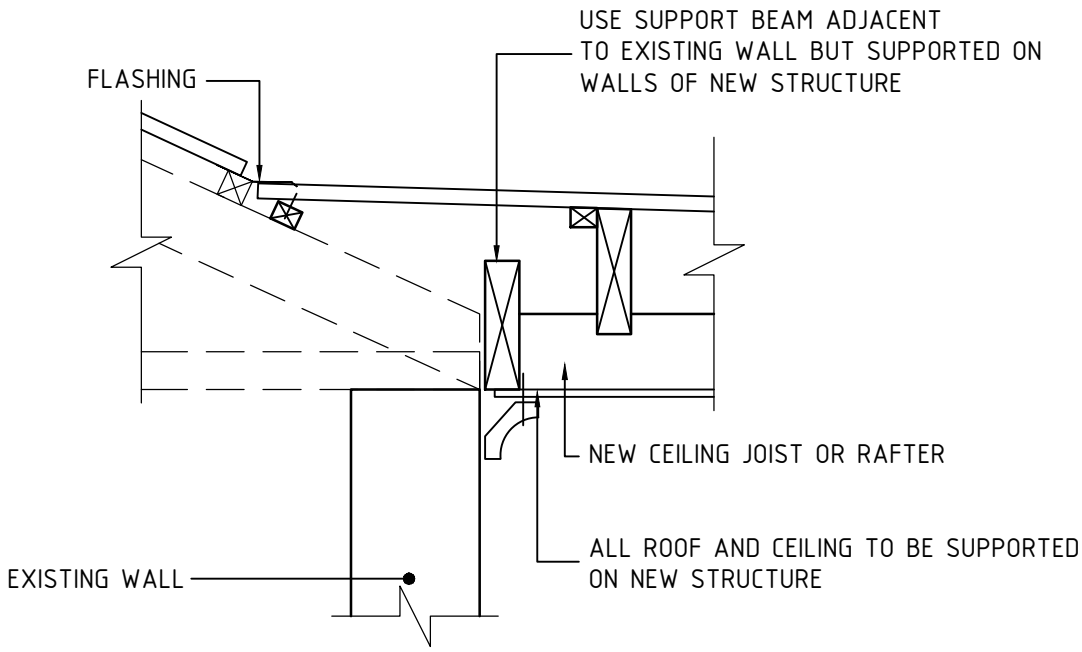
DETAIL 7: WALL / CEILING JUNCTION DETAIL

TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

NOT TO SCALE



DETAIL 8: SUGGESTED ROOF JUNCTION DETAIL

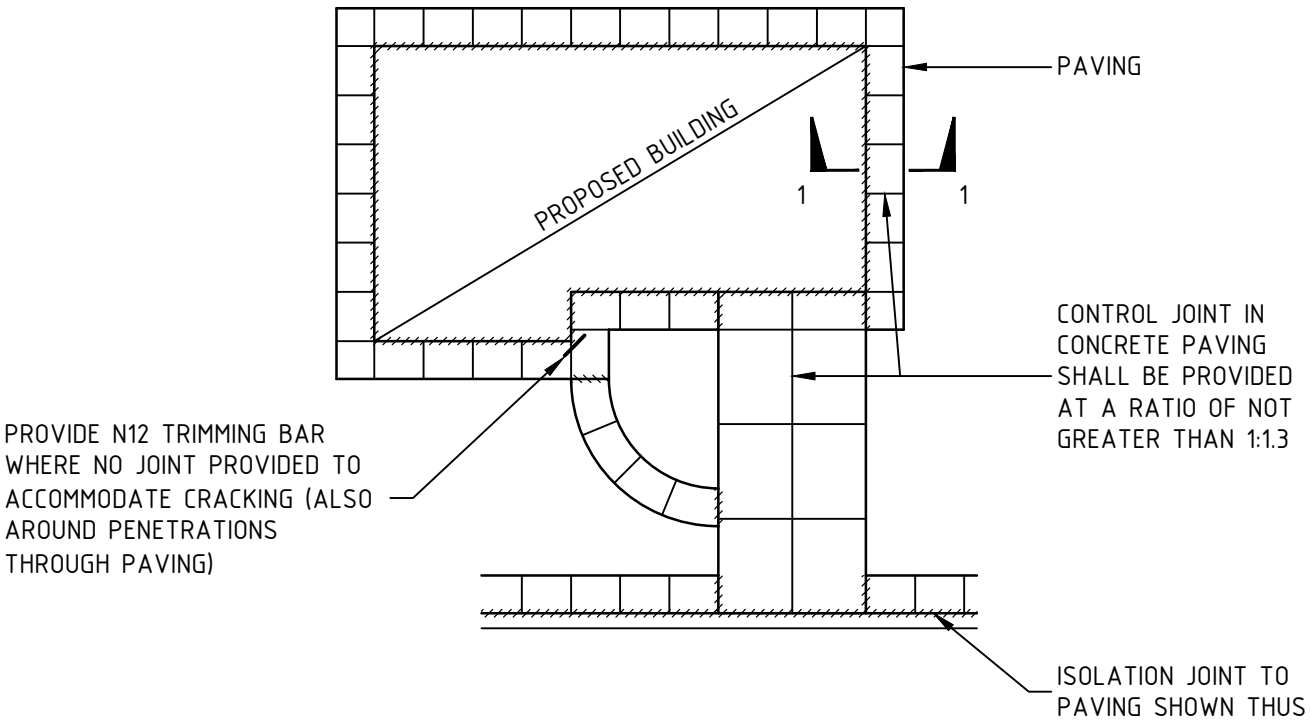


DETAIL 9: ALTERNATIVE ROOF JUNCTION DETAIL

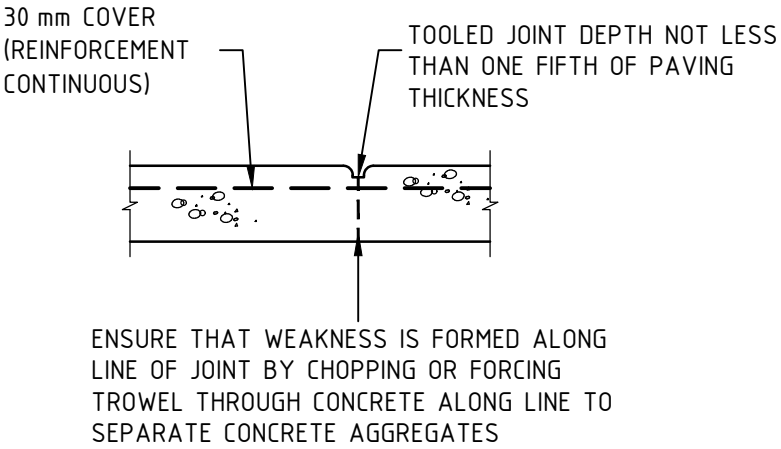
TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

PERIMETER PAVING DETAILS (CD3)

NOT TO SCALE



PLAN OF PAVING AROUND A BUILDING

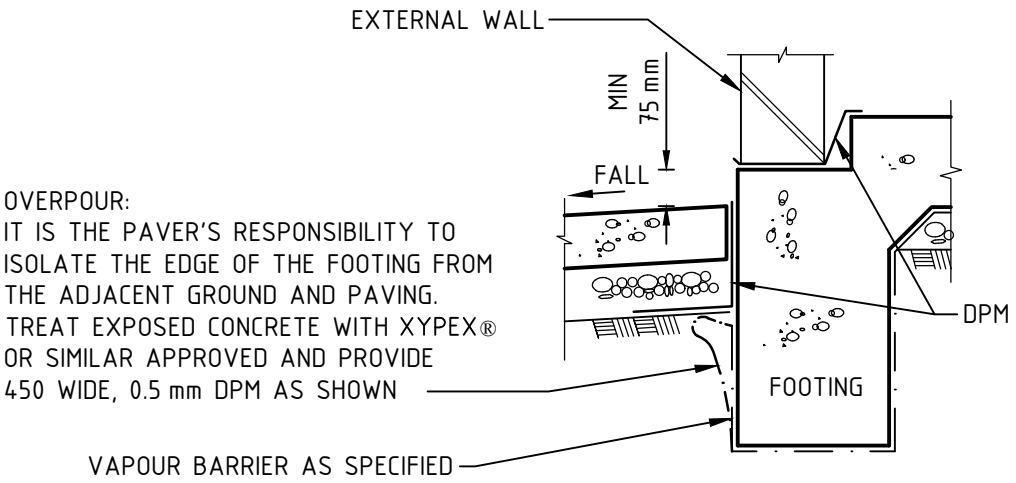


SECTION THROUGH CONTROL JOINT IN CONCRETE PAVING

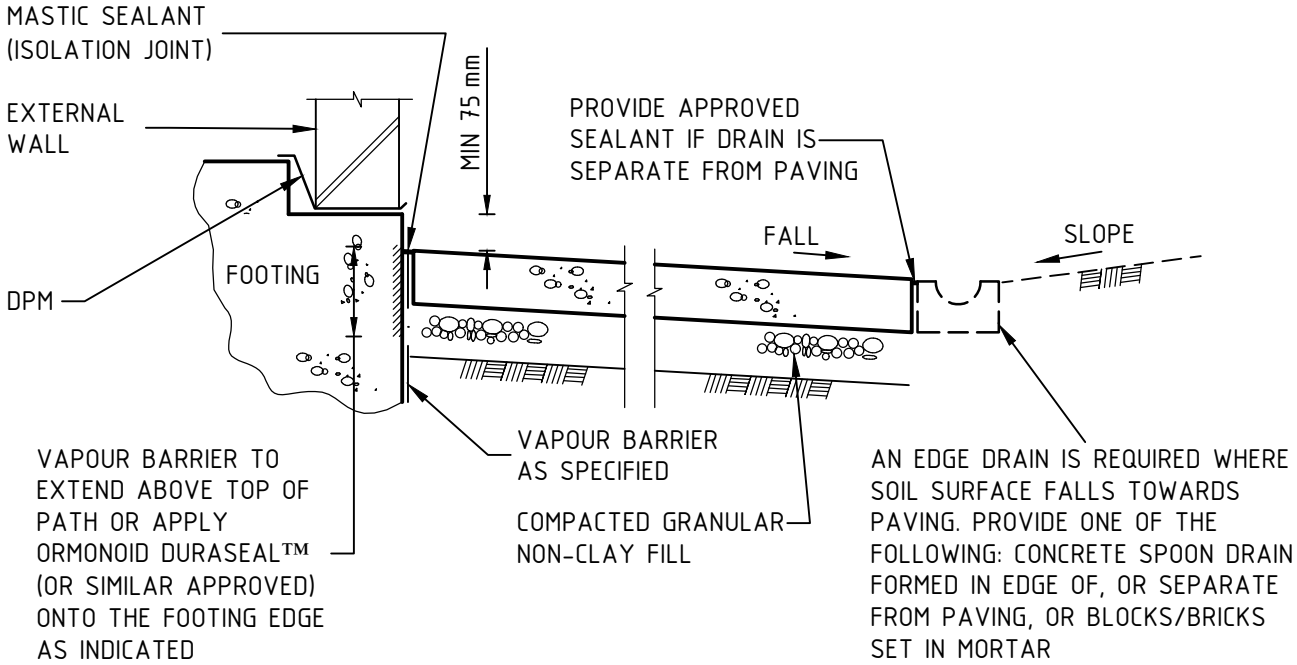
TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

PERIMETER PAVING DETAILS (CD3)

NOT TO SCALE



FOOTING PAVING JUNCTION DETAIL (WHERE OVERPOUR EXISTS)



SECTION 1-1

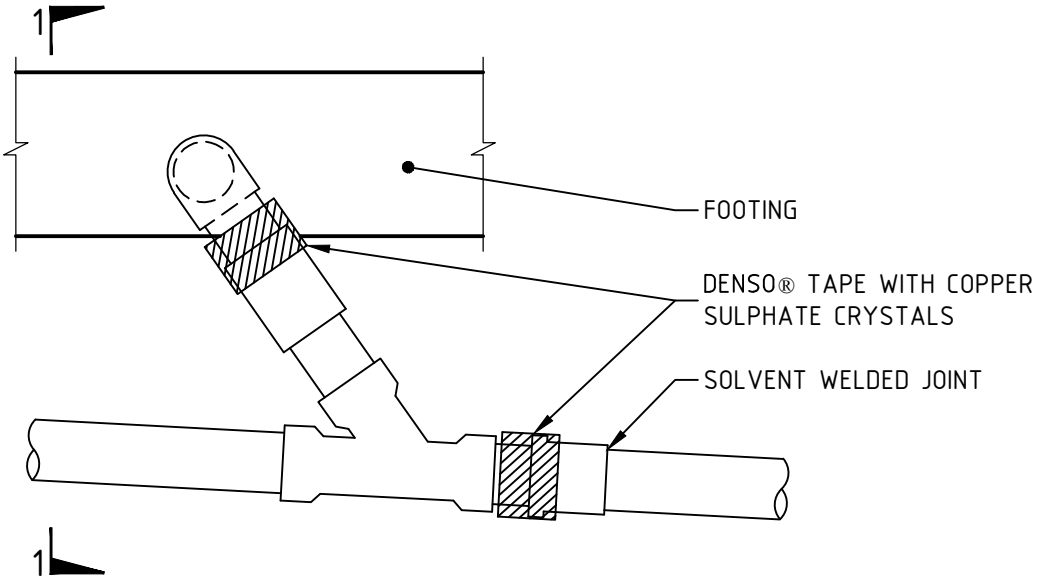
NOTES:

1. PAVING MUST NOT BRIDGE THE MASONRY DAMP PROOF MEMBRANE.
2. PAVING SHALL BE GRADED SUFFICIENTLY TO ENSURE ALL WATER CAN DRAIN CLEAR FROM THE BUILDING.
3. PROVIDE EDGE DRAINS WHERE NECESSARY TO DIVERT RUNOFF CLEAR OF THE BUILDING.
4. REFER TO CRG (SECTION 7) FOR PAVING SPECIFICATIONS INCLUDING FALLS, THICKNESSES AND REINFORCEMENT.
5. PROVIDE TERMITE PROTECTION TO AS 3660.1

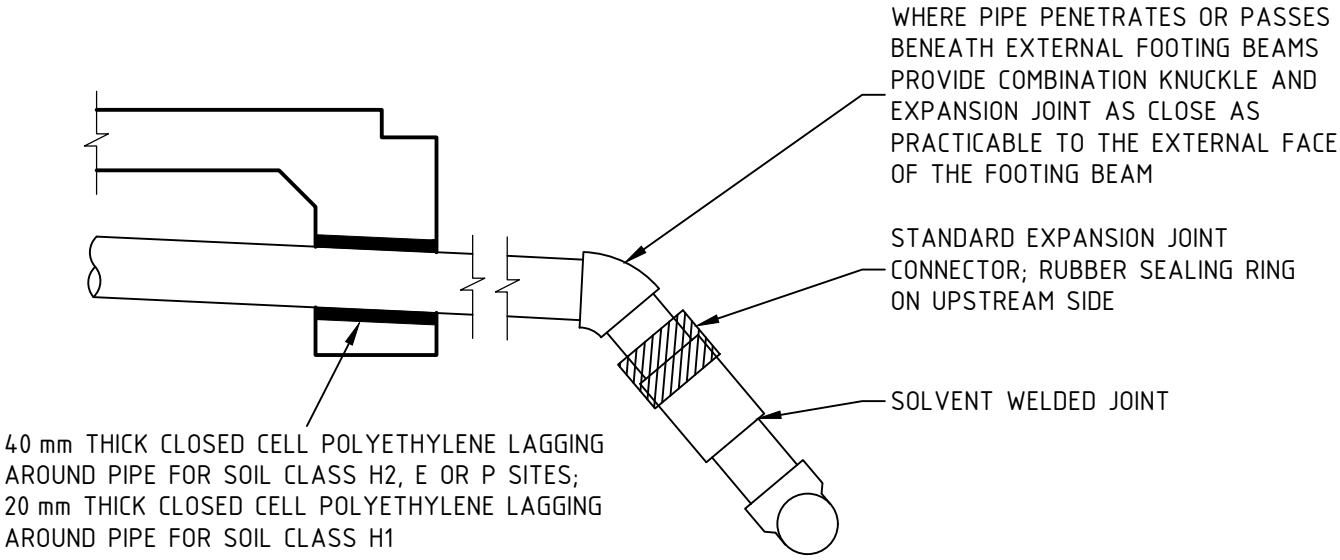
TMK Consulting Engineers
Level 6, 100 Pirie Street Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Environmental • Structural
Geotechnical • Mechanical • Electrical
Fire • Green ESD • Lifts • Hydraulics
Berri Office: 25 Vaughan Terrace, Berri SA 5343

FLEXIBLE SERVICE CONNECTION DETAIL FOR CLASS H1, H2, E OR P SITES STORMWATER & SEWER (CD5)

NOT TO SCALE



SIDE ELEVATION



SECTION 1-1

NOTES:

DUE TO THE MOISTURE REACTIVE NATURE OF SOILS ON CLASS H1, H2, E OR ANY SITE CLASSIFIED AS P SITES, IT IS REQUIRED THAT THE SERVICE PIPES INCLUDE STANDARD EXPANSION TYPE JOINT COUPLINGS.

PROVIDE FLEXIBLE CONNECTIONS TO PIPES IN ACCORDANCE WITH THE FOLLOWING:

1. CONNECTIONS ARE REQUIRED AT EACH LOCATION WHERE ANY PIPES (65 mm OR LARGER) PENETRATE OR PASS BENEATH OR THROUGH THE EXTERNAL FOOTING BEAMS
2. TWO EXPANSION JOINT CONNECTORS ARE REQUIRED, AS DETAILED ABOVE, AT EACH CONNECTION
3. THE DENSO® TAPE MUST BE SPRINKLED WITH COPPER SULPHATE CRYSTALS PRIOR TO WRAPPING AND MUST EXTEND 50 mm BEYOND THE JOINT ON BOTH SIDES
4. DETAILS ARE APPLICABLE TO SEWER AND STORM WATER PIPES
5. FOR ADDITIONAL REQUIREMENTS (IE LOCATION AND SPACING), REFER TO THE NATIONAL PLUMBING AND DRAINAGE CODE AS 3500

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

SPECIFICATION FOR THE CONSTRUCTION OF FOOTINGS AND SLABS (CRS)

1. GENERAL

1.1 The specific type of building construction is stated on BF039 *Construction Report & Footing Recommendations (CR1)*. The standard details shown are typical only, and specific items (e.g. footing dimensions, number of bars) are to be noted as in the Construction Report.

1.2 Where specific requirements or details provided in the Construction Report or on the drawings, conflict with these general specifications, the report and / or drawings shall take precedence.

Some details will not be applicable to the site. Only appropriate details need be incorporated.

1.3 The specifications below shall apply unless noted otherwise.

2. CONCRETE

2.1 Construction methods, materials, tolerances and finishes are to comply with AS 3600 Concrete Structures Code and all other relevant Australian Standards, the Building Code of Australia and any specific requirements of the Local Council.

2.2 Concrete shall be as follows:

- Grade N20 (i.e. 20 MPa) to slab on ground, footings protected by vapour barrier and residential strip / pad footings;
- Grade N25 to suspended slabs, beams and columns and non-residential footings unprotected by vapour barrier;
- Grade N32 to members in exposed exterior environments or where concrete is to have a polished finish;
- Maximum aggregate 20 mm;
- Slump to be nominal 100 mm unless noted otherwise.

2.2.1 For sites within 1 km of the shoreline of large expanses of salt water or heavy industrial areas where surfaces (e.g. verandahs, balconies, carports) are exposed, the surface shall be protected with suitable approved topping, sealer, tiles etc or the concrete grade shall be not less than N40.

2.2.2 For sites containing high sulphate or highly saline soils (or in heavy industrial areas), the concrete surface is to be protected from the aggressive soil by a 0.2 mm branded and certified vapour barrier. Alternatively, use a concrete grade of N40 or greater.

2.3 Concrete shall be supplied in accordance with AS 1379-2007 *The specification and supply of concrete*. Site mixed concrete shall not be used without written approval from this office.

2.4 Project control testing is not required, unless specifically noted elsewhere in the contract documents.

2.5 Sulphate-resisting cement (Type SR - AS 3972-2010 *General purpose and blended cements*) shall be used when specified, or when it is known by the owner, builder, local council, or concrete supplier that this cement should be used at the site.

2.6 Chemical admixtures may be used, provided the concrete supplier accepts responsibility for their use.

2.7 Placement of Concrete

2.7.1 The concrete shall be placed as close as possible to its final position, and the pour shall proceed in one continuous operation, ensuring that no more than 45 minutes elapse before placing fresh concrete against previously placed, in order to eliminate 'cold joints'.

2.7.2 All concrete shall be mechanically vibrated to ensure that it is thoroughly compacted, and all excess air voids removed. Care shall be taken to ensure that the concrete does not become segregated by local over-vibration.

2.7.3 Construction joints will not be permitted in the footings without approval from the Engineer, except where noted on the detail drawings. If a raft footing system is specified it is required that the footing be poured integrally with the floor slab. If it is necessary to pour the footing beams separately to the floor slab, the beams shall be poured to a level exposing the top reinforcement by approximately 100 mm. Where construction joints are used, the concrete surface shall be formed up vertically and the hardened surface of the first pour shall be thoroughly cleaned of all laitance, loose aggregate dirt, etc. The hardened concrete shall be thoroughly wetted and neat slurry shall be applied to its surfaces in a thin layer cement immediately prior to pouring fresh concrete.

2.7.4 The construction of a slab shall achieve the following dimensional tolerances:

- The cover to the reinforcement from the surface in contact with the ground shall be within +40 mm and -10 mm of the specified cover, except that the bottom cover to beams may be increased where the beams are deeper than specified;
- The cover to the reinforcement from the internal surface shall be within +20 mm and -10 mm of the specified cover;
- The surface level to be within ±10 mm of the specified finished floor level (for levelness);
- In the absence of any specification, a steel trowel finish with a tolerance of +/-5 mm from a 3 m straightedge shall be used (for flatness);
- The thickness of the slab and the width and depth of the beam shall not be less than the specified dimension;
- More stringent tolerances may be required for some applications such as polished concrete floors where the reflection from the surface may highlight slight undulations.

2.8 Curing

2.8.1 Curing of the slab shall commence as soon as possible after the pour and certainly within 4 hours.

2.8.2 Curing may be achieved by covering with polythene sheeting for a minimum of 7 days, or by spraying with an approved curing compound, subject to compatibility with the proposed surface finishes.

2.9 Hot Weather Concreting

2.9.1 Concrete shall not be poured when the forecast temperature exceeds 36° Celsius, without specific approval from the Engineer.

2.9.2 When the forecast temperature is between 32° Celsius and 36° Celsius pouring will only be permitted under the following conditions:

- When pouring can be completed prior to the air temperature reaching 32° Celsius.
- When the site is protected from hot drying winds.
- When the slab surface can be covered with plastic sheeting, or hessian (kept wet), within 2 hours of finishing.

3. REINFORCEMENT

3.1 In accordance with AS/NZS 4671-2001 *Steel reinforcing materials*, reinforcement designations are:

- R: Plain round structural bar
- F: Hard drawn wire fabric
- W: Hard drawn wire bar
- N: Hot rolled deformed bar
- SL: Square ribbed fabric
- RL: Rectangular ribbed fabric

3.2 Reinforcement shall be supported on concrete blocks or bar chairs, or suspended from formwork.

3.3 Reinforcement shall be placed evenly, straight and adequately wire-tied to prevent any movement and to hold it in the correct position during pouring of concrete.

3.4 Fabric shall be supported on concrete blocks or bar chairs, placed under the intersection of cross wires at 800 mm x 800 mm (maximum centres). Where the base for the slab is soft, provide spreader pans for bar chairs and / or close up the support centres as necessary.

3.5 At external corners, and intersections of external and internal footings, the reinforcement shall be lapped with a bent bar or separate corner bars, as shown on the details.

3.6 Where rod reinforcement is spliced, the minimum lap lengths shall be:

Bar Size	Lap Length (mm)	Bar Size	Lap Length (mm)
N12	500	N28	1800
N16	750	N32	2150
N20	1000	N36	2600
N24	1450		

3.7 Fabric shall be lapped one full square plus 25 mm at all joins.

3.8 Where brittle floor coverings are to be used (e.g. tiled areas), additional measures are required to control the effect of shrinkage cracking.

Such measures shall include one or more of the following:

- A flexible grout bed shall be provided, 'Resaflex' or similar.
- The placement of floor covering shall be delayed. Note: A minimum of 6 months drying of the concrete is usually required before the placement of brittle floor covering.
- Installation of control joints within the brittle floor coverings where the area exceeds 20 m2.
- 2 layers of SL72T (or 1 layer of SL92T).

3.9 Cover

3.9.1 Clear concrete cover to reinforcement, (including fitments and wire ties) shall be:

• Internal slab on fill (excludes carports):	30 mm bottom and sides, 20 mm top.
• Footings protected by vapour barrier:	40 mm bottom and sides, 20 mm top.
• Residential footings unprotected by vapour barrier:	40 mm top, 50 mm bottom and sides.
• Non-residential footings unprotected by damp-proof membrane:	50 mm top, bottom and sides.

3.9.2 Where footing beams are over-excavated, the reinforcing 'cage' is to be kept towards the top of the beam.

4. VAPOUR BARRIER

4.1 The vapour barrier shall be branded continuously '*AS 2870 Concrete Underlay, 0.2 mm High Impact Resistance*' together with the manufacturer's or distributor's name.

4.2 The vapour barrier shall be provided throughout the underside of all habitable areas and shall be continuous under all beams and slabs as depicted on the appropriate typical detail sheets.

4.3 All joints shall be lapped a minimum of 300 mm and sealed with a 50 mm wide strip of pressure-sensitive waterproof tape. All service penetrations shall be securely flashed and taped. Perforation of the vapour barrier shall be sealed before placing concrete.

4.4 Where the depth of the footing trench exceeds 800 mm, the vapour barrier shall extend down the sides only.

4.5 Where the depth of the footing trench exceeds 1000 mm, provide two layers of vapour barrier to full depth each side.

4.6 Where strip footings are continuous beyond the slab (e.g. carports, footings), the sides and base of the strip footings shall be lined with a vapour barrier for a distance of not less than 800 mm beyond the edge of the slab, unless Clause 4.4 prevails.

4.7 The vapour barrier is not mandatory under exposed slabs (carports, verandas, etc) where they are poured separately to the footing beams. Where future enclosure of carport etc, is proposed, it is required to provide the vapour barrier.

5. LEVEL PINS

5.1 Level pins puncturing the vapour barrier may be used in the footing trenches but must not be used in the area of the floor slab.

5.2 Level pins shall have 30 mm cover to all reinforcement.

5.3 Any pins used to support service pipes must be driven to a minimum of 30 mm below the finished floor level, and be fully taped to the pipe.

6. SERVICE PENETRATIONS AND FLEXIBLE CONNECTIONS

Service penetrations are permitted through footings subject to the following requirements:

6.1 A minimum of 50 mm cover shall be provided between the pipe and any reinforcement.

6.2 Pipes shall be placed through the middle third of the footing beam depth. Penetrations outside this area may require additional concrete depth or reinforcement. Where any reinforcement is cut to suit the location of pipes, additional reinforcement shall be provided, correctly placed and lapped with the main reinforcement. Such reinforcement shall be in accordance with sheet CR5-1 *Typical Footing Details – Corner Reinforcement and Service Pipe Penetration* and / or to the direction of the Engineer inspecting the work.

6.3 Where the pipe is close to the bottom bars and adequate cover is not available, additional excavation must occur below the pipe and the bottom rods placed and lapped so as to provide the correct cover.

6.4 Pipes embedded within the floor slab shall generally have 100 mm of cover over the pipe. Where this cannot be achieved the minimum cover may be reduced to 40 mm provided that the reinforcing fabric is continuous over the pipe, and the sand / rubble base is excavated to provide 100 mm of concrete all around the remainder of the pipe.

6.5 Holes provided for service penetrations through the floor slab shall not exceed 600 mm square without approval from the Engineer.

7. EDGE REBATES

7.1 Edge rebates shall be provided to all masonry cavity or veneer walls.

7.2 The minimum rebate depth shall be 25 mm, but may be increased to suit masonry coursing. The maximum rebate depth shall be 100 mm.

7.3 Rebates are not required for single leaf masonry walls, timber frame clad walls or walls on strip footings.

8. HEATING CABLES AND PIPES

8.1 Electric heating cables may be embedded in the slab without any increase in thickness.

8.2 Hydronic heating pipes may be embedded in the slab provided the slab thickness is increased by 25 mm. An additional layer of fabric (SL42 or larger) shall be provided under the pipes. The main fabric shall be placed with 20 mm cover to the top face.

9. SLABS ON FILL

9.1 Filling used under a slab, (whether existing on site or placed during site works) except where the slab has been designed as suspended, shall consist of controlled fill or rolled fill.

9.1.1 Controlled fill is material that has been placed and compacted within a defined moisture range, in layers by compaction equipment to a defined density requirement. Except as provided below, controlled fill shall be placed in accordance with engineering principles. One test for each 100 m^2 of building area (or 3 tests minimum per visit - whichever is greater) is required for every 600 mm thickness of compacted material.

Sand fill, well compacted in not more than 300 mm layers by a vibrating plate or vibrating roller, shall be deemed to comply with this requirement. This will need to be verified using acceptable testing methods.

Non-sand fill well compacted in not more than 150 mm layers by a mechanical roller, shall be deemed to comply with this requirement. In accordance with AS 1289 .5.1.1-2003 (Standard compactive effort), non-sand fill shall be compacted to 95% maximum dry density when tested.

9.1.2 Rolled fill consists of material compacted in layers of repeated rolling by an excavator. Rolled fill shall not exceed 300 mm compacted in layers of not more than 150 mm.

9.2 The fill shall be tested to ensure that it has been compacted to the specified density, OR

The slab shall be increased in thickness by 25 mm, and reinforced with an additional layer of fabric (of the same size as the top fabric), placed with 30 mm cover to the vapour barrier. The thicker slab, and additional fabric, shall be provided to the full area of any floor panel (maximum panel size of 20 m^2) (i.e. from beam-to-beam) over the deep fill, OR

Piers 500 mm (minimum) square shall be provided under the slab panel, extending to the specified minimum footing founding depth. Piers shall be located such that the distance between adjacent piers, or between a pier and a footing beam, does not exceed 1.8 m.

9.3 The above requirements may be waived when the Engineer is satisfied that the design / construction is adequate.

10. TERMITE PROTECTION

10.1 Termite protection systems shall be in accordance with AS 3660.1-2000 *Termite management – New building work.*

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

1. EARTHWORKS

1.1 Council and / or other statutory requirements giving the relationship between finished floor level, road levels, external paving and / or sewer flood gully, and paving requirement, must be adhered to. All to comply with AS 3798 Guidelines.

1.2 Unless otherwise specified in the construction report, selected approved site materials, excluding topsoil or organic-bearing soil, may be used for compacted filling. Alternatively where site materials are unsuitable because of their nature or moisture content, quarry rubble or other approved filling material may be used. The specified standard of compaction shall be provided to an area extending not less than 1 m beyond the perimeter of the building, and shall also be provided beneath any filled pavements.

1.3 Care must be taken when using vibrating and / or impact rollers if there are buildings close to the area being compacted.

1.4 Where the surface slope of an area which is to receive filling is steeper than 1 (vertical) in 8 (horizontal), a series of level benches shall be excavated along the contour over the whole of the area which will receive filling. This will stabilize the fill against downhill slip.

1.5 The footings specified in the construction report have been proportioned assuming that the contractor will achieve the specified compaction. No footing beam shall be founded in the filling unless the Engineer has checked its compaction standard and given written acceptance of its compliance with the specifications.

1.6 If shallow fill exists or is placed without the use of appropriate compaction equipment, the filling will be assumed to be incapable of supporting any building load. Accordingly any concrete slab over such filling will have increased thickness and reinforcement while trenched / bored piers founded into firm natural ground may also be specified for the footings (including waffle type). The Engineer may waive this requirement if on inspection and / or checking of the filling shows it will be able to support the design loads. Settlement of uncompacted fill can lead to damage to buildings, services, pavements, etc.

2. EXCAVATOR

2.1 It is imperative that the Owner provide sufficient supervision of the cut and fill operation in order to ensure that satisfactory completion of the site works and drainage scheme proposal are adhered to.

2.2 Vegetation and roots must be scraped off and removed from the building area at the commencement of cutting and filling. Where trees and large shrubs are removed, the surrounding soils must be watered to raise the moisture content to that of the other soils under the proposed building (refer to Section 4 for process).

2.3 Where bank heights do not exceed 2.0 m and the natural slope of the site does not exceed 1 in 5, the batter slopes recommended in Table 1 may be used.

TABLE 1: DESIRABLE BATTER SLOPES

Material	Surface Slope (Maximum)
Heavy clay	1 vertical to 1.0 horizontal
Sands and cohesionless soils	1 vertical to 1.5 horizontal
Weathered rock in good condition	1 vertical to 0.5 horizontal
Sound rock	Near vertical

2.4 The extent of the cut and fill outside the building line shall not be exceeded with respect to the following requirements:

2.4.1 Generally cut or fill within the property (i.e. not on boundary) should not exceed 900 mm unless a suitable retaining wall is specified or complies with Clause 2.3.

2.4.2 Cut or fill on the boundary shall not exceed 600 mm, unless a suitable retaining wall is specified and shall not undermine any structure that exists on an adjacent property. That is, no cut or trenching is permissible anywhere on the site if there is a risk of undermining existing structures.

2.5 Fill used under a slab (whether existing on site or placed during site works) shall consist of controlled fill or rolled fill except where the slab has been designed as suspended.

2.5.1 Controlled fill is material that has been placed and compacted, within a defined moisture range, in layers by compaction equipment to a defined density requirement. Except as provided below, controlled fill shall be placed

in accordance with engineering principles. One test for each 100 m^2 of building area (or 3 tests minimum per visit - whichever is greater) is required for every 600 mm thickness of compacted material.

Sand fill, well compacted in not more than 300 mm layers by a vibrating plate or vibrating roller, shall be deemed to comply with this requirement. This will need to be verified using acceptable testing methods.

Non-sand fill well compacted in not more than 150 mm layers by a mechanical roller, shall be deemed to comply with this requirement. In accordance with AS 1289.5.1.1-2003 (Standard compactive effort), non-sand fill shall be compacted to 95% maximum dry density when tested.

2.5.2 Rolled fill consists of material compacted in layers of repeated rolling by an excavator. Rolled fill shall not exceed 300 mm compacted in layers not more than 150 mm.

2.6 Embankments shall be protected from damage arising from surface erosion or ground water flow.

Slopes and grades of the cut bench or platform shown on the drainage plan are to be strictly adhered to, to allow for the site to be drained. In particular, a temporary toe may need to be cut in the ground at the base of cut banks to provide a drain. This drain should fall sufficiently to the low side so that water does not pond. On sites where erosion may be a critical problem provision of trench drains above the cut bank may be required to prevent erosion during the construction phase.

2.7 If a retaining wall has been specified, the cut or fill must not exceed the design height / requirements of the wall.

3. SITE PREPARATION

3.1 After completion of primary earthworks the site must be prepared for footing construction. Ideally, for raft construction, or strip footings where the soil surface under the floors is sealed, soils beneath the building area should be kept in a moist condition. For strip footings where the soil surface under the floors is not sealed, the building area should be kept in a dry condition.

3.2 For concrete floors provide a working surface of a minimum compacted thickness of 100 mm (50 mm for waffle rafts) of quarry rubble or other approved material. The selected material must be free of any sharp aggregate which could damage the vapour barrier. If sharp aggregate is evident on the surface a blinding layer of sand is recommended.

4. PRE-WETTING OF SOILS

4.1 On Class H or E sites pre-wetting of soil under slabs is most advantageous, especially if construction occurs in summer or autumn. In some cases pre-wetting of the site will be mandatory, but in all cases (except as noted in Clause 3.1) it is a desirable procedure aimed at reducing the future heave of reactive clays. Similarly, pre-wetting of the site is mandatory where a new structure is proposed to be constructed over a site which had previously been:

1. Occupied by a building with suspended ground floors (e.g. timber floors, concrete slabs on brick build up, etc).
2. Sites which have had significant amounts of established vegetation or even a single large tree.
3. Part of open cropping land.

4.2 Pre-wetting can best be achieved by watering the site as follows:

1. Prior to the placement of underfloor fill mark out the area of the proposed residence (+1 m around the perimeter).
2. Apply water to the area by using garden sprinklers for a minimum of 2 hours daily for 10 to 14 days immediately prior to the commencement of construction.

   Alternatively, a garden drip irrigation system may be used with drippers evenly spaced along the hose. The flow rate required depends on the site coverage of the building (+1 m around the perimeter) and equates to 1 L/m^2 per hr for 8 to 10 days with the system running 24 hours a day. For example, if an average building and perimeter paving area of 200 m^2 is required to be covered, set the irrigation system at a flow rate of 200 L/hr. This rate should ensure minimum run-off.
3. Provide underfloor fill within 3 days of the completion of pre-wetting.

Notes:
1. Regular checking of the wetting of the site is required to ensure an even water distribution.
2. Care must be taken to ensure that the pre-wetting does not impact detrimentally on adjacent sites or structures.

4.3 As a general rule the pre-wetting exercise will be deemed to be effective if moisture has penetrated at least to a depth of 1 m below the surface. This can be checked by the provision of exploratory holes.

It is recommended that this be undertaken by this office.

5. TERMITE PROTECTION

5.1 A Termite Protection System shall be provided in accordance with AS 3660.1-2014 *Termite management – New building work*. The system provided can only minimize the likelihood of termite infestation and it is stressed that termites can bridge or breach barrier systems. Regular inspections in accordance with the code must be carried out by the Owner.

6. SITE DRAINAGE

6.1 Due to differential moisture variations (i.e. wetting or drying) being the main cause of movement in clay soils, the provision of effective drainage is of great importance as it reduces the possibility of footings having to cope with extreme soil movements. The following outlines common causes of moisture variations.

6.2 Wetting Up

6.2.1 Leaking sewer, water or stormwater pipes.

6.2.2 Downpipes discharging too close to the building.

6.2.3 Sloping sites and inadequate drainage causing water to pond or collect close to the building.

6.2.4 Seepage on sloping sites caused by water travelling on the topsoil-clay, or soil-rock, interface. Cut-off drains are required in this situation.

6.2.5 Garden or lawn watering immediately adjacent to the footings. As a general rule this is not acceptable and must not be done without the explicit approval of the Engineer.

6.2.6 Over-watering of gardens and lawns.

6.2.7 Inadequate soakage trenches.

6.2.8 Flooding during, and after, building construction.

6.3 Drying Out

6.3.1 The non-provision of paving, particularly on the north and west sides of the building, coupled with the non-establishment of a garden.

6.3.2 A change from an established garden situation to a native garden coupled with a substantially reduced level of watering.

6.3.3 The most common cause of drying out is that caused by trees being planted too close to the footings. Trees and large shrubs require substantial amount of water, and if the soil near the tree dries out, the roots will extend in search of soil moisture. Clays will shrink as they dry, and they may cause the building to settle.

Removal of large trees creates the opposite problem. As soil moisture is gradually restored, clays swell and may lift footings.

Many factors determine the extent of clay-drying by trees and the more important are the soil type, the size and number of trees and their species. For single trees, the drying zone area is usually the mature tree height, but the zone will be significantly larger for groups of rows of trees. Although it is known that the species can influence the extent and severity of the drying zone, little definite information is available. Some Australian trees are particularly efficient in extracting water from very dry soils and can be more dangerous than non-Australian species. The effect of tree drying on the amount of movement is also related to the reactivity of the clay. To minimize the risk of damage, trees (especially groups of trees) shall not be planted near the building on a reactive clay site, and the following limits shall comply:

Di = 1.5 Ht for Class E and H2 sites
Di = 1.0 Ht for all other sites

Where Di is the distance of the tree from the building, and Ht is the mature height of the tree.

Planting of trees should be avoided near the foundation of a building or neighbouring building on reactive sites as they can cause damage due to drying of the clay at substantial distances. To reduce, but not eliminate, the possibility of damage, tree planting should be restricted to a distance from the house as follows:

i) 1½ x mature height for Class E sites.
ii) 1 x mature height of Class H1 and Class H2 sites.
iii) ¾ x mature height for Class M sites.

Where rows or groups of trees are involved, the distance from the building shall be increased by 50%.

These suggested limits mean that on the average suburban block, trees that grow higher than 8 m to 9 m are often impractical unless the owner accepts the risk of some damage to the building.

6.4 Due to the above factors the following work must be carried out, to minimize the detrimental effects of moisture variations.

6.4.1 Establish lawns and gardens around the building as soon as possible, and certainly within a maximum of 4 months from completion of the building.

6.4.2 Ensure all roof stormwater is discharged to the street where possible or alternatively discharged on the low side of the site not less than 6 m from the building, but not so as to concentrate a flow of water onto neighbouring property (also refer to Clause 6.6).

6.4.3 Large garden beds should not be located near the building. This will avoid the possibility of introducing too much moisture to the foundation soil by overwatering. The area near the building should be planned for paths or covered with gravel and plastic sheeting. Gardens and lawns should be watered adequately but not excessively. Uniform, consistent watering can is important to prevent damage to the foundation during dry spells such as droughts or dry summers.

6.4.4 After footings have been completed the site surface adjacent to the footings shall be graded by cutting and / or filling to provide a fall away from the building for a distance of not less than 1.0 m. Any channel formed must be graded to discharge all run-off away from the building area. Generally any cut area shall be drained via a surface drain at the base of the cut embankment discharging to the low side of the site. On steep or large sites where significant catchment area is present uphill from the building, a surface drain must also be constructed across the top of the embankment. Water must not pond adjacent to footings. If ponding occurs this water must be pumped out immediately and the above grading and drainage implemented at once.

6.5 Due to constraints of site and building levels, the cover to underground pipes may be less than the manufacturer's specification. This is necessary to prevent very significant cost increases in site works which would otherwise be required. Some damage (which shall be repaired immediately) may occur to pipes if trenching for other services is undertaken, or if vehicles travel over garden areas.

Modifications to site levels can be made if the owner does not accept these conditions.

6.6 Where site drainage designs are not included with this report, they shall be prepared by others experienced in site drainage, and shall comply with the details and requirements of this report.

6.7 **Subsurface Drainage**

Where specified in the recommendations or shown on the site drainage plan, subsurface drainage shall be installed in accordance with any details provided. Note: potential seepage or subsurface drainage problems cannot always be recognized from the results of the site investigation. All of the potential problems with respect to subsurface water flow or seepage may not be evident at the time of the investigation, or even at the time of construction, however, it may become evident after the building has been occupied for the first winter.

7. PAVING REQUIREMENTS

7.1 Pavements shall be not less than 900 mm in width (and preferably 1200 mm in width for Class E sites).

7.2 Concrete pavements shall comply with Table 2.

TABLE 2: CONCRETE PAVEMENTS

		FOR FOOT TRAFFIC ONLY		FOR LIGHT VEHICLE TRAFFICE	
Soil Classification	**Minimum* Cross Fall**	**Thickness (mm)**	**Reinforcement**	**Thickness (mm)**	**Reinforcement**
A or S	1 in 30	75	SL52 [2 m]**	100	SL62 [3 m]
M	1 in 20	75	SL52 [2 m]	100	SL62 [3 m]
H1	1 in 20	75	SL62 [2 m]	110	SL72 [4 m]
H2 or E	1 in 20	100	SL62 [3 m]	120	SL72 [4 m]

**The minimum cross fall may be dictated by the maximum allowable stated in AS1428-2009 Design for access and mobility.*
*** [ ] indicates maximum distance between control joints (noting that length of adjacent sides should be in the ratio of 1 to 1.3 maximum)*
Note: for Class P (Problem) sites or pavement on uncompacted fill, refer to this office.

The paving and the ground in the immediate vicinity of the building shall be graded to slope away from the building area at a grade of 50 mm in 1 m.

7.3 Control joints shall be provided in accordance with the details attached.

7.4 Alternative pavements may be provided, e.g. brick or block pavers, hotmix, etc. Construction must be in accordance with the manufacturers or supplier's specifications, with minimum cross falls as noted above.

7.5 Where the class of soil is H or E it is recommended that paving be constructed at the end of winter, when the site soils are wet, so that cross falls constructed in the paving will not reduce. It is important, however, if the house is occupied during a winter period and no paving provided, that the soil surface around the perimeter of the house is maintained in a well drained state until such time as paving is installed. If, on these soils, it is necessary to construct paving at other times of the year, e.g. the end of summer, the cross fall provided should be not less than twice that is indicated on Table 2.

7.6 Pavements shall have a minimum set down below the rebate of 75 mm.

7.7 Paving shall be constructed on a firm clean base. Ensure that all building debris is removed from the perimeter of the building. Provide a compacted quarry rubble base if necessary to elevate paving and achieve the necessary cross fall.

7.8 The paving shall not be constructed above any damp-proof course or built-in damp- proof membrane, unless other adequate damp-proofing measures are taken.

7.9 On reactive soil sites it may be found that paving separates horizontally from the perimeter of the building. It is important that any gaps between the building and paving be immediately sealed with a flexible mastic sealant.

8. BUILDING CONSTRUCTION AND ARTICULATION

8.1 It should be realized that there are many factors which affect the performance of the building. Visible cracking can be caused by shrinkage and warping of timbers, crazing of plaster, contraction and expansion of masonry and shrinkage of concrete, as well as the most commonly attributed cause, footing distortion. Generally minor cracking is of no significance and will not detract from the performance or durability of the building. It is uneconomical, if not impossible, to eliminate all such imperfections.

8.2 It is generally recommended that masonry walls be articulated at all or some openings. Articulation involves the incorporation of movement joints (control joints). The provision of all control joints at locations specified in the report is mandatory. Where no control joints are specified for footing movement requirements, control joints must be provided in walls longer than 12 m.

8.3 Where new masonry abuts existing masonry, full height mastic filled control joints shall be used.

8.4 Because it is very difficult to prevent tilting of an extension relative to the existing building, the extension must be constructed so as to permit relative movement between the new and the existing building. This provision for relative movement applies to all work including roofs, floors, tiling, wall and ceiling finishes, etc.

9. SERVICES

9.1 Unless approved otherwise, service trenches must be positioned so that the distance between the trench and the edge of the footing is not less than the depth of the trench below the base of the footing. If this cannot be achieved the footings must be piered as indicated on the detail sheets.

9.2 All service trenches both inside and outside the perimeter of the building must be carefully backfilled with approved material, and compacted. The trenches should be sloped away from the building, and should be backfilled with clay in the

top 300 mm within 1.5 m of the building, and where pipes pass under the footings, the trench should be backfilled with clay or concrete to prevent the ingress of water beneath the footing.

9.3 On Class H or E sites special care must be taken to ensure that flexible service connections are used so as to allow for differential soil movement. An expansion coupling must be provided immediately outside the building, where the sewer connections penetrate the footing beam and at the junction of the branch to the main sewer pipe.

9.4 On Class H, E or P (filled sites) sites, a flexible junction must be provided where downpipes connect into the underground stormwater drainage pipes. A sleeved fitting is adequate, but this should be sealed with silicone on Class H or E sites.

9.5 Where pipes pass through a footing beam they must be lagged (i.e. wrapped) in accordance with the following:

- Class S, M: Provide 20 mm thick lagging (not necessarily closed cell).
- Class H1: Provide 20 mm thick closed cell polythene lagging.
- Class H2, E & P: Provide 40 mm thick closed cell polythene lagging.

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

1. GENERAL

1.1 These notes shall be read in conjunction with the architectural drawings, the specifications and the Engineer's Report, etc.

1.2 All dimensions and levels shall be confirmed with the architectural drawings and / or checked on site.

1.3 Engineer's drawings must not be scaled.

1.4 The builder and / or agent shall be responsible for maintaining the stability of all structures and any elements until their completion and shall ensure that no part of structures or any elements are overstressed by excessive loading.

1.5 The specifications below shall apply unless noted otherwise.

1.6 Requests for information will generally be responded to by the engineer within 5 working days, whilst reviews of shop drawings generally within 10 working days.

2. CONCRETE

2.1 Concrete construction to comply with AS 3600-2009 *Concrete structures.*

2.2 Concrete shall be as follows:

- Grade N20 (i.e. 20 MPa) to slab on ground, footings protected by vapour barrier and residential strip / pad footings.
- Grade N25 to suspended slabs, beams, columns and non residential footings unprotected by vapour barrier.
- Grade N32 to members exposed to exterior environments or where concrete is to have a polished finish.
- Maximum aggregate 20 mm.
- Slump to be nominal 100 mm unless noted otherwise.

2.2.1 For sites within 1 km of the shoreline of large expanses of salt water or heavy industrial areas where surfaces (e.g. verandahs, balconies, carports) are exposed, the surface shall be protected with suitable topping, sealer, tiles etc or the concrete grade shall be not less than N40.

2.2.2 For sites containing high sulphate or highly saline soils (or in heavy industrial areas), the concrete surface is to be protected from the aggressive soil by a 0.2 mm branded and certified vapour barrier. Alternatively, use a concrete grade of N40 or greater.

2.3 Construction joints to be thoroughly scabbled of all laitance and poorly compacted material. Vertical joints to be poured against shuttering (refer also BF062 *Specification for the construction of footings and slabs (CRS)* Clause 2.7.3).

2.4 All concrete to be properly cured by keeping all exposed surfaces in a moist, damp condition for at least the first 7 days after placing, or by spraying with an approved curing compound, subject to compatibility with proposed surface finishes.

2.5 Minimum stripping times*:

- Slab-soffit 14 days, props 21 days.
- Beams-sides 3 days, soffit 21 days.
- Columns and Walls - (unloaded) 3 days.

**Specific instructions on formwork stripping times / de-propping etc are required in the cases of multi-level work.*

The system of propping including any re-shoring or back-propping proposals is the responsibility of the builder / contractor and is subject to the approval of the Superintendent.

2.6 In accordance with AS/NZS 4671-2001 *Steel reinforcing materials,* reinforcement designations are as follows:

- R: Plain round structural bar
- F: Hard drawn wire fabric
- W: Hard drawn wire bar
- N: Hot rolled deformed bar
- SL: Square ribbed fabric
- RL: Rectangular ribbed fabric

2.7 Provide 0.2 mm High Impact Resistance branded polythene membrane to AS 2870 throughout underside of floor slabs on ground, all laps to be 300 mm and sealed with a 50 mm wide strip of pressure-sensitive waterproof tape.

2.8 All filling to be non-clay material compacted in 150 mm layers to 90% maximum dry density in accordance with AS 3798 *Guidelines on earthworks for Commercial and Residential developments*.

2.9 Where rod reinforcement is spliced, the minimum lap length shall be:

Bar Size	Lap Length (mm)	Bar Size	Lap Length (mm)
N12	500	N28	1800
N16	750	N32	2150
N20	1000	N36	2600
N24	1450		

2.10 Laps to slab mesh to be one (1) full mesh panel plus 25 mm.

2.11 Clear concrete cover to reinforcement, (including fitments and wire ties), shall be:

- Internal slab on fill: 30 mm bottom and sides, 20 mm top.
- Footings protected by vapour barrier: 40 mm bottom and sides, 20 mm top.
- Residential footings unprotected by vapour barrier: 40 mm top, 50 mm bottom and sides.
- Non-residential footings unprotected by damp-proof membrane: 50 mm top, bottom and sides.
- Suspended slabs, beams and columns: 20 mm internal, 40 mm external.
- Where concrete is exposed to aggressive soils: 65 mm general, 55 mm where protected by an approved membrane.

2.12 Concrete is to be separated from the supporting brick work by two (2) layers of 0.5 mm thick viscourse.

2.13 Walls must not be built on suspended concrete slabs or beams until form work and props supporting same have been removed.

2.14 Tension cracks may occur in slabs, apply suitable sealant for exposed surfaces to prevent possible moisture ingress.

2.15 Provide 10 mm isolation joints where concrete is adjacent steel work / masonry. Provide suitable filler and sealant.

3. MASONRY

3.1 Construction to comply with AS 3700-2011 *Masonry structures*.

3.2 Minimum characteristic unconfined compressive strength of units to be as follows:

- Clay bricks: 40 MPa
- Concrete bricks: 10 MPa
- Concrete hollow blocks: 15 MPa

3.3 Mortar: Brick work: 1: 1 : 6 (Cement / Lime / Sand) Block work: 1: 1 : 6

3.4 Infill concrete grout to reinforced masonry to be Grade 15, slump 230 +/ - 30, 10 mm aggregate.

3.5 For hollow block retaining walls, all cores are to be grouted.

3.6 Grouting to reinforced masonry shall be compacted by rodding with a plain round bar. All air pockets and bubbles must be displaced during compaction. However, care must be taken to avoid damaging or dislodging the masonry or reinforcement while compacting the grout.

4. STEEL WORK

4.1 All Hot Rolled Steel to comply with AS 4100-1998 *Steel structures*, AS/NZS 4600-2005 *Cold formed welding structures* and AS 2327.1-2003 *Composite structures – Simply supported beams*.

4.2 All welding to comply with AS/NZS 1554, parts 1, 2 & 3.

4.3 All fillet welds to be 6 mm (category SP unless noted otherwise) extending the full length of the edges in contact, except where plate thicknesses are less than 6 mm, use a weld size to match.

4.4 The steel worker shall supply all HD bolts, nuts and all other bolts and washers required for the erection of the steel work, holes for HD bolts to be 3 mm oversize, holes for other bolts to be no more than 2 mm oversize. Minimum connection: 10 mm plate with 2 M16 8.8/S bolts unless otherwise noted.

4.5 Where HSFG bolts are required bolting shall comply with AS 4100.

4.7 All base plates, HD bolts and columns in concrete which is in contact with ground to have concrete cover of 75 mm minimum.

4.8 Minimum edge distance taken from centre of fastener *(Where 'D' is the nominal diameter of the fastener)* shall be:

- Sheared or hand flame cut edge: 1.75D
- Rolled plate, machine flame cut sawn or planed edge: 1.50D
- Rolled edge of a rolled section: 1.25D

4.8 Steel work to be concrete encased must first be wrapped with RF41 mesh. The reinforcement is to be placed 25 mm from the steel work.

4.9 Provide a 10 mm clearance between vertical faces of steel work and adjacent masonry walls. Provide W6 ties between steel work and masonry at 600 centres (max).

4.10 All steel work to be adequately propped and braced during construction until all permanent bracing, masonry and cladding has been erected.

4.11 All cold formed sections are to be constructed in accordance with the manufacturer's specifications. Trimming members the same size as the adjoining member shall be provided at no additional cost, to support all edges of sheeting at an angle other than 90 degrees to purlin / girt (refer to purlin manufacturer for details).

4.12 Steel work Protective coatings to be:

• Exposed external steel work within 1 km from breaking surf or within 100 m of salt water not subject to breaking surf, or heaving industrial areas, or corrosive water:	Hot-Dip Galvanized, and painted.
• Exposed external steel work (not exposed to corrosive environment):	Hot-Dip Galvanized, 'Dimet' treated or one coat sprayed Inorganic zinc silicate paint over class 2.5 abrasive blast surface.
• Steel work acting as downpipe or gutter:	Hot-Dip Galvanized.
• Internal steel work (not exposed to moisture or corrosive environment):	Red oxide zinc chromate primer (Rozc) over wire brush surface.

Note: All steelwork in contact with the ground, paving or soil etc, shall, in addition to the protection required above, be either wrapped with "Denso" tape or encased with concrete a minimum 75 mm thick.

4.13 Two (2) copies of shop detail drawings are to be submitted to the engineer and review of the same obtained before commencing fabrication. Review will not cover dimensions. Shop drawings will generally be reviewed by the engineers within 10 working days.

5. TIMBER

5.1 All to comply with AS 1720.1-2010 *Timber structures – Design methods* and AS 1684 *Residential timber framed construction*.

5.2 All MGP10 grade timber must exclude "heart in" material to give the timber a minimum joint group strength of JD4, in accordance with AS1720.

6. EARTHWORKS

All to comply with AS 3798-2007 *Guidelines on earthworks for commercial and residential developments.*

7. SITE INSPECTIONS

Must be carried out at the following stages (Refer to *Construction Report and Footing Recommendations (CR1)* for engineer recommendations):

- After site preparation and trenching for the footing beams.
- After the preparation of reinforcement, prior to the placement of any concrete.

Additional inspections may be carried out at the discretion of the Engineer and / or as requested by the Owner / Agent[1]:

- At the concrete pour.
- After completion of the masonry prior to construction of the roof to ensure correct placement of control joints.
- Upon completion of the installation of paving, stormwater drains, pipes and structures.

8. SURFACE PROTECTIVE COATINGS

All structural members and surfaces, i.e. beams, columns, walls, floors, ceilings, roofs and the like both internally and externally shall be coated with an approved protective coating to suit their intended use / exposure environment, which is to be applied in strict accordance with the manufacturer's recommendations and specifications (see also Clause 4.12).

9. RETAINING WALLS

Refer to sheet BF063 *General notes for retaining wall construction (RWN).*

10. TERMITE PROTECTION

Termite protection system shall be in accordance with AS 3660.1 *Termite management – New building work*.

[1] *Agent refers to architect, builder, project manager, contractor, supervisor or any other such person that has authority to act on the Owner's behalf.*

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

STRUCTURAL CALCULATIONS AND DETAILS (SR1)

Agent:	STUDIO NINE ARCHITECTS	**Job Number:**	1702160
Owner:	MICHAEL CALABRO	**Date:**	05/07/2017
Project:	PROPOSED RESIDENTIAL APARTMENTS	**Order No.**	
Project Location:	168 PROSPECT ROAD, PROSPECT		

The Calculations and Details enclosed give specific recommendations for the above mentioned building / structure. These must be read in conjunction with all listed attachments. Changes to the design or construction must not be made without further written advice from the Engineer. A full copy of this document is to be forwarded to all future owner(s).

This report is valid for a period of 24 months, based on current standards, regulations, etc.

ATTACHMENTS: CRCS, SDN, SC1, FC1-FC19, SL1-SL76, TR1-TR20, SF1-SF31, WP1-WP8, RC1-RC29, LS1-LS37, (A1 DRAWING S0, S100/A, S101/A, S102/A, S103/A, S104/A, S200/A, S201/A, S202/A, S300/A, S301/A, S302/A, S303/A, S304/A, S305/A, S306/A, S307/A, S400/A, S400/A, S400/A, S401/A, S402/A, S403/A, S404/A, S405/A, S406/A, S407/A, S408/A, S409/A, S410/A, S411/A

SITE INSPECTIONS:

As otherwise required by the Engineer or requested by the client / contractor.

NOTE: 1. These inspections will incur additional fees.
2. We require 24 hours notice when booking inspections.

ADDITIONAL NOTES/REQUIREMENTS:

1. Flexible connections for sewer and stormwater pipes are required on this site.
2. The design gust wind speed for this site has been calculated to be in the order of 40 m/s (ultimate limit state).
3. Refer to A1 drawings for all structural details.

For and on behalf of
TMK Consulting Engineers

TONY GARREFFA
Senior Associate / Team Leader

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

CONDITIONS FOR THE USE OF STRUCTURAL CALCULATIONS AND DETAILS (CRCS)

1. GENERAL

1.1 These Structural Calculations and Details (hereinafter named the "Report") give specific recommendations for the particular building described in this report. This Report must be read in conjunction with all listed attachments. Changes to the design or construction must not be made without further written advice from the Engineer.

1.2 The Owner and all contactors will comply in all respects and at all times with all terms, conditions and recommendations contained in, or attached to, this Report.

1.2.1 It is essential that the Owner reads the entire report carefully as it contains important information, relating not only to the construction, but also to obligations and liabilities.

1.2.2 If the Owner requires different details to that recommended, our office must be notified prior to the commencement of construction, and advice will be given accordingly.

1.2.3 If there are any aspects of the Report that are not understood, please contact the Engineer.

1.3 The Engineer may (and the Owner hereby authorizes the Engineer to):

1.3.1 Issue instructions (including an instruction to cease construction) on behalf of the Owner to any person engaged in the construction of the building, or any part thereof, to ensure construction of the building in accordance with this Report and any modification thereof. If any modification as aforesaid may be likely to result in additional construction costs exceeding $3,500.00 (plus GST), the Engineer may issue an instruction to cease construction in order to obtain the approval of the Owner for such modification.

1.3.2 Make such modifications to the Report as the Engineer may deem necessary during the course of construction.

1.4 The Owner shall be responsible for, and indemnify the Engineer against, all and any costs and charges and all claims and demands made for any additional costs incurred by reason of any act, requirement or instruction of the Engineer made or given pursuant to Clause 1.3.

1.5 The Engineer shall not be liable for any defect in or damage to the building / construction caused by or contributed to by any breach of the terms, conditions and recommendations committed, permitted or allowed by the Owner.

1.6 Where more than one person is named as the Owner, all these terms, conditions and recommendations shall bind all such persons jointly and each such person severally, and any instruction or information given to the Engineer by any one such person shall be deemed to be given by all other such persons.

2. TERMS OF ENGAGEMENT

2.1 All work will be carried out in accordance with TMK's standard '*Terms and Conditions of Engagement for Consulting Services*'.

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

1. GENERAL

1.1 These notes shall be read in conjunction with the architectural drawings, the specifications and the Engineer's Report, etc.

1.2 All dimensions and levels shall be confirmed with the architectural drawings and / or checked on site.

1.3 Engineer's drawings must not be scaled.

1.4 The builder and / or agent shall be responsible for maintaining the stability of all structures and any elements until their completion and shall ensure that no part of structures or any elements are overstressed by excessive loading.

1.5 The specifications below shall apply unless noted otherwise.

1.6 Requests for information will generally be responded to by the engineer within 5 working days, whilst reviews of shop drawings generally within 10 working days.

2. CONCRETE

2.1 Concrete construction to comply with AS 3600-2009 *Concrete structures.*

2.2 Concrete shall be as follows:

- Grade N20 (i.e. 20 MPa) to slab on ground, footings protected by vapour barrier and residential strip / pad footings.
- Grade N25 to suspended slabs, beams, columns and non residential footings unprotected by vapour barrier.
- Grade N32 to members exposed to exterior environments or where concrete is to have a polished finish.
- Maximum aggregate 20 mm.
- Slump to be nominal 100 mm unless noted otherwise.

2.2.1 For sites within 1 km of the shoreline of large expanses of salt water or heavy industrial areas where surfaces (e.g. verandahs, balconies, carports) are exposed, the surface shall be protected with suitable topping, sealer, tiles etc or the concrete grade shall be not less than N40.

2.2.2 For sites containing high sulphate or highly saline soils (or in heavy industrial areas), the concrete surface is to be protected from the aggressive soil by a 0.2 mm branded and certified vapour barrier. Alternatively, use a concrete grade of N40 or greater.

2.3 Construction joints to be thoroughly scabbled of all laitance and poorly compacted material. Vertical joints to be poured against shuttering (refer also BF062 *Specification for the construction of footings and slabs (CRS)* Clause 2.7.3).

2.4 All concrete to be properly cured by keeping all exposed surfaces in a moist, damp condition for at least the first 7 days after placing, or by spraying with an approved curing compound, subject to compatibility with proposed surface finishes.

2.5 Minimum stripping times*:

- Slab-soffit 14 days, props 21 days.
- Beams-sides 3 days, soffit 21 days.
- Columns and Walls - (unloaded) 3 days.

**Specific instructions on formwork stripping times / de-propping etc are required in the cases of multi-level work.*

The system of propping including any re-shoring or back-propping proposals is the responsibility of the builder / contractor and is subject to the approval of the Superintendent.

2.6 In accordance with AS/NZS 4671-2001 *Steel reinforcing materials,* reinforcement designations are as follows:

- R: Plain round structural bar
- F: Hard drawn wire fabric
- W: Hard drawn wire bar
- N: Hot rolled deformed bar
- SL: Square ribbed fabric
- RL: Rectangular ribbed fabric

2.7 Provide 0.2 mm High Impact Resistance branded polythene membrane to AS 2870 throughout underside of floor slabs on ground, all laps to be 300 mm and sealed with a 50 mm wide strip of pressure-sensitive waterproof tape.

2.8 All filling to be non-clay material compacted in 150 mm layers to 90% maximum dry density in accordance with AS 3798 *Guidelines on earthworks for Commercial and Residential developments*.

2.9 Where rod reinforcement is spliced, the minimum lap length shall be:

Bar Size	Lap Length (mm)	Bar Size	Lap Length (mm)
N12	500	N28	1800
N16	750	N32	2150
N20	1000	N36	2600
N24	1450		

2.10 Laps to slab mesh to be one (1) full mesh panel plus 25 mm.

2.11 Clear concrete cover to reinforcement, (including fitments and wire ties), shall be:

- Internal slab on fill: 30 mm bottom and sides, 20 mm top.
- Footings protected by vapour barrier: 40 mm bottom and sides, 20 mm top.
- Residential footings unprotected by vapour barrier: 40 mm top, 50 mm bottom and sides.
- Non-residential footings unprotected by damp-proof membrane: 50 mm top, bottom and sides.
- Suspended slabs, beams and columns: 20 mm internal, 40 mm external.
- Where concrete is exposed to aggressive soils: 65 mm general, 55 mm where protected by an approved membrane.

2.12 Concrete is to be separated from the supporting brick work by two (2) layers of 0.5 mm thick viscourse.

2.13 Walls must not be built on suspended concrete slabs or beams until form work and props supporting same have been removed.

2.14 Tension cracks may occur in slabs, apply suitable sealant for exposed surfaces to prevent possible moisture ingress.

2.15 Provide 10 mm isolation joints where concrete is adjacent steel work / masonry. Provide suitable filler and sealant.

3. MASONRY

3.1 Construction to comply with AS 3700-2011 *Masonry structures*.

3.2 Minimum characteristic unconfined compressive strength of units to be as follows:

- Clay bricks: 40 MPa
- Concrete bricks: 10 MPa
- Concrete hollow blocks: 15 MPa

3.3 Mortar: Brick work: 1: 1 : 6 (Cement / Lime / Sand) Block work: 1: 1 : 6

3.4 Infill concrete grout to reinforced masonry to be Grade 15, slump 230 +/ - 30, 10 mm aggregate.

3.5 For hollow block retaining walls, all cores are to be grouted.

3.6 Grouting to reinforced masonry shall be compacted by rodding with a plain round bar. All air pockets and bubbles must be displaced during compaction. However, care must be taken to avoid damaging or dislodging the masonry or reinforcement while compacting the grout.

4. STEEL WORK

4.1 All Hot Rolled Steel to comply with AS 4100-1998 *Steel structures*, AS/NZS 4600-2005 *Cold formed welding structures* and AS 2327.1-2003 *Composite structures – Simply supported beams*.

4.2 All welding to comply with AS/NZS 1554, parts 1, 2 & 3.

4.3 All fillet welds to be 6 mm (category SP unless noted otherwise) extending the full length of the edges in contact, except where plate thicknesses are less than 6 mm, use a weld size to match.

4.4 The steel worker shall supply all HD bolts, nuts and all other bolts and washers required for the erection of the steel work, holes for HD bolts to be 3 mm oversize, holes for other bolts to be no more than 2 mm oversize. Minimum connection: 10 mm plate with 2 M16 8.8/S bolts unless otherwise noted.

4.5 Where HSFG bolts are required bolting shall comply with AS 4100.

4.7 All base plates, HD bolts and columns in concrete which is in contact with ground to have concrete cover of 75 mm minimum.

4.8 Minimum edge distance taken from centre of fastener *(Where 'D' is the nominal diameter of the fastener)* shall be:

- Sheared or hand flame cut edge: 1.75D
- Rolled plate, machine flame cut sawn or planed edge: 1.50D
- Rolled edge of a rolled section: 1.25D

4.8 Steel work to be concrete encased must first be wrapped with RF41 mesh. The reinforcement is to be placed 25 mm from the steel work.

4.9 Provide a 10 mm clearance between vertical faces of steel work and adjacent masonry walls. Provide W6 ties between steel work and masonry at 600 centres (max).

4.10 All steel work to be adequately propped and braced during construction until all permanent bracing, masonry and cladding has been erected.

4.11 All cold formed sections are to be constructed in accordance with the manufacturer's specifications. Trimming members the same size as the adjoining member shall be provided at no additional cost, to support all edges of sheeting at an angle other than 90 degrees to purlin / girt (refer to purlin manufacturer for details).

4.12 Steel work Protective coatings to be:

• Exposed external steel work within 1 km from breaking surf or within 100 m of salt water not subject to breaking surf, or heaving industrial areas, or corrosive water:	Hot-Dip Galvanized, and painted.
• Exposed external steel work (not exposed to corrosive environment):	Hot-Dip Galvanized, 'Dimet' treated or one coat sprayed Inorganic zinc silicate paint over class 2.5 abrasive blast surface.
• Steel work acting as downpipe or gutter:	Hot-Dip Galvanized.
• Internal steel work (not exposed to moisture or corrosive environment):	Red oxide zinc chromate primer (Rozc) over wire brush surface.

Note: All steelwork in contact with the ground, paving or soil etc, shall, in addition to the protection required above, be either wrapped with "Denso" tape or encased with concrete a minimum 75 mm thick.

4.13 Two (2) copies of shop detail drawings are to be submitted to the engineer and review of the same obtained before commencing fabrication. Review will not cover dimensions. Shop drawings will generally be reviewed by the engineers within 10 working days.

5. TIMBER

5.1 All to comply with AS 1720.1-2010 *Timber structures – Design methods* and AS 1684 *Residential timber framed construction*.

5.2 All MGP10 grade timber must exclude "heart in" material to give the timber a minimum joint group strength of JD4, in accordance with AS1720.

6. EARTHWORKS

All to comply with AS 3798-2007 *Guidelines on earthworks for commercial and residential developments.*

7. SITE INSPECTIONS

Must be carried out at the following stages (Refer to *Construction Report and Footing Recommendations (CR1)* for engineer recommendations):

- After site preparation and trenching for the footing beams.
- After the preparation of reinforcement, prior to the placement of any concrete.

Additional inspections may be carried out at the discretion of the Engineer and / or as requested by the Owner / Agent[1]:

- At the concrete pour.
- After completion of the masonry prior to construction of the roof to ensure correct placement of control joints.
- Upon completion of the installation of paving, stormwater drains, pipes and structures.

8. SURFACE PROTECTIVE COATINGS

All structural members and surfaces, i.e. beams, columns, walls, floors, ceilings, roofs and the like both internally and externally shall be coated with an approved protective coating to suit their intended use / exposure environment, which is to be applied in strict accordance with the manufacturer's recommendations and specifications (see also Clause 4.12).

9. RETAINING WALLS

Refer to sheet BF063 *General notes for retaining wall construction (RWN).*

10. TERMITE PROTECTION

Termite protection system shall be in accordance with AS 3660.1 *Termite management – New building work*.

[1] *Agent refers to architect, builder, project manager, contractor, supervisor or any other such person that has authority to act on the Owner's behalf.*

TMK Consulting Engineers
Level 6, 100 Pirie Street, Adelaide SA 5000
Tel: 08 8238 4100 • Fax: 08 8410 1405
Email: tmksa@tmkeng.com.au
Civil • Structural • Environmental
Geotechnical • Mechanical • Electrical
Fire • Hydraulics • Lifts • Green ESD
Berri Office: 25 Vaughan Terrace, Berri SA 5343

STRUCTURAL CALCULATIONS (SC1)

Agent:	STUDIO NINE ARCHITECTS	**Job Number:**	1702160
Owner:	MICHAEL CALABRO	**Date:**	05/07/2017
Project:	PROPOSED RESIDENTIAL APARTMENTS		
Project Location:	168 PROSPECT ROAD, PROSPECT		

GENERAL NOTES:

1. These calculations are to be read in conjunction with the associated Architectural Drawings, Footing Construction Report, Structural Drawings and / or Details.

2. All work to comply with relevant Australian Standards including but not limited to:

AS/NZ 1170	-	Structural design actions
AS 1554	-	Structural steel welding
AS 1684	-	Residential timber framed construction
AS 1720	-	Timber structures
AS 2327	-	Composite structures
AS 3600	-	Concrete structures
AS 3610	-	Formwork for concrete
AS 3700	-	Masonry structures
AS 4100	-	Steel structures
AS/NZS 4600	-	Cold formed steel structures
AS 1163	-	Structural steel hollow sections
AS 2159	-	Piling - Design and installation
AS/NZS 2312	-	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 3850	-	Tilt up concrete construction
AS 4678	-	Earth retaining structures

STRUCTURAL CALCULATIONS INDEX

Footing calculations	FC1 - FC19
Suspended slab design	SL1 - SL76
Reinforced concrete transfer structure	TR1 - TR20
Upper floor steel framing	SF1 – SF31
Wall panel design	WP1 – WP8
Roof calculations	RC1 – RC29
Lateral stability design	LS1 – LS37

Footing Design

- Footings modelled in ETABS
- Design for a maximum bearing of 250kPa under ultimate load combinations.
- Adopt footings in model:
  - 600 wide x 700 deep tie footings between pads & under wall panels
  - 3200 sq pad x 700 deep below lift shaft.
  - "Bell shaped" pad 700 deep below concrete columns on grids G & J (PF1)
  - 3000 sq + 700 deep pad below heaviest isolated column.
  - 2400 sq + 700 deep pad to all other single column pads.

Settlements

- Refer to ETABS output; maximum settlement under serviceability loading ≈ 6.0mm
  ⇒ consider ok by inspection

Bearing Pressures

- Refer to model output; bearing pressures under ultimate loads typically in the order of 100 - 150kPa. Strip footing bearing pressure locally in front corner ≈ 255kPa but quickly dissipates lower.
  ⇒ consider bearing pressures under footing system ok.

Footing reinforcement

Pads supporting single columns

- Refer to bending moment output; $M^* \approx 280$ kN.m/m (averaged over critical metre strip)

$$\Rightarrow A_{st} = \frac{280 \times 10^6}{0.8 \times 500 \times 650 \times 0.9} = 1197 \text{ mm}^2/\text{m}$$

$$A_{st\,min} \approx 0.002 \times 650 \times 1000 = \underline{1300 \text{ mm}^2/\text{m}} \rightarrow \text{governs}$$

⇒ N16 @ 150 c/c each way bottom.

Pads supporting double columns

- Refer to bending moment output; $M^* \approx 330$ kNm, averaged over critical metre strip

$\Rightarrow A_{ST} = \dfrac{330 \times 10^6}{0.8 \times 500 \times 650 \times 0.9} = \underline{1410\ mm^2/m}$ governs.

$A_{ST(min)} = 1300\ mm^2/m$

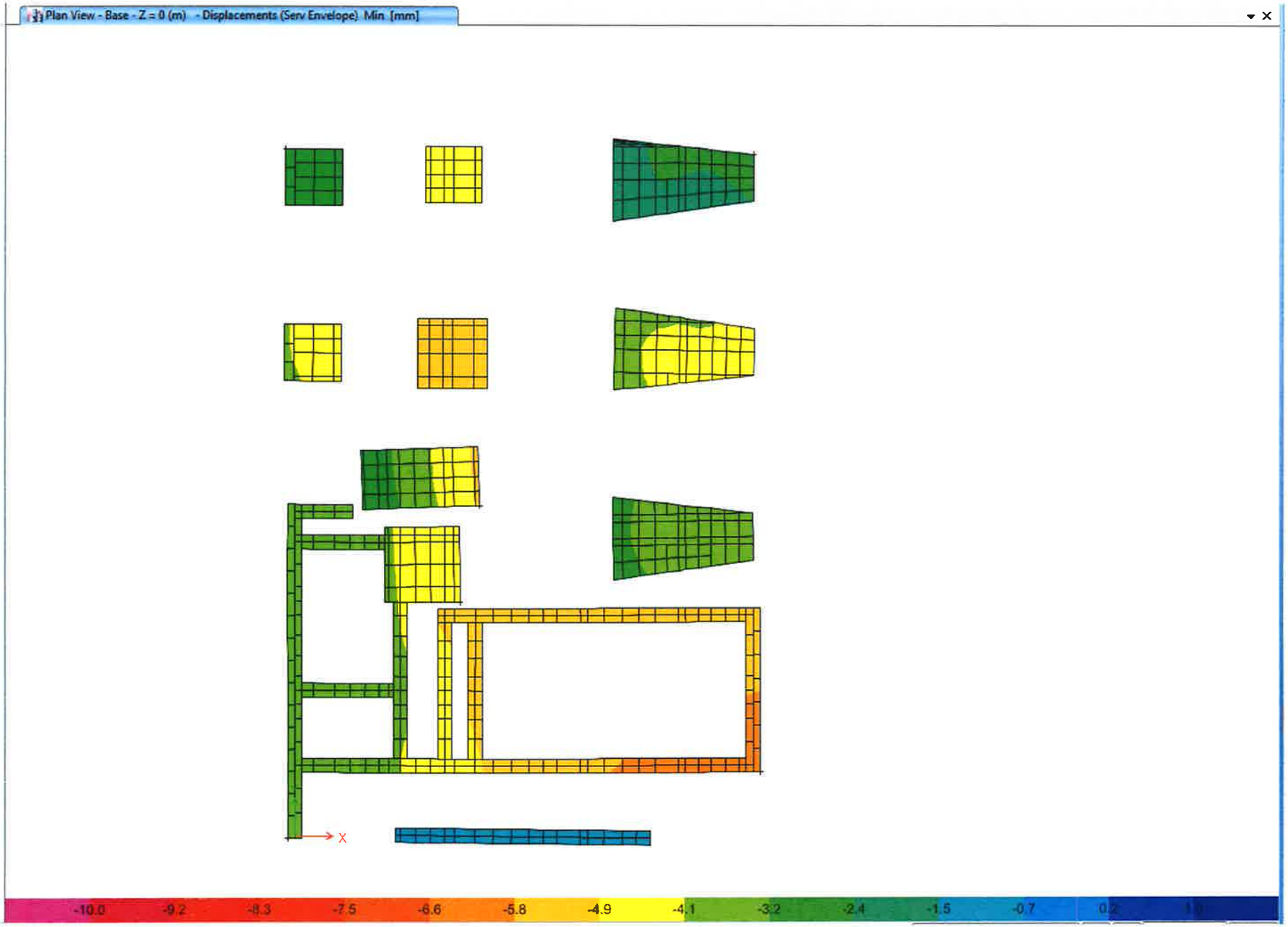
$\Rightarrow$ N16 @ 142 c/c $\Rightarrow$ $\boxed{\text{adopt N16 @ 125 c/c each way top \& bottom to pads PF1 \& PF5}}$

<u>Pad Footing to lift shaft</u>

- Refer to bending moment output for PF3; $M^* \approx 50\ kNm$

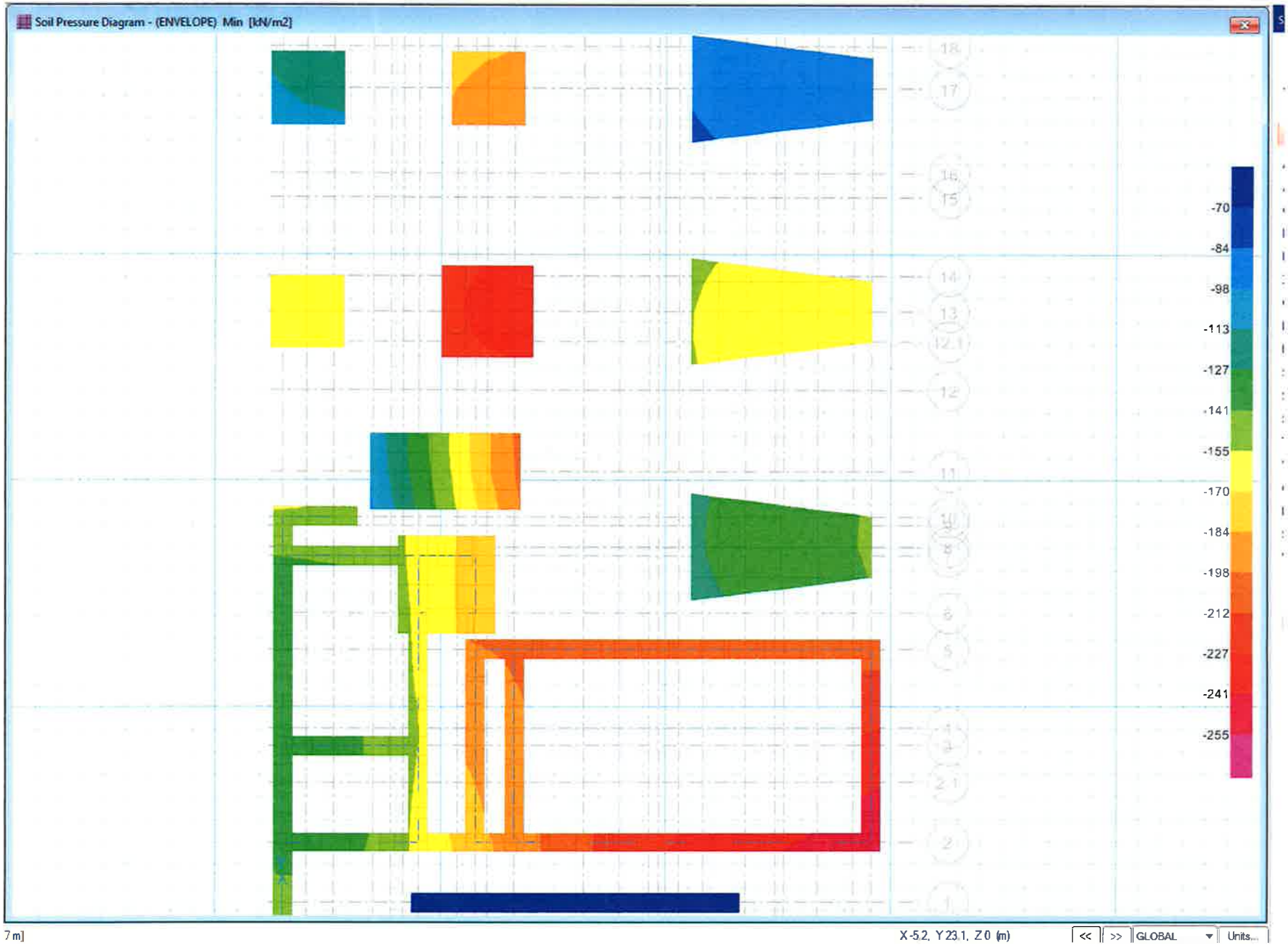
$\Rightarrow$ by inspection minimum steel will be required top & bottom

$\Rightarrow$ <u>adopt N16 @ 150 c/c each way top & bottom to PF3</u>

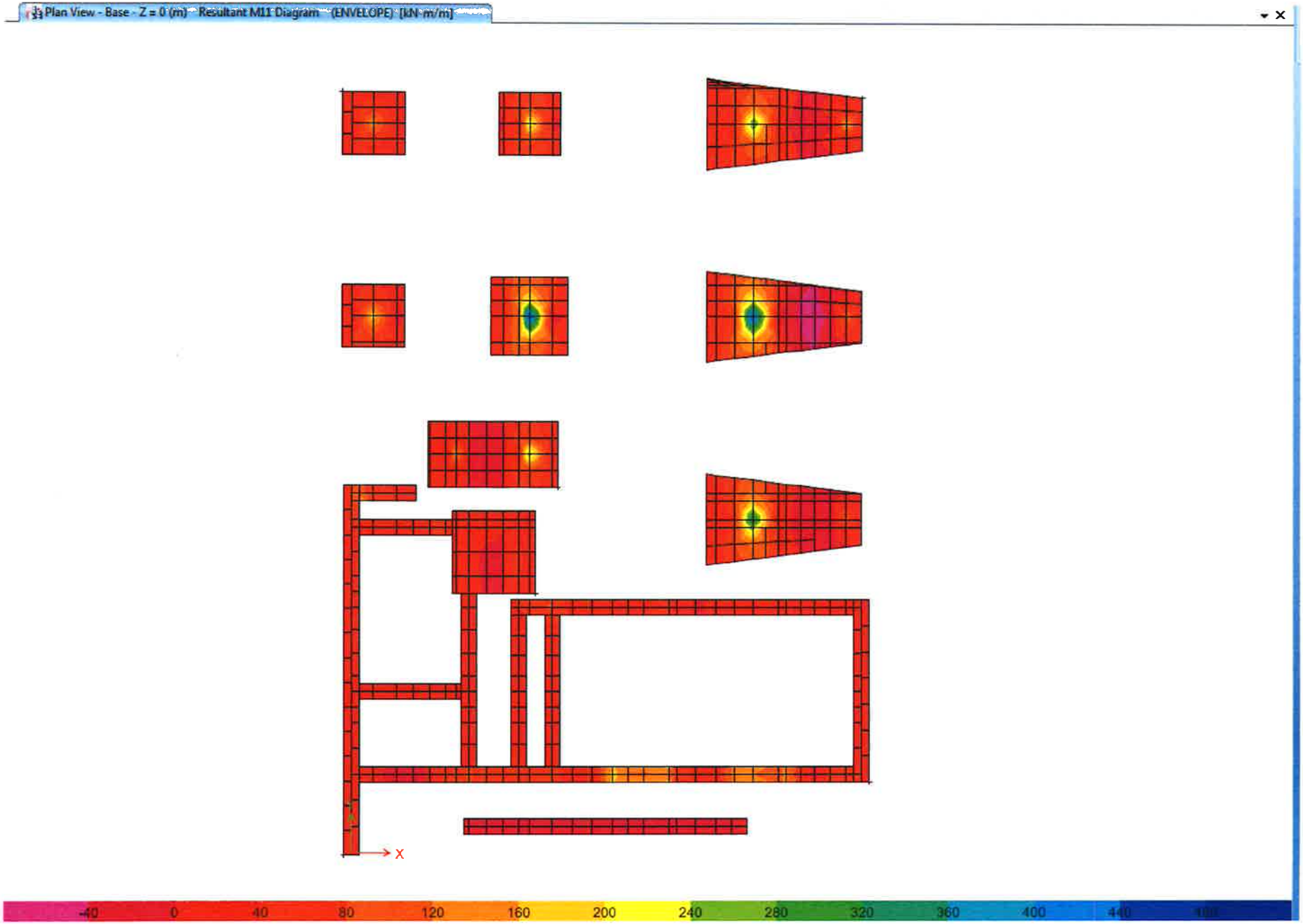


ETABS MODEL – Overall Footings, Expected settlements under serviceability loading (mm).

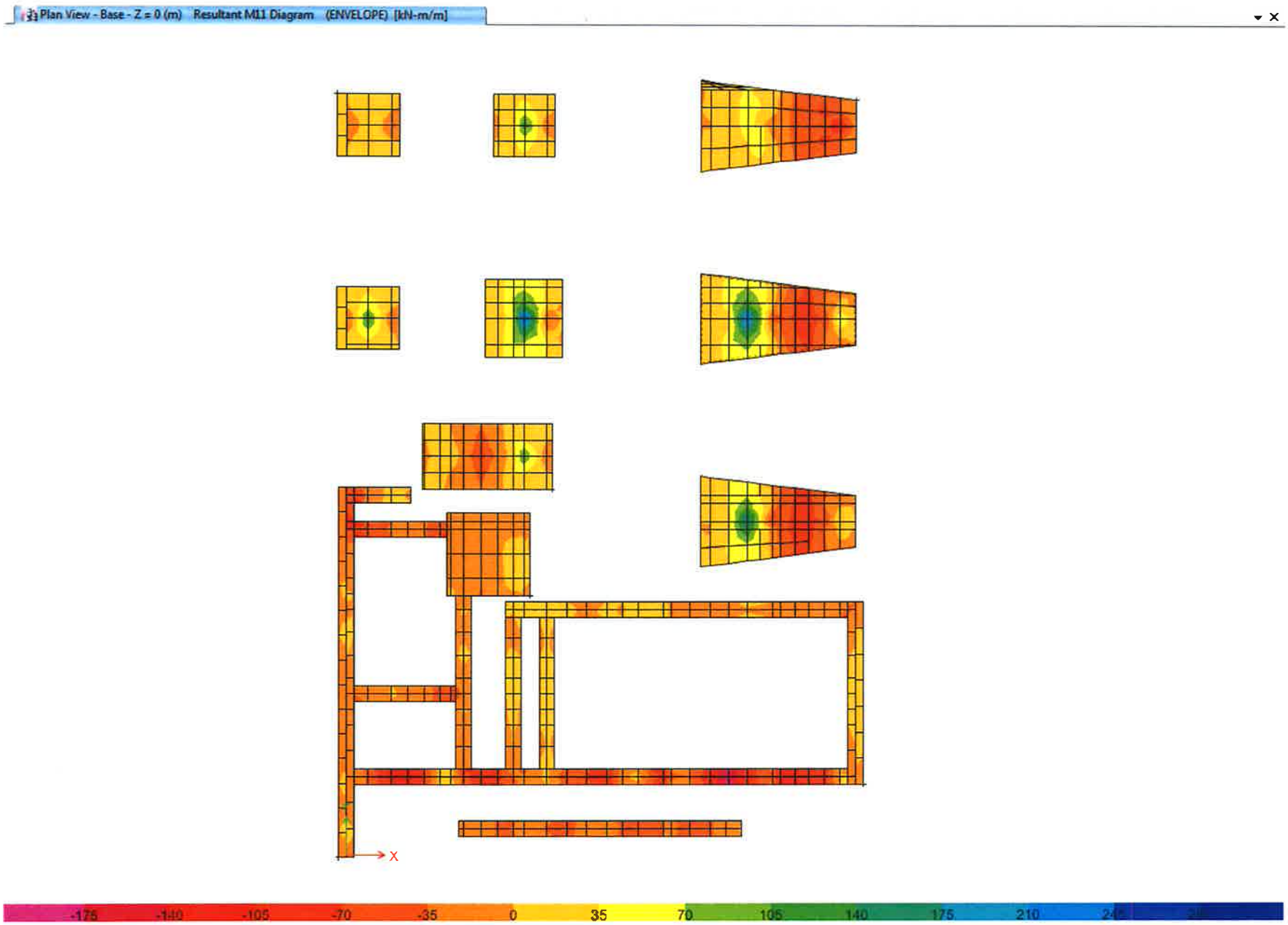
FC3



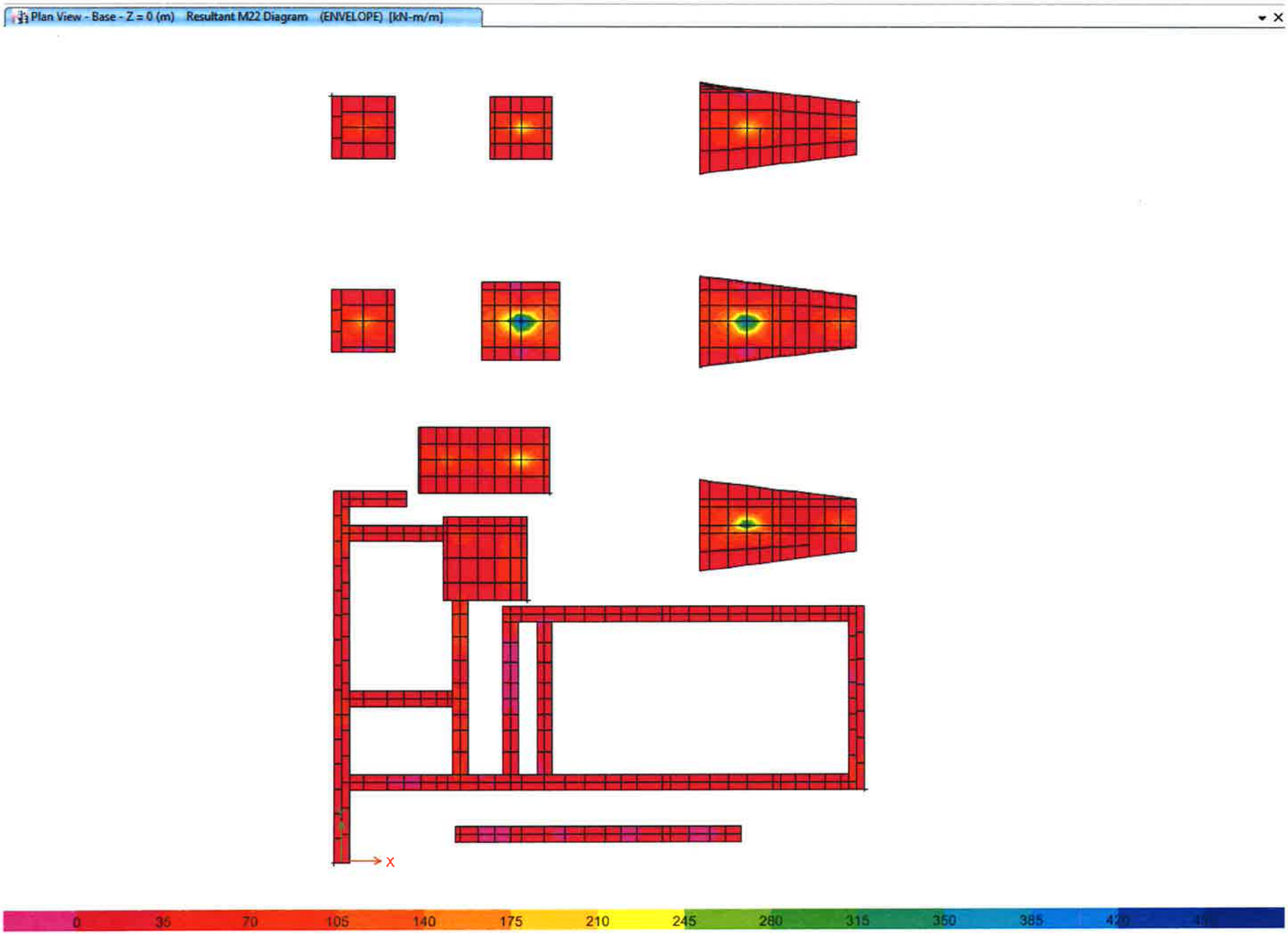
SAFE OUTPUT – Soil Bearing Pressures Under Ultimate Loading (kPa)



ETABS MODEL – Overall Footings, Bending Moments X Direction Largest Positive (kN.m/m)

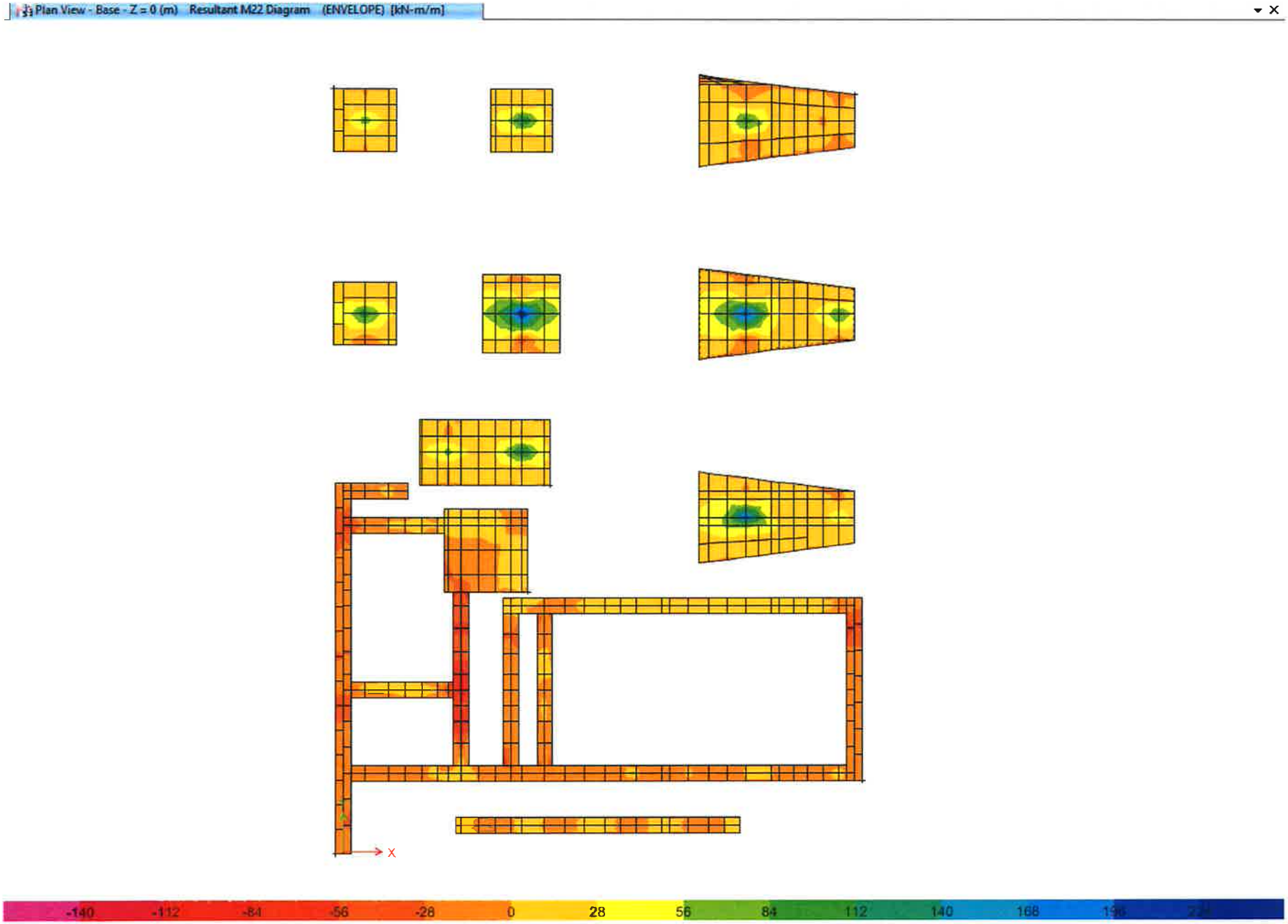


ETABS MODEL – Overall Footings, Bending X Direction Largest Negative (kN.m/m)

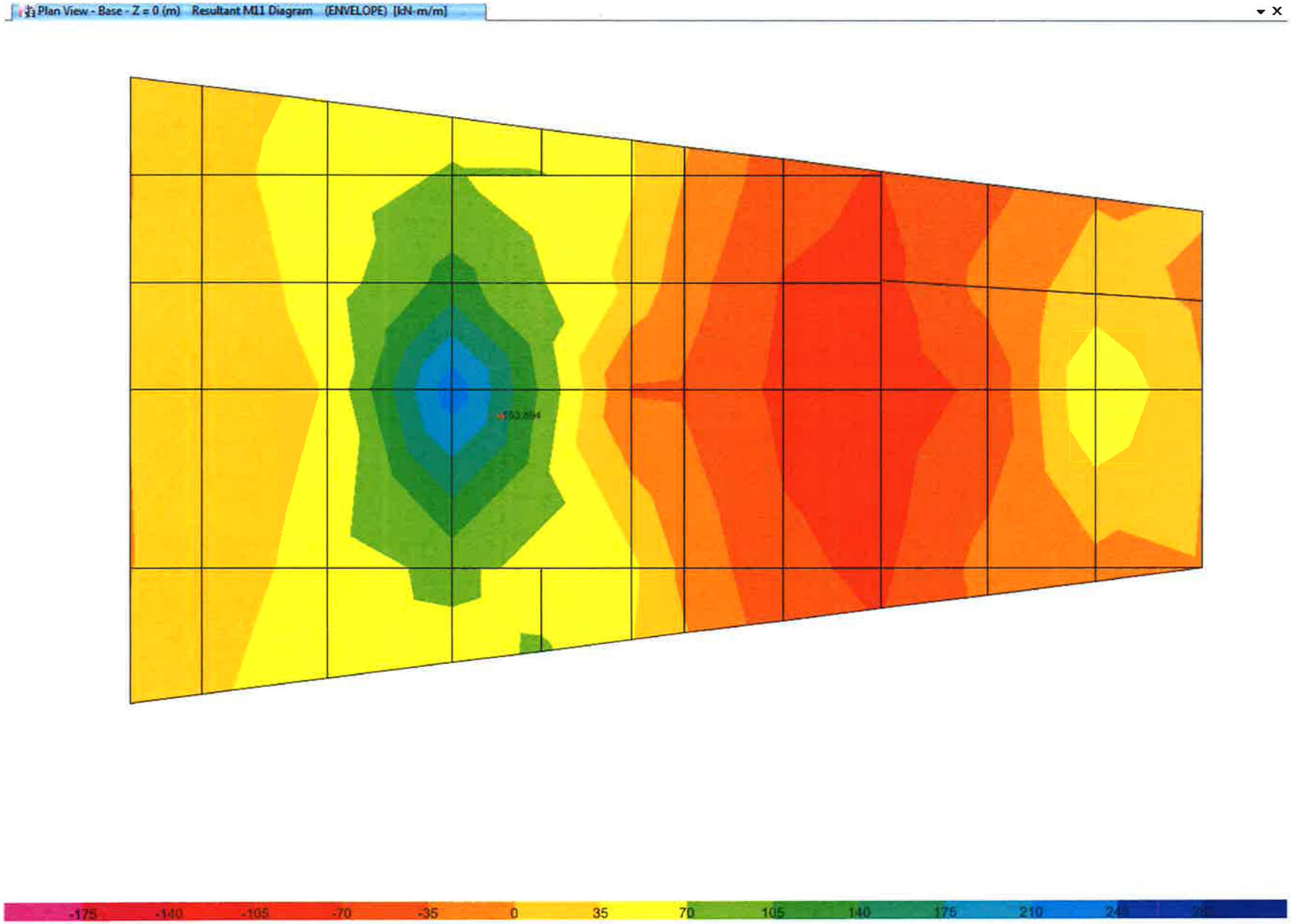


ETABS MODEL – Overall Footings, Bending Y Direction Largest Positive (kN.m/m)

FC7

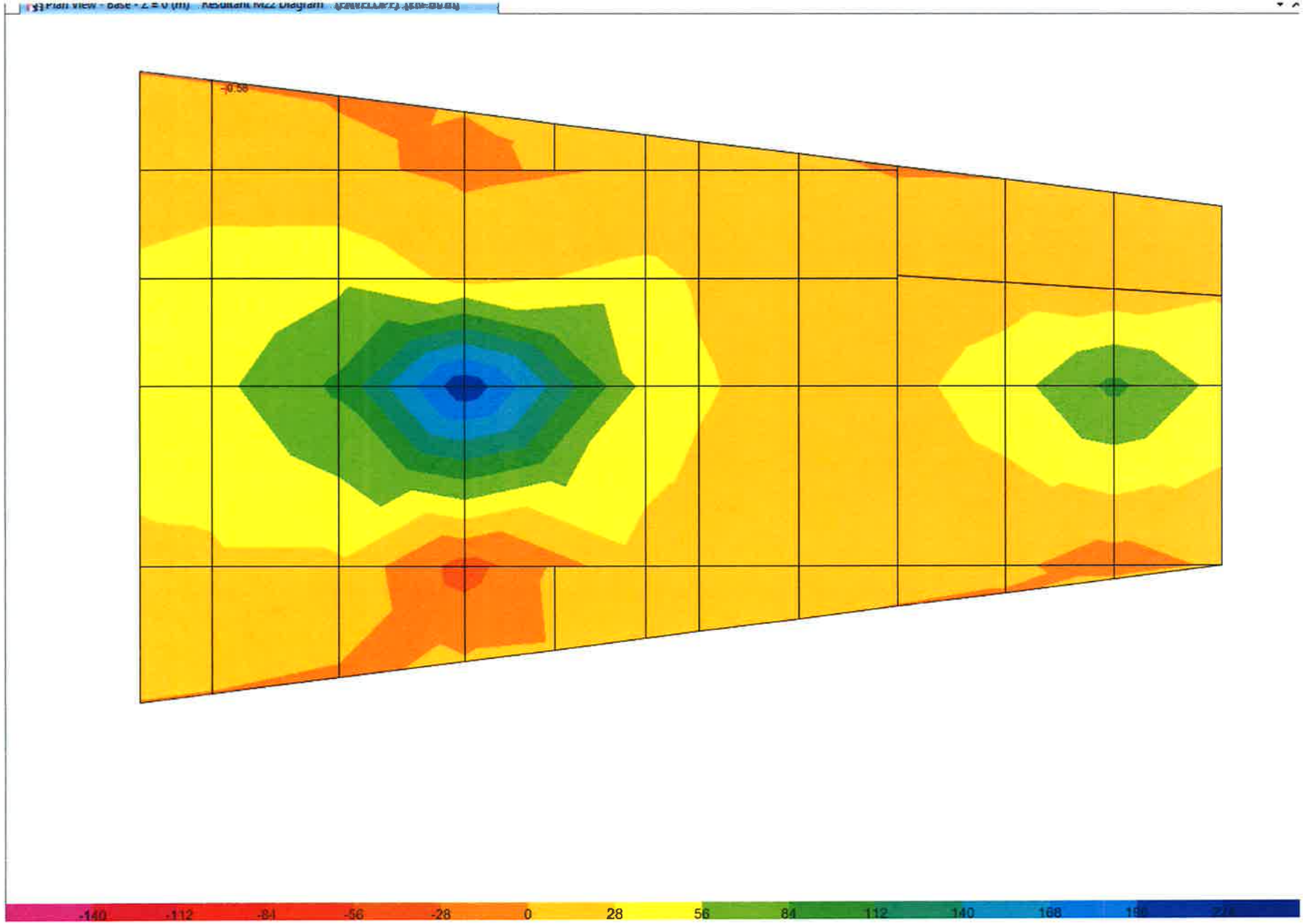


ETABS MODEL – Overall Footings, Bending Y Direction Largest Negative (kN.m/m)

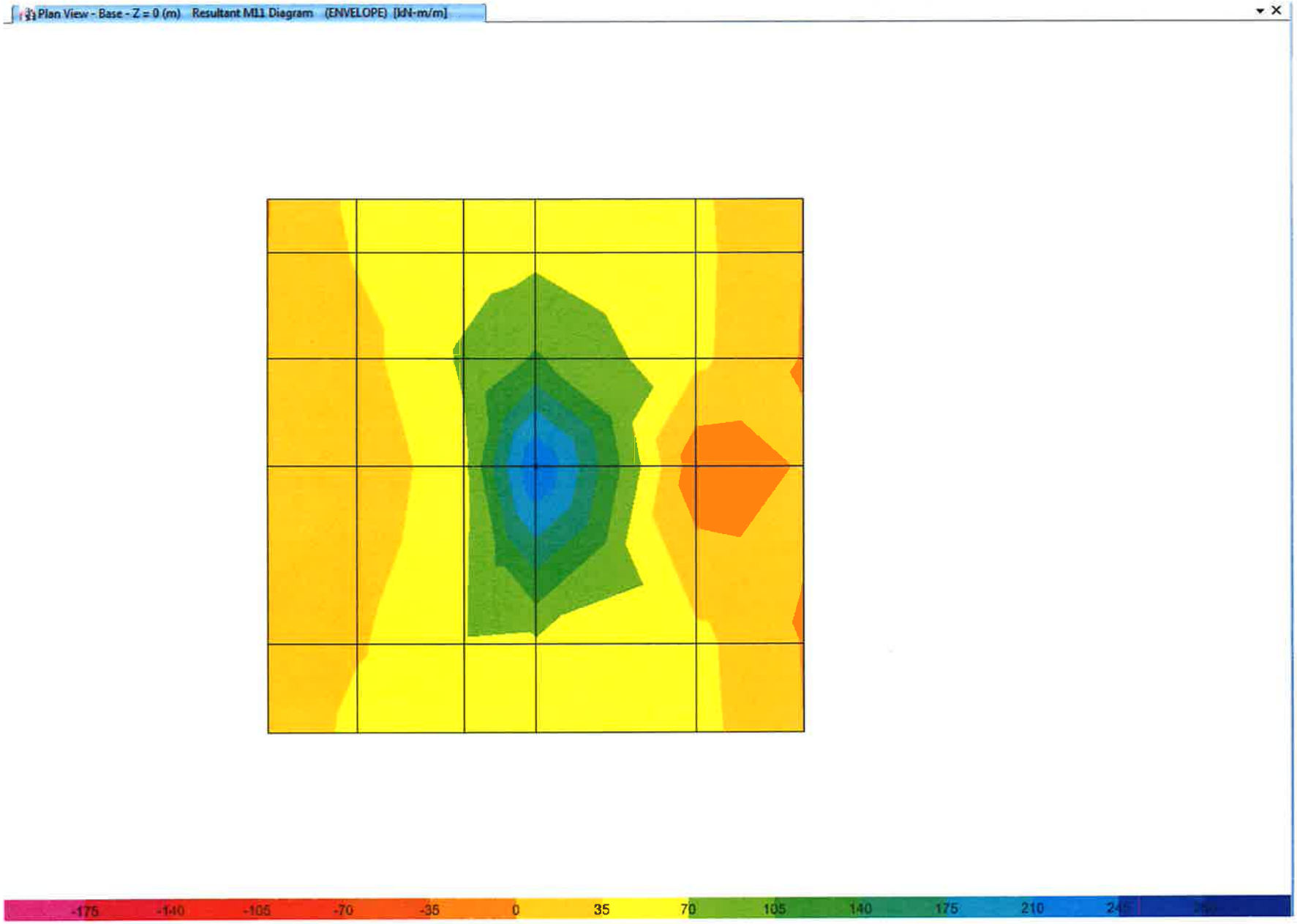


ETABS MODEL – PF1 Bending X Direction Absolute Max (kN.m/m)

FC9

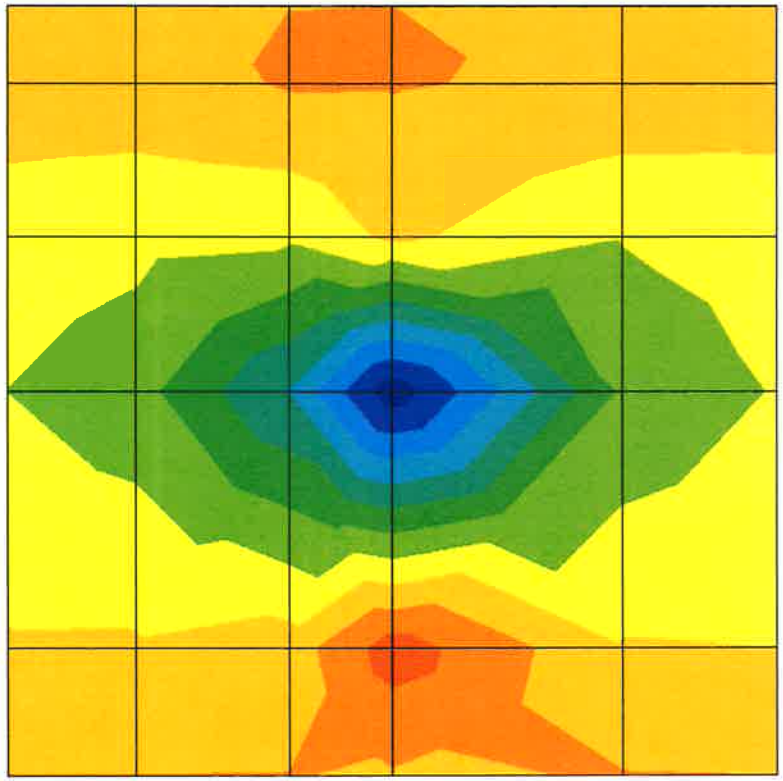


ETABS MODEL – PF1 Bending Y Direction Absolute Max (kN.m/m)

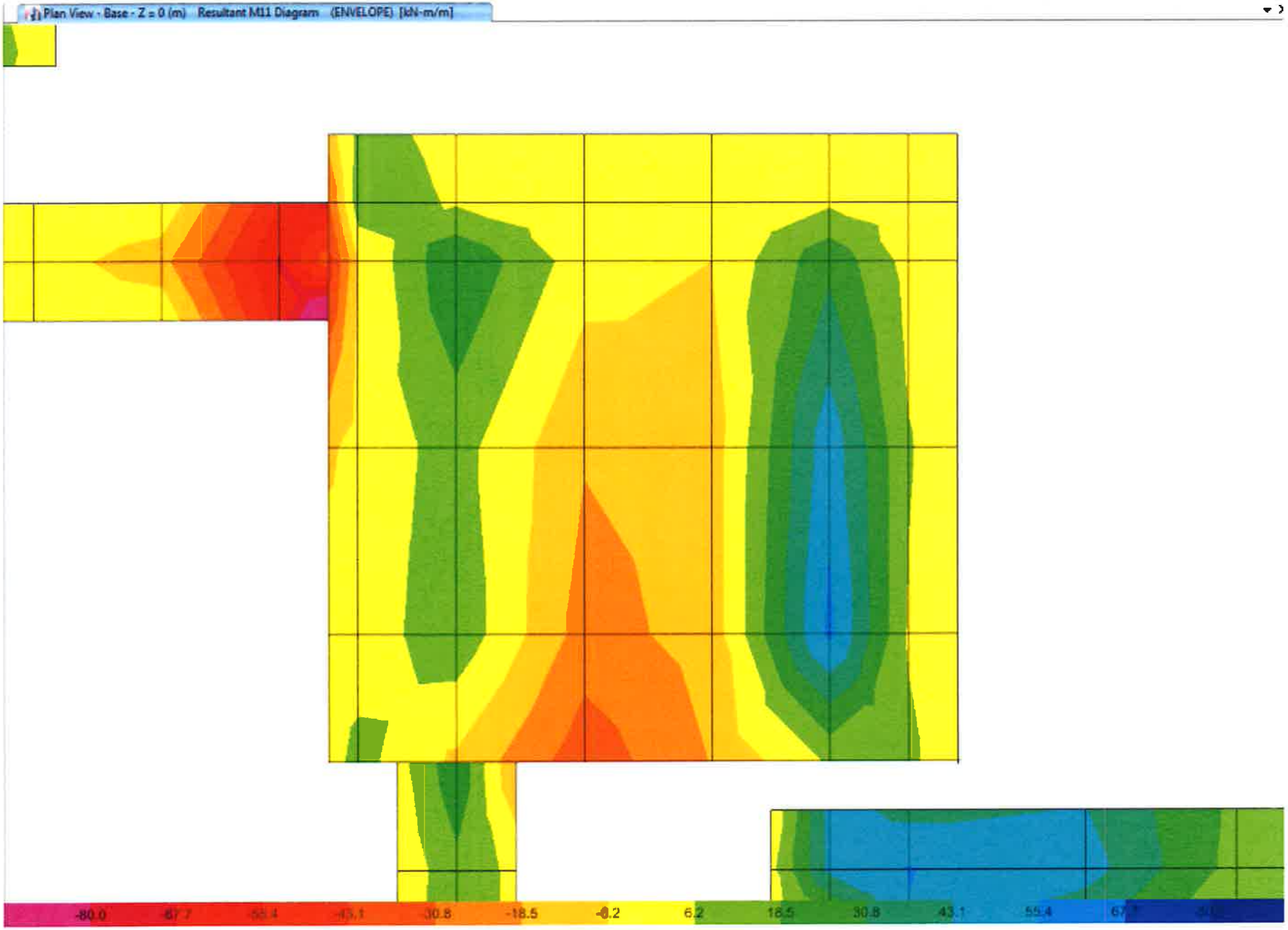


ETABS MODEL – PF2 Bending X Direction Absolute Max (kN.m/m)

Plan View - Base - Z = 0 (m) Resultant M22 Diagram (ENVELOPE) [kN-m/m]

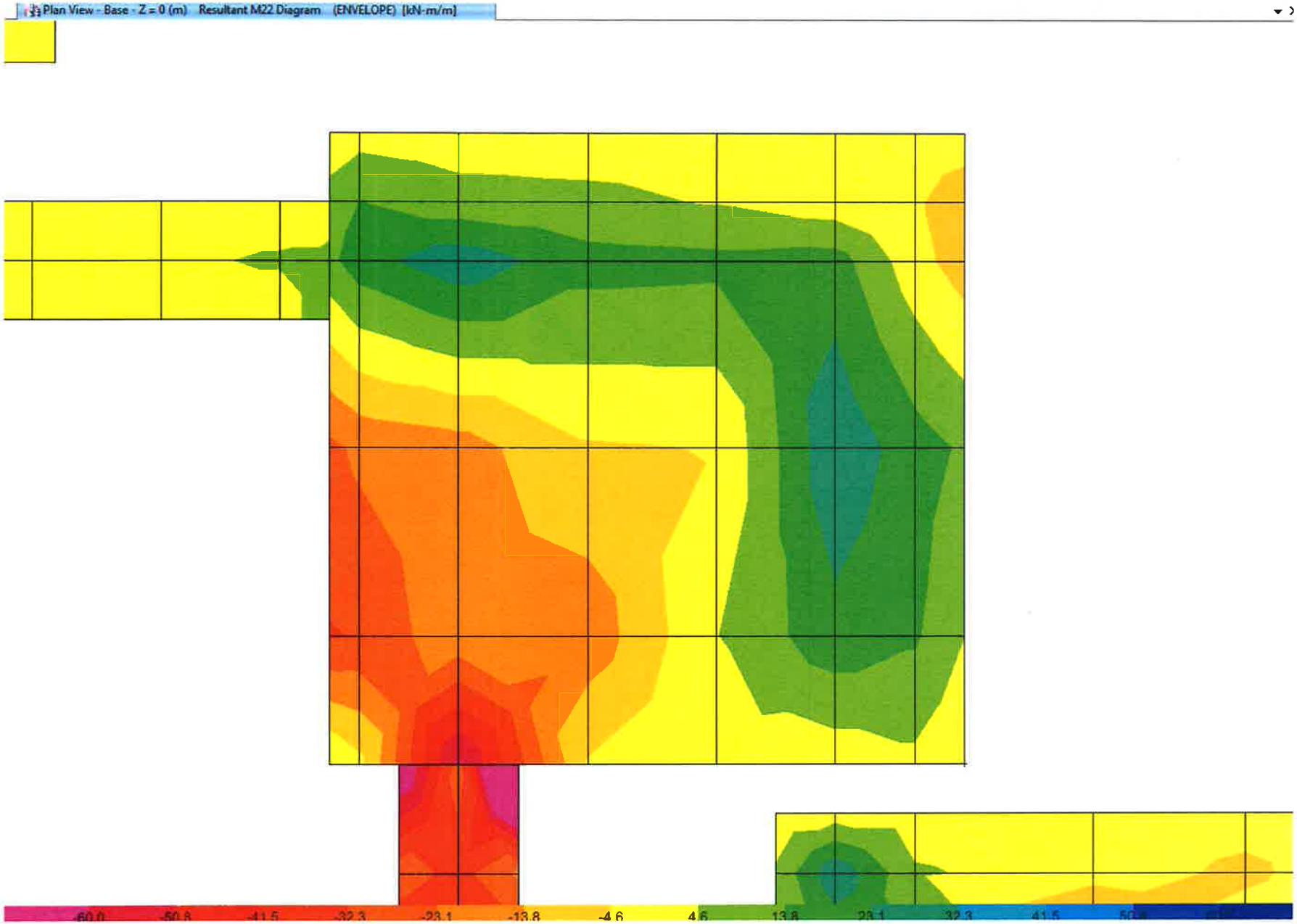


ETABS MODEL – PF2 Bending Y Direction Absolute Max (kN.m/m)



ETABS MODEL – PF3 Bending X Direction Absolute Max (kN.m/m)

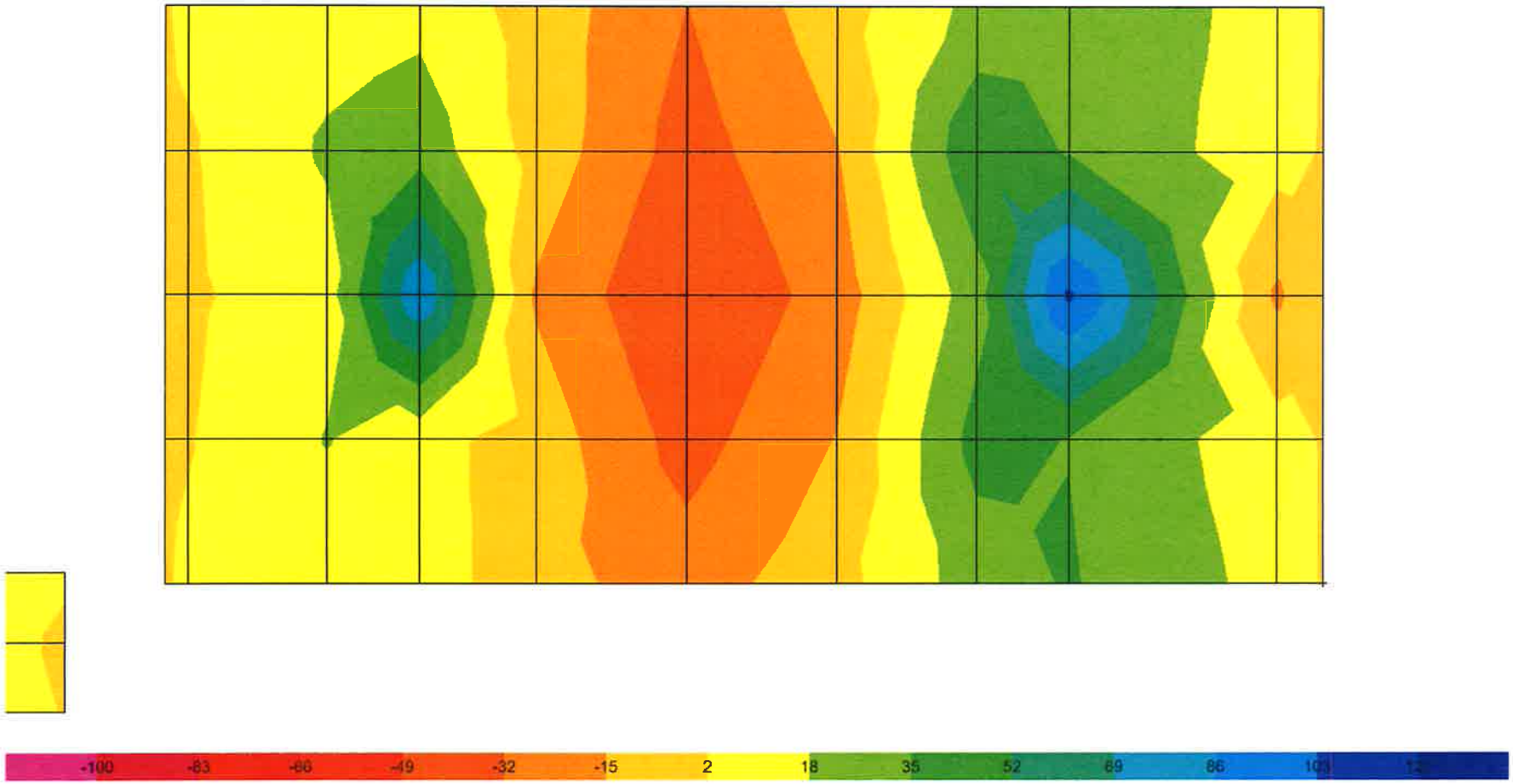
FC13



ETABS MODEL – PF3 Bending Y Direction Absolute Max (kN.m/m)

FC14

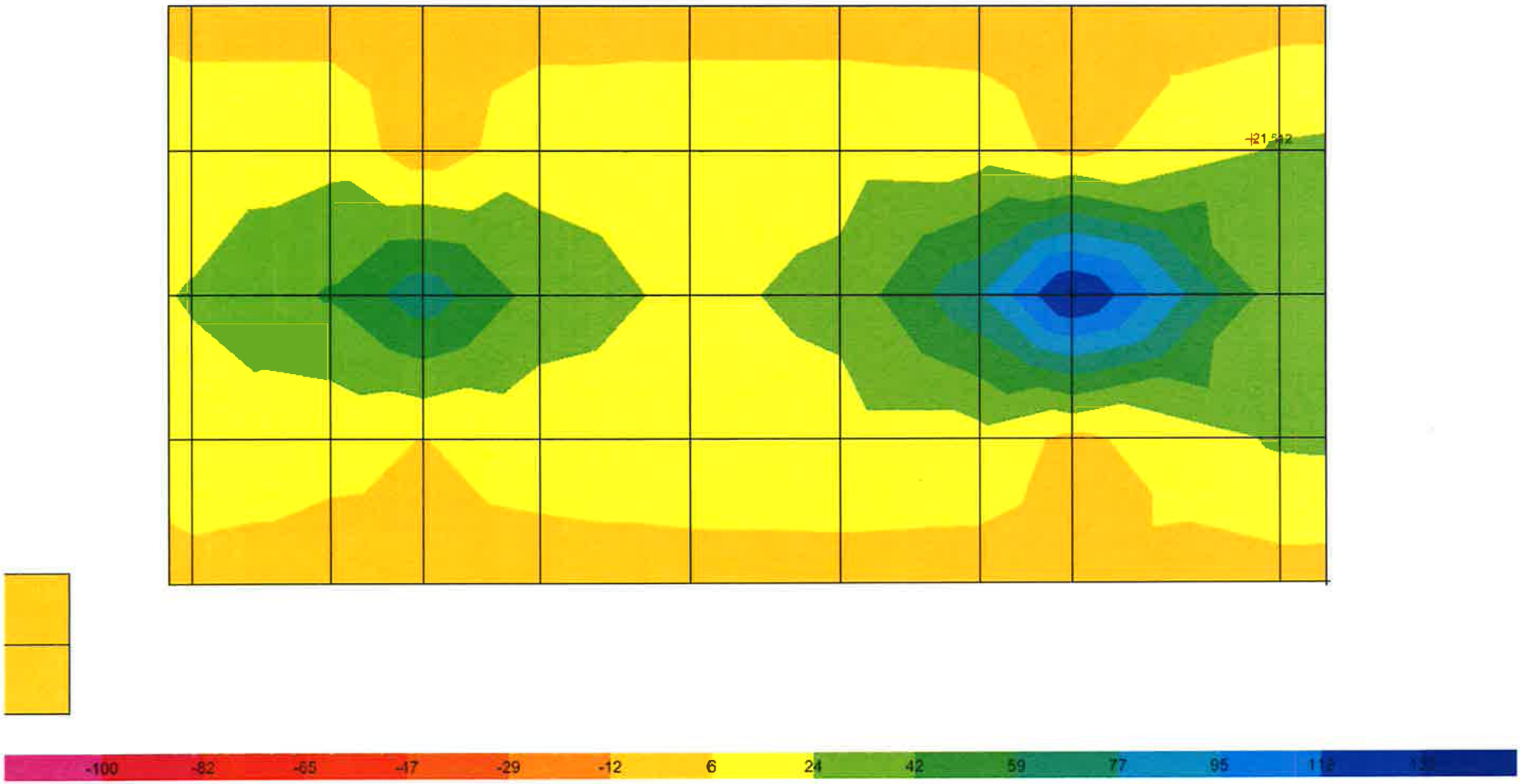
Plan View - Base - Z = 0 (m) Resultant M11 Diagram (ENVELOPE) [kN-m/m]



ETABS MODEL – PF5 Bending X Direction Absolute Max (kN.m/m)

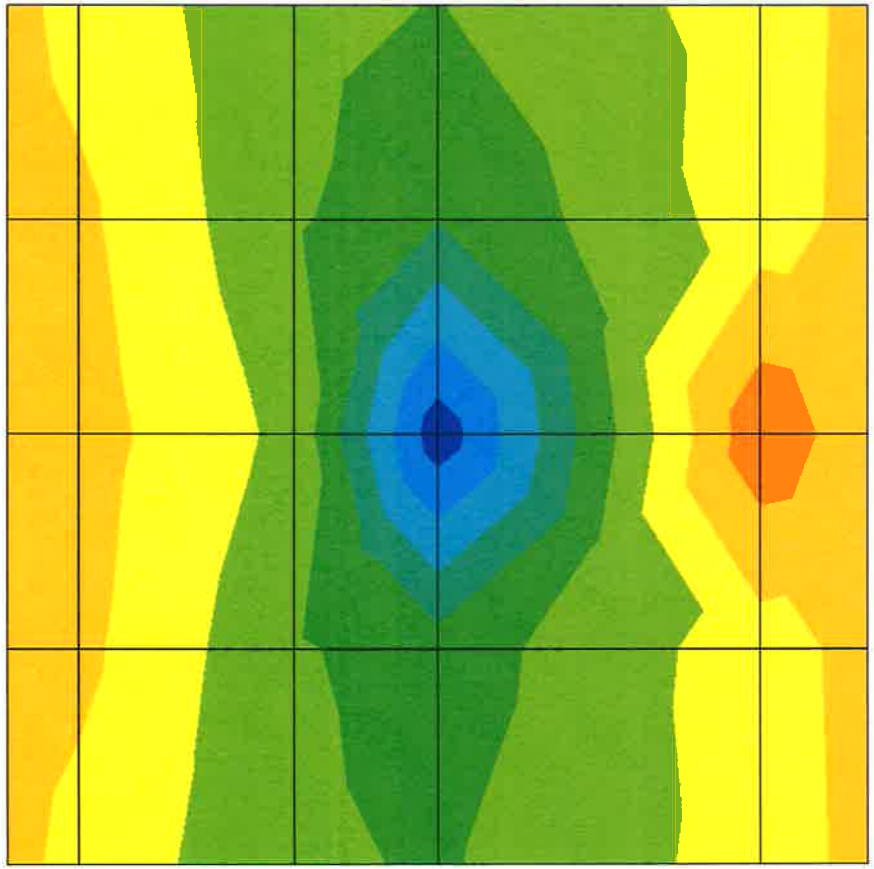
FC15

Plan View - Base - Z = 0 (m) Resultant M22 Diagram (ENVELOPE) [kN-m/m]



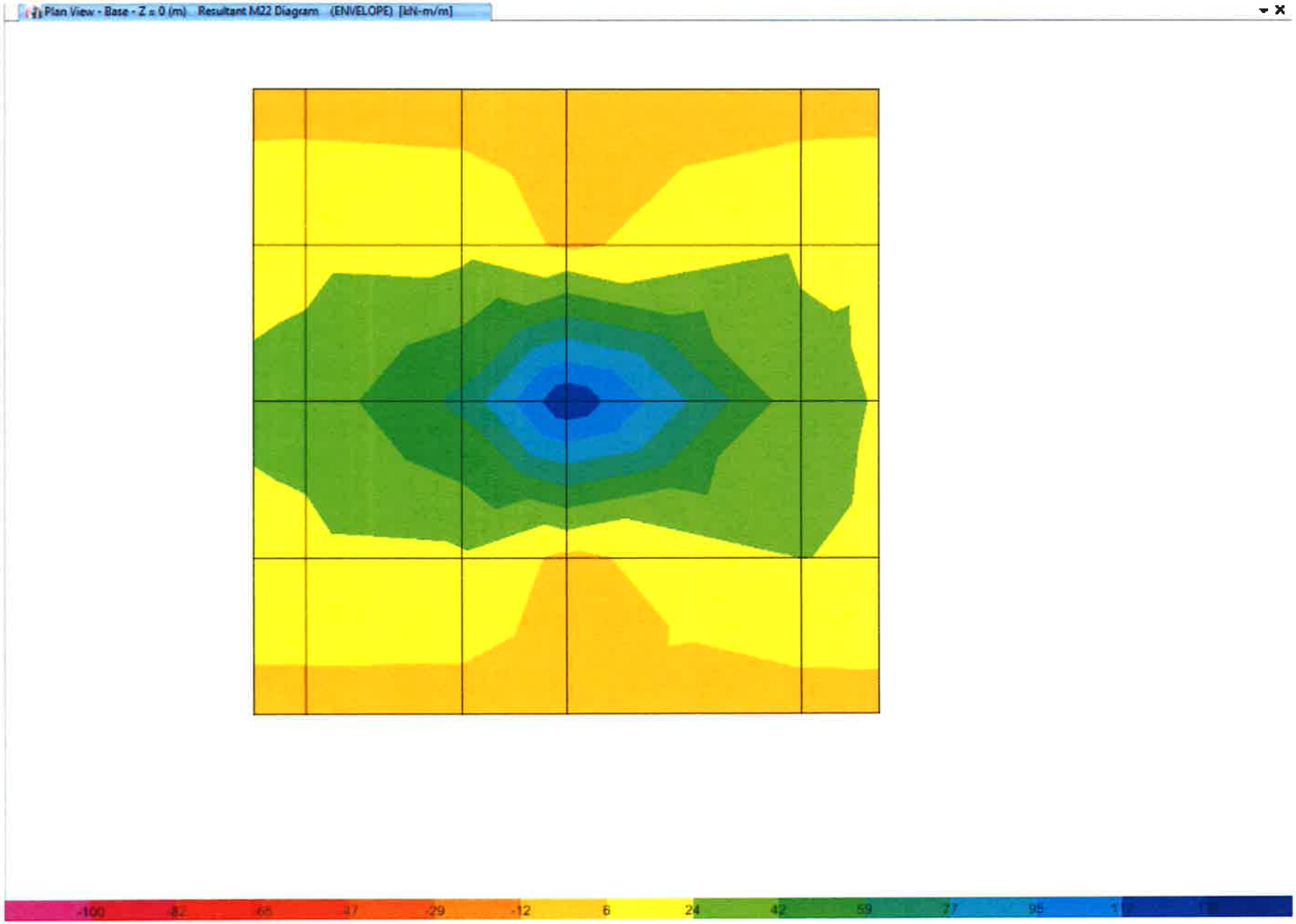
ETABS MODEL – PF5 Bending Y Direction Absolute Max (kN.m/m)

Plan View - Base - Z = 0 (m) Resultant M11 Diagram (ENVELOPE) [kN-m/m]



ETABS MODEL – PF2 Bending X Direction Absolute Max (kN.m/m)

FC17



ETABS MODEL – PF2 Bending Y Direction Absolute Max (kN.m/m)

F218

REACTIVE SOIL MOVEMENT CALCULATIONS

Sub-number :

Boreholes : 1 to 4

These calculations comply with the requirements of AS 2870—2011 and "Special Provisions for the Design of Residential Slabs and Footings for South Australian Conditions", February 2013.

The values of the Differential Mound Movement y_m for the Centre Heave (C/H) and Edge Heave (E/H) conditions are intended for use in the Walsh Method of Analysis and comply with Clause F2 of AS 2870—2011.

Depth of Design Suction Change :	4.0	metres	Table 2.4
Depth of the Cracked Zone :	3.0	metres	Clause 2.3.2
Include the effects of trees :	N	(Y=Yes, N=No)	

Summary of soil profile parameters used in calculations

	HOLE 1		HOLE 2		HOLE 3		HOLE 4	
Fill < 5 yrs **		metres		metres		metres		metres
Cut < 2 yrs **		metres		metres		metres		metres
Bedrock **		metres		metres		metres		metres
Water Table **		metres		metres		metres		metres
Horizons	Depth	Ips	Depth	Ips	Depth	Ips	Depth	Ips
1	0.30	0.005	0.30	0.005	0.30	0.005		
2	0.80	0.015	0.60	0.015	0.70	0.015		
3	1.90	0.010	1.00	0.010	1.60	0.010		
4	2.40	0.015	1.50	0.015	2.25	0.015		
5	3.10	0.020	2.20	0.020	2.50	0.020		
6	3.60	0.035	3.00	0.035	3.20	0.035		
7	4.40	0.045	4.20	0.045	4.40	0.045		

** Leave blank if this parameter does not influence the design

Summary of tree effect parameters (to AS 2870—2011 Appendix H)

This design EXCLUDES TREE EFFECTS

HT =	n/a	Design height of row of trees (m)	
D_t =	n/a	Distance to row of trees (m)	
D_i / HT =	n/a	Tree Factor	Appendix H
S_v =	n/a	Surface Value of ΔpF	Table 2.4
Δu_{base} =	n/a	due the effect of the row of trees	
and H_t =	n/a	metres	Appendix H

Summary of calculated surface movement values

	HOLE 1	HOLE 2	HOLE 3	HOLE 4
Characteristic Surface Movement, y_s (mm)	**32.4**	**46.0**	**37.8**	**n/a**
Surface Movement due to the Effects of Trees, y_t (mm)	**n/a**	**n/a**	**n/a**	**n/a**

The maximum value of y_s is **46 mm** **Site Classification : H1-D** **(Table 2.3)**

=>For design, use:	**C/H: y_m =**	**32 mm**	Appendix F2
	E/H: y_m =	**23 mm**	Appendix F2
=>For design, use:	**y_t =**	**n/a mm**	Appendix H

Notes / Comments :

In the case where trees have been found on the site or tree planting is planned in the vicinity of the proposed works, this design attempts to account for their effects by allowing for a vertical soil movement greater than would be expected to occur as a result of normal seasonal moisture movements beneath and adjacent to the footing. However, due to the complexity of tree root geometry, variable moisture extraction by the tree and the difficulty in predicting future tree growth, a precise design for the effects of trees is outside current knowledge.

The Owner must understand that, although appropriate precautions have been taken in this design for the effects of trees, some tree-induced movement in the structure must be accepted.

Suspended Slab Design

- Model off-formed slabs in ETABS; see output extracts for strength & deflection checks.
- Model One-way Decking slabs using RAPT (see output attached) Check fire using spreadsheets; noting that based on using KF57 1.0mm BMT profile required fire steel can be reduced by 381 (for 90min) & 361 mm²/m (for 120min). Refer to Fielders manual extract - table 2.4.

Loads

Superimposed DL ~ 0.5kPa
General live load ~ 2.0kPa
Balcony live load - 3.0kPa
Foyer + corridor live load ~ 4.0kPa.

* Also as requested by builder; no soffit set downs for internal wet areas => design in RAPT for minimum required thickness then increase by 40mm.
* Balconies require 90mm FFL set down => provide soffit set down for these.

Fire Design

- As stated above, KF57 rib contribution of 381 mm²/m or 361 mm²/m toward fire reinf.
- From Bondek spreadsheets (equivalent profile) Asf ≤ 350mm²/m in all slab situations.
  => no additional fire reinf required to decking

Checked : .....
Date : ..../..../.....

Project Name: 168 Prospect Road
Project Number: 1702160
Frame Description: 3S1 Single Span
Designer: FK
K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\3S1 Single Span.rpf

RAPT - Version: 6.2.2.2
Reinforced And Post-Tensioned Concrete Analysis & Design Package
Copyright(C) 1988 - 2010 PCDC Pty. Ltd. All Rights Reserved

FIELDERS KINGFLOR® COMPOSITE STEEL FORMWORK

Licensee
TMK Consulting Engineers
105 Waymouth Street
Adelaide SA 5000
318662120608UPN3

Input

General

Design Code	List	Australia - AS3600*SAVED*
Material	List	Australia - Australian Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Slab
Panel Type	List	Internal
Strip Type	List	One way - Full Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	32MPa
Concrete - Columns	List	40MPa
Top Reinforcement Cover	mm	20
Bottom Reinforcement Cover	mm	20
Self Weight Definition	List	Program Calculated
Pattern Live Load	Y/N	
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	6700	250	1200	1200
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse prestress (P/A)
	A	List	mm	MPa
1	1	Knife-Edge	1200	
2	2	Knife-Edge	1200	

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Extra Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1. Self Weight - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Description A
1	1	0	6	2	0	6	

2. Extra Dead Load - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Description A
1	1	0	0.5	2	0	0.5	

3. Live Load - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Live Load reduction #.#	Description A
1	1	0	2	2	0	2	1	

Load Combinations : Ultimate

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Live Load	1.2	1.2	1.5
2	Live Load	0.9	0.9	1.5
3	Dead Load	1.35	1.35	0

Load Combinations : Short Term Service

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Live Load	1	1	0.7

Load Combinations : Permanent Service

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Live Load	1	1	0.4

Load Combinations : Deflection

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Short Term - Deflection	1	1	0.7
2	Permanent - Deflection	1	1	0.4
3	Initial - Deflection	1	0	0

Load Combinations : Transfer Prestress

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Transfer	1	0	0

Load Combinations : Pre Existing

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3 Live Load #.#
1	Pre Existing	1	0	0

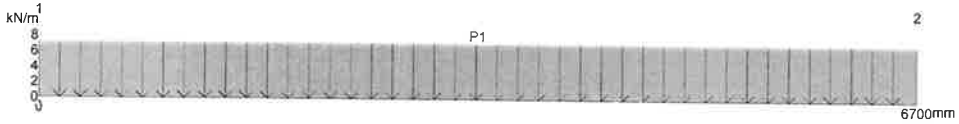
3S1 - Single Span

SL2

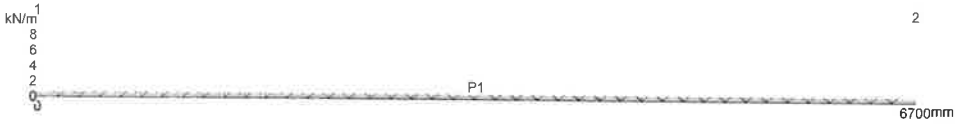
Load Combinations : Construction

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Construction	1	0	0

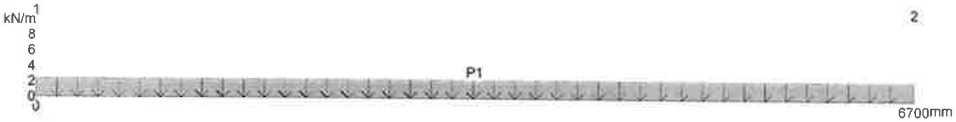
Load Case 1 : 1. Self Weight



Load Case 2 : 2. Extra Dead Load



Load Case 3 : 3. Live Load



Reinforcement

Reinforcement Use	Reinforcement Type	Preferred Bar Size	Number of Legs
	List	List	#
Flexural Bar	N 500MPa		
Flexural Mesh	F 450MPa		
Shear Option 1	N 500MPa	10	2
Shear Option 2	N 500MPa	12	2
Shear Option 3	N 500MPa	16	2
Punching Shear	N 500MPa	10	1

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	99	0			N	N
Span Reinforcement	300	99		0	0	N	N

Design Zones : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Top Cover at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Top Cover at Right end	Maximum Bar Size	Minimum Bar Size	Preferred bar size	Minimum Number of Bars
	List		mm	mm	mm		mm	mm	mm	List	List	List	#
1	Bar	1	0	0	20	2	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	mm	%	%
1	0	0	0

Design Zones : Bottom

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Bottom Cover at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Bottom Cover at Right End	Maximum Bar Size	Minimum Bar Size	Preferred bar size	Minimum Number of Bars
	List		mm	mm	mm		mm	mm	mm	List	List	List	#
1	Bar	1	0	0	20	2	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	mm	%	%
1	0	0	0

User Defined : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Top Cover at left end	% Development of Left End of Bar in Tension	% Development of Left End of Bar in Compression	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Top Cover at Right end	% Development of Right End of Bar in Tension
	List		mm	mm	mm	%	%		mm	mm	mm	%
1	L 500MPa	1	0	0	35	0	0	2	0	0	35	0

Layer Number	% Development of Right End of Bar in Compression	Bar Size	Mesh full width of Design Cross-section	Width of mesh	% in Flange	Layer attached after the PreExisting Load Case
	%	List	Y/N	mm	%	Y/N
1	0	102	Y	0	0	N

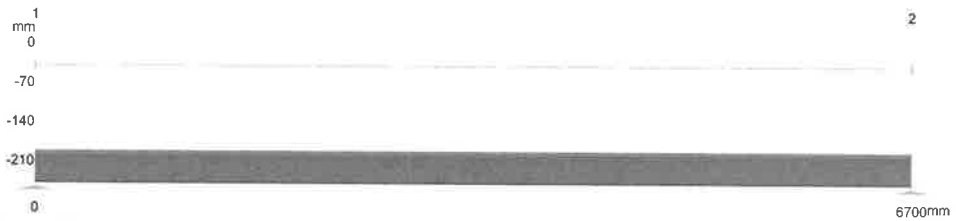
or N12 @300c/c OK

User Defined : Metal Decking

Layer Number	Metal Deck Type	Left End Reference Column	Distance to Left End of Metal Deck	Distance to Start of Concrete Void from Start of Sheet	Right End Reference Column	Distance to Right End of Metal Deck	Distance to End of Concrete Void from End of Sheet	Sheet Thickness	Number of Sheets	Description
	List	#	mm	mm	#	mm	mm	List	#	A
	KF57	1	0	0	2	0	0	1.0mm	4	

Reinforcement Design Zones

Reinforcement Design Zones User Defined



Design Data

Capacity Reduction factor (phi) for Flexure	#.#	0.8
Capacity Reduction factor (phi) for Shear	#.#	0.7
Material Factor for Concrete in Flexure	#.#	1
Material Factor for Concrete in Shear	#.#	1
Material Factor for Reinforcement	#.#	1
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.4
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	N
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment
Moment Diagram Offset For Flexure Calculations	List	Code Default

SL3

Limit Reinforcement Strain	Y/N	N
Beam Shear Critical Section Location	List	Code Critical Section

Maximum Service Stress Change - Prestressed Sections	MPa	150
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C.	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	N

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	25
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Incremental Deflection Warning Limit - Maximum Deflection	mm	25
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	25.6
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#
Pattern Live Load for Ultimate Strength	Y/N
Pattern Live Load for Crack Control	Y/N
Pattern Live Load For Deflections	Y/N
Pattern Live Load for Deflection Permanent Load Combination	Y/N

Material Properties

Concrete

Description	32MPa	40MPa
Characteristic Compressive Strength	32	40
Mean Compressive Strength	37.22	45.9
Lower Characteristic Tensile Strength	3.39	3.79
Upper Characteristic Tensile Strength	5.43	6.07
Concrete Weight	2447	2447
Design Concrete Modulus	29443.8	32919.2
Mean Concrete Modulus	31754.7	35263.5
Ultimate Concrete Modulus	29443.8	32919.2
Basic Shrinkage Strain	850	850
Basic Creep Factor	3.4	2.5
Concrete Strain Limit	0.003	0.003

Reinforcement Bar

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
N	Deformed	500	2e5	N	0.05	540	90	-1	-1	-1	-1	Y	

Nominal Bar Size A	Bar Diameter mm	Bar Area mm2	Bar Inertia mm4	Bar Weight kg/m	Stock Length mm
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
24	24	452	16292.6	3.55	12000
28	28	616	30184	4.83	12000
32	32	804	51492.6	6.31	12000
36	36	1020	82481.1	7.99	12000
40	40	1260	1.257e5	9.86	12000

Reinforcement Mesh

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
L	Deformed	500	2e5	L	0.015	515	90	-1	-1	-1	-1	Y	

Nominal Mesh Size A	Main Bar Diameter mm	Main Bar Area mm2/m	Main Bar Spacing mm	Main Bar Inertia mm4	Cross bar Diameter mm	Cross bar Area mm2/m	Cross Bar Spacing mm	Mesh Weight kg/m2	Stock Length mm
62	6	141	200	0	6	141	200	0	0
72	7	179	200	0	7	179	200	0	0
82	8	227	200	0	8	227	200	0	0
92	9	290	200	0	9	290	200	0	0
102	10	354	200	0	10	354	200	0	0
81	8	454	100	0	8	454	100	0	0
718	7	358	100	0	8	227	200	0	0
818	8	454	100	0	8	227	200	0	0
918	9	581	100	0	8	227	200	0	0
1018	10	709	100	0	8	227	200	0	0
1118	11	899	100	0	8	227	200	0	0
1218	12	1112	100	0	8	227	200	0	0

Metal Decking

Sheet Designation	Yield Stress	Youngs Modulus	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexexure	Material Factor Shear	Capacity Reduction Factor Flexuse	Capacity Reduction Factor Shear	Flexural Rebar For Shear	Description
KF57	550	2e5	0.035	600	90	-1	-1	-1	-1	Y	

Nominal Size A	Sheet Thickness mm	Sheet Width mm	Sheet Height mm	Number of Rib Spaces #	Sheet Centroid from Bottom mm	Sheet Area mm2	Sheet Inertia mm4	Mechanical Resistance kN/m2	Sheet Weight kg/m
.75mm	0.8	300	58	1	14.5	358.5	1.449e5	476	0
.9mm	0.9	300	58	1	14.5	430.2	1.799e5	580	0
1.0mm	1	300	58	1	14.5	477.9	1.999e5	645	0

Elevation view

Plan view

Warnings

Input

No errors or warnings were found.

Output

No errors or warnings were found.

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0

SL4

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Below	kNm	-0	-0	-0
Reaction	kN	24.12	2.01	8.04
Elastic Rotation	#.#	1.82e-3	1.52e-4	6.06e-4
Elastic Axial Shortening	mm	0	0	0

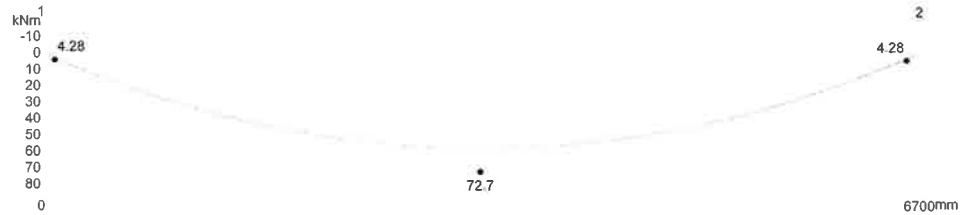
Col No. 2		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	24.12	2.01	8.04
Elastic Rotation	#.#	-1.82e-3	-1.52e-4	-6.06e-4
Elastic Axial Shortening	mm	0	0	0

Load Combinations
Column Actions

Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	31.75	31.75	43.41	43.41	35.27	43.41
Elastic Rotation	#.#	2.39e-3	2.39e-3	3.27e-3	3.27e-3	2.66e-3	3.27e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	31.75	31.75	43.41	43.41	35.27	43.41
Elastic Rotation	#.#	-2.39e-3	-2.39e-3	-3.27e-3	-3.27e-3	-2.66e-3	-3.27e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Ultimate Flexure



Moment Moment 1 Moment 2

Shear Shear 1 Shear 2

Flexural Design
Ultimate

Reinforcement Top Total | Bottom Total | Top Ultimate | Bottom Ultimate | Min Top | Min Bot

Capacity Minimum | Ultimate Design | Initial | Final

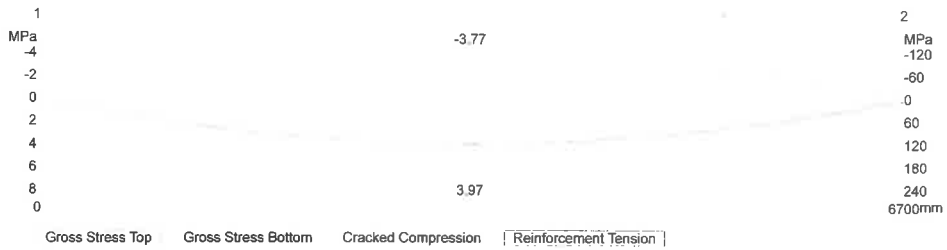
Neutral Axis Depth Initial | Final

Service
Maximum Moment Condition

Gross Stress Top | Gross Stress Bottom | Cracked Compression | Reinforcement Tension

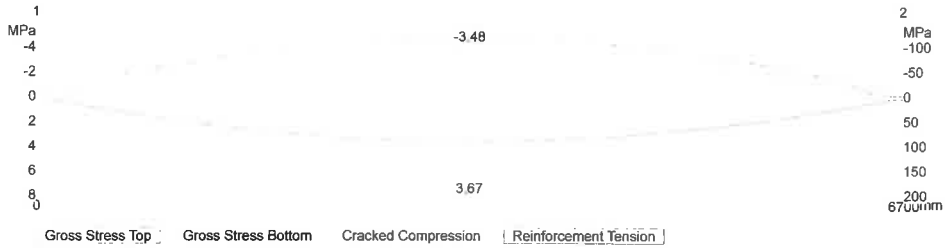
S15

Reversal Moment Condition

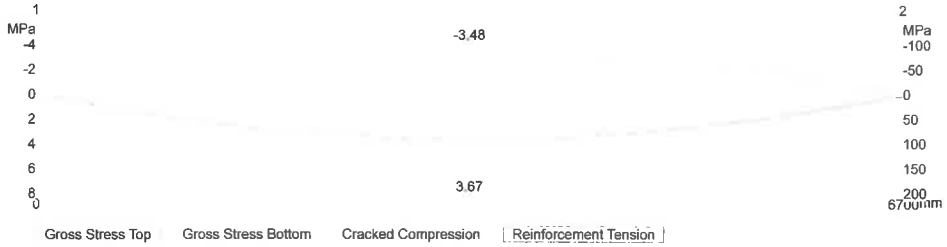


Permanent

Maximum Moment Condition



Reversal Moment Condition



Shear Design

Beam

Span 1

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets			Shear Comments
												2 legs N10	2 legs N12	2 legs N16	
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
100	42.12	4.28	0	224	463.19	1200	0	0	0	1204.22	0	0	0	0	
200	40.82	8.42	0	224	416.89	1200	126.93	99999	126.93	1204.22	0	0	0	0	No shear steel
445	37.65	18.04	0	235.5	0	1200	122.67	99999	122.67	1266.05	0	0	0	0	No shear steel
690	34.47	26.87	0	235.5	0	1200	129.45	99999	129.45	1266.05	0	0	0	0	No shear steel
935	31.48	33.84	0	235.5	0	1200	135.58	99999	135.58	1266.05	0	0	0	0	No shear steel
1180	28.31	41.16	0	235.5	0	1200	141.21	99999	141.21	1266.05	0	0	0	0	No shear steel
1425	25.13	47.71	0	235.5	0	1200	123.41	99999	123.41	1266.05	0	0	0	0	No shear steel
1675	22.46	50.75	0	235.5	0	1200	130.24	99999	130.24	1266.05	0	0	0	0	No shear steel
2233	15.23	61.26	0	235.5	0	1200	143.34	99999	143.34	1266.05	0	0	0	0	No shear steel
2791	8.94	64.06	0	235.5	0	1200	154.41	99999	154.41	1266.05	0	0	0	0	No shear steel
3350	3.02	62.62	0	235.5	0	1200	164.1	99999	164.1	1266.05	0	0	0	0	No shear steel
3908	-8.93	64.07	0	235.5	0	1200	154.43	99999	154.43	1266.05	0	0	0	0	No shear steel
4466	-15.22	61.28	0	235.5	0	1200	143.36	99999	143.36	1266.05	0	0	0	0	No shear steel
5025	-22.46	50.75	0	235.5	0	1200	130.24	99999	130.24	1266.05	0	0	0	0	No shear steel
5270	-25.07	47.84	0	235.5	0	1200	123.55	99999	123.55	1266.05	0	0	0	0	No shear steel
5515	-28.24	41.31	0	235.5	0	1200	141.32	99999	141.32	1266.05	0	0	0	0	No shear steel
5760	-31.42	34	0	235.5	0	1200	135.7	99999	135.7	1266.05	0	0	0	0	No shear steel
6005	-34.41	27.04	0	235.5	0	1200	129.58	99999	129.58	1266.05	0	0	0	0	No shear steel
6250	-37.58	18.22	0	235.5	0	1200	122.82	99999	122.82	1266.05	0	0	0	0	No shear steel
6500	-40.82	8.42	0	224	416.89	1200	126.93	99999	126.93	1204.22	0	0	0	0	No shear steel

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets			Shear Comments
												2 legs N10	2 legs N12	2 legs N16	
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
6600	-42.12	4.28	0	224	463.19	1200	0	0	0	1204.22	0	0	0	0	

Design Comments:-
- Shear areas and spacings adjusted for Fitment hook location as per AS3600 cl 8.2.12.4, hooks at: Top of Fitment (.8 for tension at top surface only)

Punching

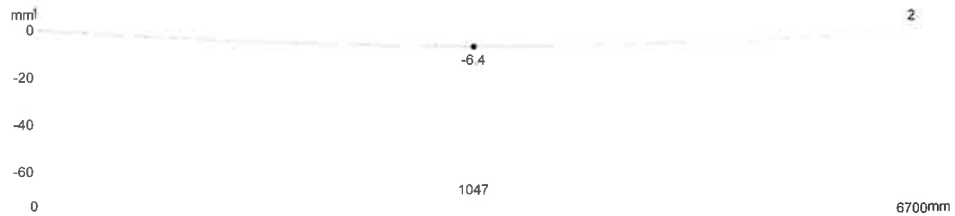
Column Head Critical Section

Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	phi Vuo	phi Vu	phi Vumin	phi Vumax	side beam	Moment Transfer	Asw/s reqd	result
A	#.#	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	kN	A	A	mm2/mm	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!

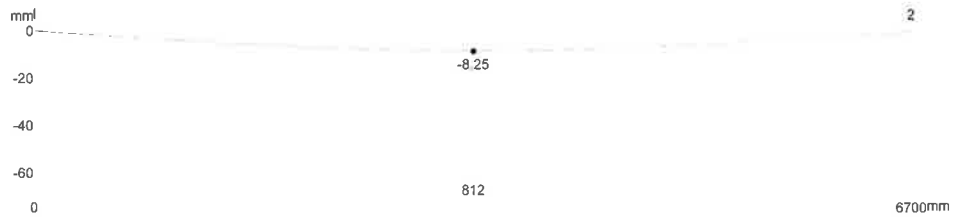
Deflections

Live Load on All Spans

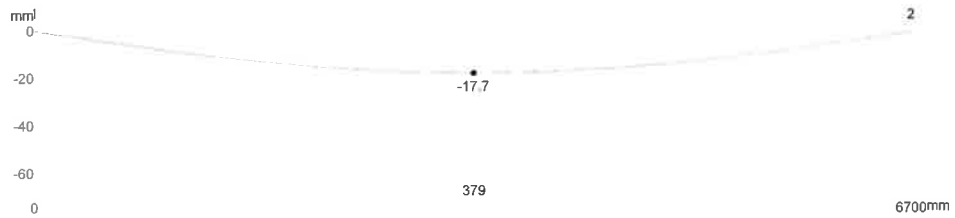
Transfer



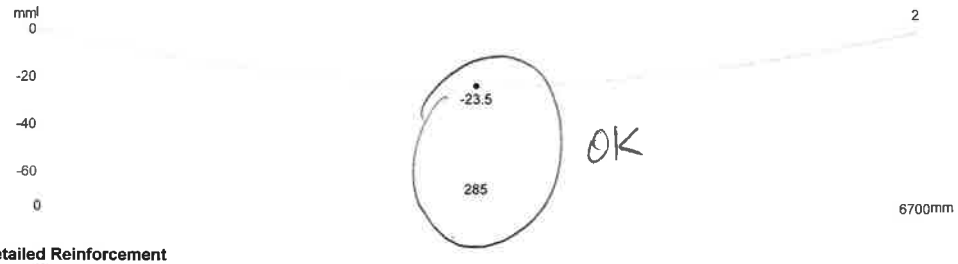
Short Term



Incremental



Total Long Term



Detailed Reinforcement

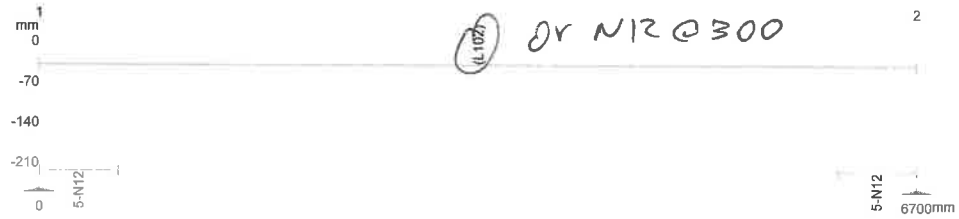
Span 1

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
100	0	0	0	26	1200	No Steel Added	40	300	463.19	224	1200	5 N12 @ 292.7
200	0	0	0	26	1200	No Steel Added	40	300	416.89	224	1200	4 N12 @ 325.3
445	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
690	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
935	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
1180	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
1425	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
1675	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
2233	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
2791	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
3350	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
3908	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
4466	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
5025	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
5270	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
5515	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
5760	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
6005	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
6250	0	0	0	26	1200	No Steel Added	40	300	0	224	1200	No Steel Added
6500	0	0	0	26	1200	No Steel Added	40	300	416.89	224	1200	4 N12 @ 325.3
6600	0	0	0	26	1200	No Steel Added	40	300	463.19	224	1200	5 N12 @ 292.7

Shear Reinforcement				
	Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Reinforcement Layout



Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

SL7

Project Name: 168 Prospect Road
Project Number: 1702160
Frame Description: 3S1 Double Span
Designer: FK
K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\3S1 Double Span.rpf

RAPT - Version: 6.2.2.2
Reinforced And Post-Tensioned Concrete Analysis & Design Package
Copyright(C) 1988 - 2010 PCDC Pty. Ltd. All Rights Reserved

FIELDERS KINGFLOR® COMPOSITE STEEL FORMWORK

Licensee
TMK Consulting Engineers
105 Waymouth Street
Adelaide SA 5000
318662120608UPN3

Input

General

Design Code	List	Australia - AS3600*SAVED*
Material	List	Australia - Australian Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Slab
Panel Type	List	Internal
Strip Type	List	One way - Full Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	32MPa
Concrete - Columns	List	40MPa
Top Reinforcement Cover	mm	20
Bottom Reinforcement Cover	mm	20
Self Weight Definition	List	Program Calculated
Pattern Live Load	Y/N	Y
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	7800	210	1200	1200
2	7800	210	1200	1200
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse prestress (P/A)
	A	List	mm	MPa
1	1	Knife-Edge	1200	
2	2	Knife-Edge	1200	
3	3	Knife-Edge	1200	

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Extra Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1. Self Weight - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m2		mm	kN/m2	A
1	1	0	5.04	3	0	5.04	

2. Extra Dead Load - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m2		mm	kN/m2	A
1	1	0	0.5	3	0	0.5	

3. Live Load - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Live Load reduction	Description
		mm	kN/m2		mm	kN/m2	#.#	A
1	1	0	2	3	0	2	1	

Load Combinations : Ultimate

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1.2	1.2	1.5
2	Live Load	0.9	0.9	1.5
3	Dead Load	1.35	1.35	0

Load Combinations : Short Term Service

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.7

Load Combinations : Permanent Service

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.4

Load Combinations : Deflection

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Short Term - Deflection	1	1	0.7
2	Permanent - Deflection	1	1	0.4
3	Initial - Deflection	1	0	0

Load Combinations : Transfer Prestress

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Transfer	1	0	0

Load Combinations : Pre Existing

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Pre Existing	1	0	0

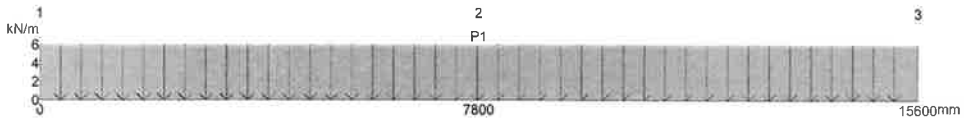
3S1 - Double Span

SLS

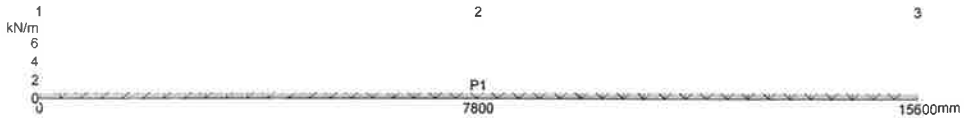
Load Combinations : Construction

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	##	##	##
1	Construction	1	0	0

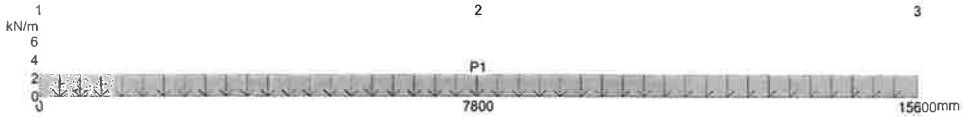
Load Case 1 : 1. Self Weight



Load Case 2 : 2. Extra Dead Load



Load Case 3 : 3. Live Load



Reinforcement

Reinforcement Use	Reinforcement Type	Preferred Bar Size	Number of Legs
	List	List	#
Flexural Bar	N 500MPa		
Flexural Mesh	F 450MPa		
Shear Option 1	N 500MPa	10	2
Shear Option 2	N 500MPa	12	2
Shear Option 3	N 500MPa	16	2
Punching Shear	N 500MPa	10	1

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	99	0			N	N
Span Reinforcement	300	99		0	0	N	N

Design Zones : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Top Cover at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Top Cover at Right end	Maximum Bar Size	Minimum Bar Size	Preferred bar size	Minimum Number of Bars
	List		mm	mm	mm		mm	mm	mm	List	List	List	#
1	Bar	1	0	0	20	3	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	mm	%	%
1	0	0	0

Design Zones : Bottom

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Bottom Cover at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Bottom Cover at Right End	Maximum Bar Size	Minimum Bar Size	Preferred bar size	Minimum Number of Bars
	List		mm	mm	mm		mm	mm	mm	List	List	List	#
1	Bar	1	0	0	20	3	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars	Minimum Steel area as %	% in Flange
	mm	%	%
1	0	0	0

User Defined : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Top Cover at left end	% Development of Left End of Bar in Tension	% Development of Left End of Bar in Compression	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Top Cover at Right end	% Development of Right End of Bar in Tension
	List		mm	mm	mm	%	%		mm	mm	mm	%
1	L 500MPa	1	0	0	35	0	0	3	0	0	35	0

Layer Number	% Development of Right End of Bar in Compression	Bar Size	Mesh full width of Design Cross-section	Width of mesh	% in Flange	Layer attached after the PreExisting Load Case
	%	List	Y/N	mm	%	Y/N
1	0	102	Y	0	0	N

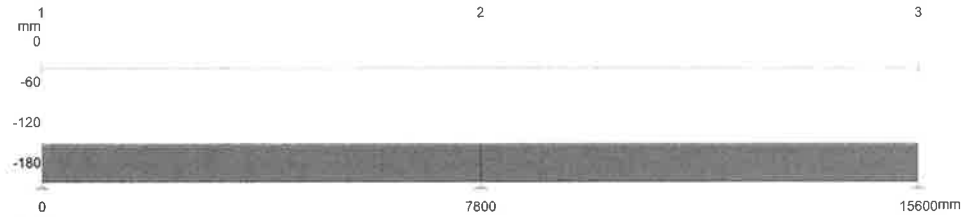
Or N12@300

User Defined : Metal Decking

Layer Number	Metal Deck Type	Left End Reference Column	Distance to Left End of Metal Deck	Distance to Start of Concrete Void from Start of Sheet	Right End Reference Column	Distance to Right End of Metal Deck	Distance to End of Concrete Void from End of Sheet	Sheet Thickness	Number of Sheets	Description
	List	#	mm	mm	#	mm	mm	List	#	A
	KF57	1	0	0	2	0	0	.75mm	4	
	KF57	2	0	0	3	0	0	.75mm	4	

Reinforcement Design Zones

Reinforcement Design Zones User Defined



Design Data

Capacity Reduction factor (phi) for Flexure	#.#	0.8
Capacity Reduction factor (phi) for Shear	#.#	0.7
Material Factor for Concrete in Flexure	#.#	1
Material Factor for Concrete in Shear	#.#	1
Material Factor for Reinforcement	#.#	1
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.4
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	N
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment

SL9

Moment Diagram Offset For Flexure Calculations	List	Code Default
Limit Reinforcement Strain	Y/N	N
Beam Shear Critical Section Location	List	Code Critical Section

Maximum Service Stress Change - Prestressed Sections	MPa	150
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C.	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	N

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	25
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Incremental Deflection Warning Limit - Maximum Deflection	mm	25
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	25.6
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#	1
Pattern Live Load for Ultimate Strength	Y/N	Y
Pattern Live Load for Crack Control	Y/N	Y
Pattern Live Load For Deflections	Y/N	Y
Pattern Live Load for Deflection Permanent Load Combination	Y/N	N

Material Properties

Concrete

Description	32MPa	40MPa
Characteristic Compressive Strength	32	40
Mean Compressive Strength	37.22	45.9
Lower Characteristic Tensile Strength	3.39	3.79
Upper Characteristic Tensile Strength	5.43	6.07
Concrete Weight	2447	2447
Design Concrete Modulus	29443.8	32919.2
Mean Concrete Modulus	31754.7	35263.5
Ultimate Concrete Modulus	29443.8	32919.2
Basic Shrinkage Strain	850	850
Basic Creep Factor	3.4	2.5
Concrete Strain Limit	0.003	0.003

Reinforcement Bar

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
N	Deformed	500	2e5	N	0.05	540	90	-1	-1	-1	-1	Y	

Nominal Bar Size A	Bar Diameter mm	Bar Area mm2	Bar Inertia mm4	Bar Weight kg/m	Stock Length mm
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
24	24	452	16292.6	3.55	12000
28	28	616	30184	4.83	12000
32	32	804	51492.6	6.31	12000
36	36	1020	82481.1	7.99	12000
40	40	1260	1.257e5	9.86	12000

Reinforcement Mesh

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
L	Deformed	500	2e5	L	0.015	515	90	-1	-1	-1	-1	Y	

Nominal Mesh Size A	Main Bar Diameter mm	Main Bar Area mm2/m	Main Bar Spacing mm	Main Bar Inertia mm4	Cross bar Diameter mm	Cross bar Area mm2/m	Cross Bar Spacing mm	Mesh Weight kg/m2	Stock Length mm
62	6	141	200	0	6	141	200	0	0
72	7	179	200	0	7	179	200	0	0
82	8	227	200	0	8	227	200	0	0
92	9	290	200	0	9	290	200	0	0
102	10	354	200	0	10	354	200	0	0
81	8	454	100	0	8	454	100	0	0
718	7	358	100	0	8	227	200	0	0
818	8	454	100	0	8	227	200	0	0
918	9	581	100	0	8	227	200	0	0
1018	10	709	100	0	8	227	200	0	0
1118	11	899	100	0	8	227	200	0	0
1218	12	1112	100	0	8	227	200	0	0

Metal Decking

Sheet Designation	Yield Stress	Youngs Modulus	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexexure	Material Factor Shear	Capacity Reduction Factor Flexuse	Capacity Reduction Factor Shear	Flexural Rebar For Shear	Description
KF57	550	2e5	0.035	600	90	-1	-1	-1	-1	Y	

Nominal Size A	Sheet Thickness mm	Sheet Width mm	Sheet Height mm	Number of Rib Spaces #	Sheet Centroid from Bottom mm	Sheet Area mm2	Sheet Inertia mm4	Mechanical Resistance kN/m2	Sheet Weight kg/m
.75mm	0.8	300	58	1	14.5	358.5	1.449e5	476	0
.9mm	0.9	300	58	1	14.5	430.2	1.799e5	580	0
1.0mm	1	300	58	1	14.5	477.9	1.999e5	645	0

Elevation view

Plan view

Warnings

Input

No errors or warnings were found.

Output

Warning:Total deflection in at least one span is greater than defined limit.

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0

SL10

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Below	kNm	-0	-0	-0
Reaction	kN	17.69	1.76	7.02
Elastic Rotation	#.#	2.03e-3	2.02e-4	8.07e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 2		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	58.96	5.85	23.4
Elastic Rotation	#.#	0	0	0
Elastic Axial Shortening	mm	0	0	0

Col No. 3		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	17.69	1.76	7.02
Elastic Rotation	#.#	-2.03e-3	-2.02e-4	-8.07e-4
Elastic Axial Shortening	mm	0	0	0

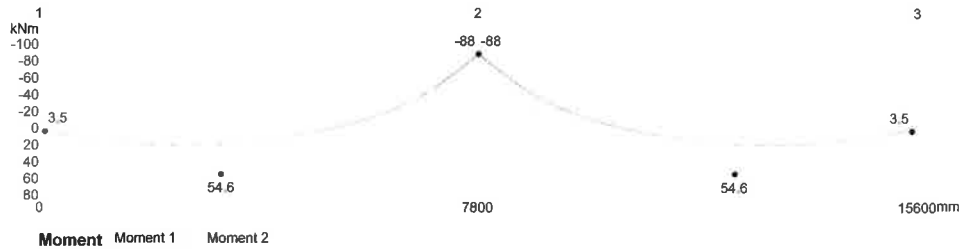
Load Combinations
Column Actions

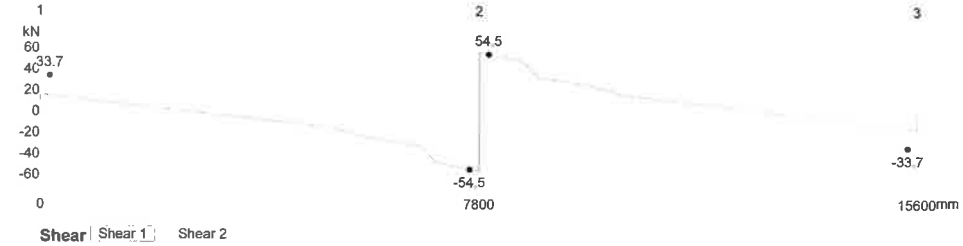
Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	24.36	24.36	33.86	33.86	15.74	35.62
Elastic Rotation	#.#	2.8e-3	2.8e-3	3.89e-3	3.89e-3	1.41e-3	4.5e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	81.19	81.19	112.87	112.87	75.88	112.87
Elastic Rotation	#.#	0	0	0	0	-1.21e-3	0
Elastic Axial Shortening	mm	0	0	0	0	0	0

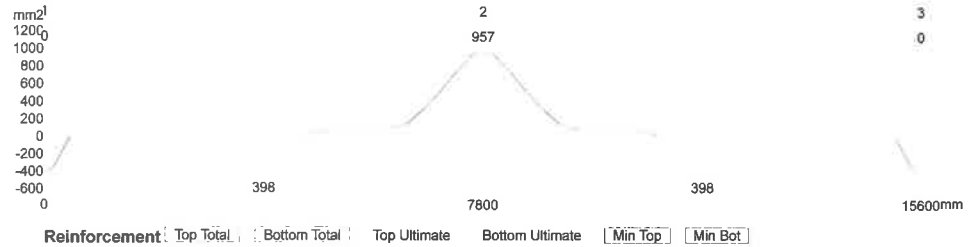
Col No. 3		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	24.36	24.36	33.86	33.86	15.74	35.62
Elastic Rotation	#.#	-2.8e-3	-2.8e-3	-3.89e-3	-3.89e-3	-1.41e-3	-4.5e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

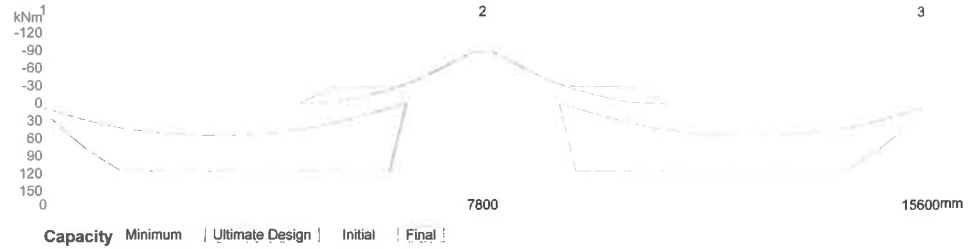
Ultimate Flexure

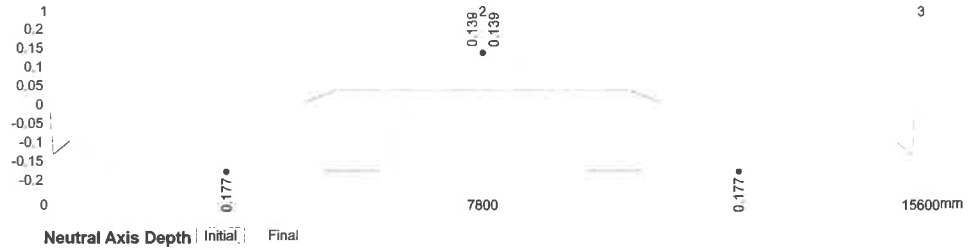




Flexural Design
Ultimate





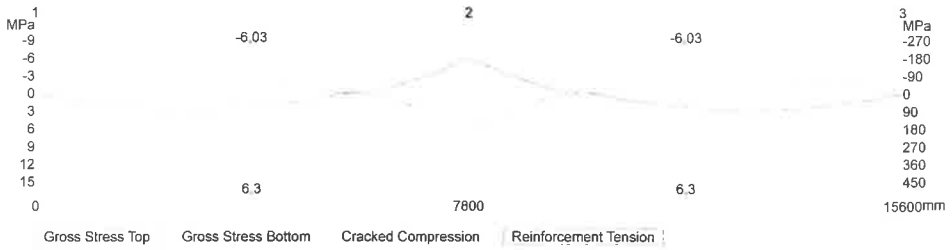


SL11

Service

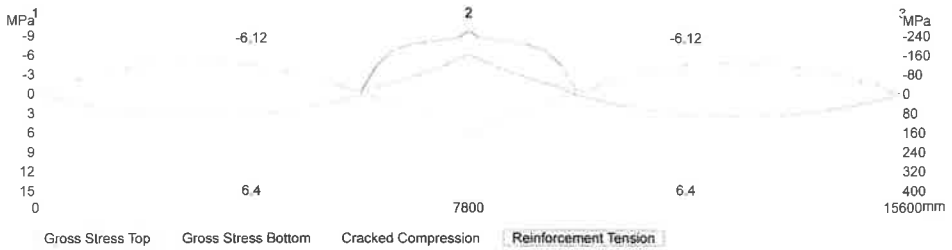
Maximum Moment Condition

Reversal Moment Condition

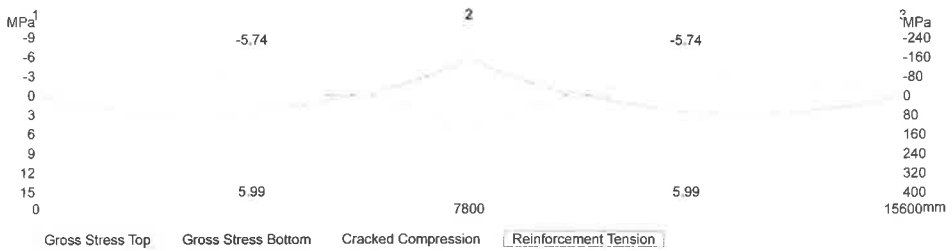


Permanent

Maximum Moment Condition



Reversal Moment Condition



Shear Design

Beam

Span 1

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
100	34.46	3.5	0	184	398.15	1200	0	0	0	989.18	0	0	0	0	
168	33.67	5.82	0	184	348.47	1200	108	99999	108	989.18	0	0	0	0	No shear steel

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
465	30.23	15.31	0	195.5	0	1200	112.06	99999	112.06	1051.01	0	0	0	0	No shear steel
762	26.8	23.78	0	195.5	0	1200	119.39	99999	119.39	1051.01	0	0	0	0	No shear steel
1059	23.63	29.81	0	195.5	0	1200	125.91	99999	125.91	1051.01	0	0	0	0	No shear steel
1356	20.19	36.31	0	195.5	0	1200	131.82	99999	131.82	1051.01	0	0	0	0	No shear steel
1653	16.75	41.8	0	195.5	0	1200	137.24	99999	137.24	1051.01	0	0	0	0	No shear steel
1950	14.13	42.72	0	195.5	0	1200	142.26	99999	142.26	1051.01	0	0	0	0	No shear steel
2600	6.78	44.59	0	195.5	0	1200	152.17	99999	152.17	1051.01	0	0	0	0	No shear steel
3250	-6.78	35.49	0	195.5	0	1200	160.58	99999	160.58	1051.01	0	0	0	0	No shear steel
3900	-13.81	34.18	0	195.5	0	1200	160.58	99999	160.58	1051.01	0	0	0	0	No shear steel
4550	-20.13	28.22	0	195.5	0	1200	160.58	99999	160.58	1051.01	0	0	0	0	No shear steel
5200	-26.88	16.75	0	195.5	0	1200	152.17	99999	152.17	1051.01	0	0	0	0	No shear steel
5850	-34.4	-3.17	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
6147	-37.42	-11.32	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
6444	-40.86	-22.95	0	184	146.51	1200	104.93	99999	104.93	989.18	0	0	0	0	No shear steel
6741	-44.3	-35.59	0	184	313.26	1200	114.28	99999	114.28	989.18	0	0	0	0	No shear steel
7038	-47.61	-48.4	0	184	517.99	1200	124	99999	124	989.18	0	0	0	0	No shear steel
7335	-51.05	-63.05	0	184	746.48	1200	133.3	99999	133.3	989.18	0	0	0	0	No shear steel
7632	-54.49	-78.72	0	184	956.63	1200	140.84	99999	140.84	989.18	0	0	0	0	No shear steel
7799	-56.42	-87.98	0	184	956.63	1200	0	0	0	989.18	0	0	0	0	

Design Comments:-
- Shear areas and spacings adjusted for Fitment hook location as per AS3600 cl 8.2.12.4, hooks at: Top of Fitment (.8 for tension at top surface only)

Span 2

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1	56.42	-87.98	0	184	956.64	1200	0	0	0	989.18	0	0	0	0	
168	54.49	-78.72	0	184	956.64	1200	140.84	99999	140.84	989.18	0	0	0	0	No shear steel
465	51.05	-63.05	0	184	746.48	1200	133.3	99999	133.3	989.18	0	0	0	0	No shear steel
762	47.61	-48.4	0	184	517.99	1200	124	99999	124	989.18	0	0	0	0	No shear steel
1059	44.3	-35.59	0	184	313.26	1200	114.28	99999	114.28	989.18	0	0	0	0	No shear steel
1356	40.86	-22.95	0	184	146.51	1200	104.93	99999	104.93	989.18	0	0	0	0	No shear steel
1653	37.42	-11.32	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
1950	34.4	-3.17	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
2600	26.88	16.75	0	195.5	0	1200	152.17	99999	152.17	1051.01	0	0	0	0	No shear steel
3250	20.13	28.22	0	195.5	0	1200	160.58	99999	160.58	1051.01	0	0	0	0	No shear steel
3900	13.81	34.18	0	195.5	0	1200	160.58	99999	160.58	1051.01	0	0	0	0	No shear steel
4550	6.78	35.49	0	195.5	0	1200	160.58	99999	160.58	1051.01	0	0	0	0	No shear steel
5200	-6.78	44.59	0	195.5	0	1200	152.17	99999	152.17	1051.01	0	0	0	0	No shear steel
5850	-14.13	42.72	0	195.5	0	1200	142.26	99999	142.26	1051.01	0	0	0	0	No shear steel
6147	-16.75	41.8	0	195.5	0	1200	137.24	99999	137.24	1051.01	0	0	0	0	No shear steel
6444	-20.19	36.31	0	195.5	0	1200	131.82	99999	131.82	1051.01	0	0	0	0	No shear steel
6741	-23.63	29.81	0	195.5	0	1200	125.91	99999	125.91	1051.01	0	0	0	0	No shear steel
7038	-26.8	23.78	0	195.5	0	1200	119.39	99999	119.39	1051.01	0	0	0	0	No shear steel
7335	-30.23	15.31	0	195.5	0	1200	112.06	99999	112.06	1051.01	0	0	0	0	No shear steel
7632	-33.67	5.82	0	184	348.47	1200	108	99999	108	989.18	0	0	0	0	No shear steel
7700	-34.46	3.5	0	184	398.15	1200	0	0	0	989.18	0	0	0	0	

Punching

Column Head Critical Section

Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	phi Vuo	phi Vu	phi Vumin	phi Vumax	side beam	Moment Transfer	Asw/s reqd	result
A	#.#	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	kN	A	A	mm2/mm	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!

SL12

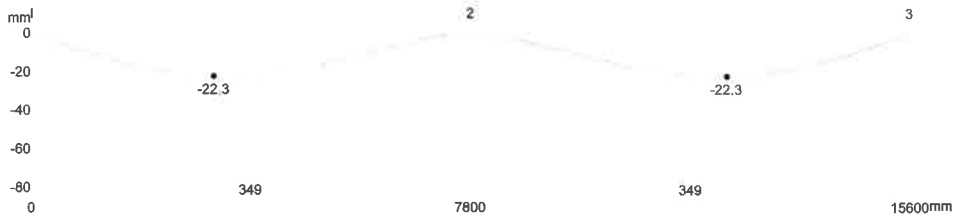
Deflections

Live Load on All Spans

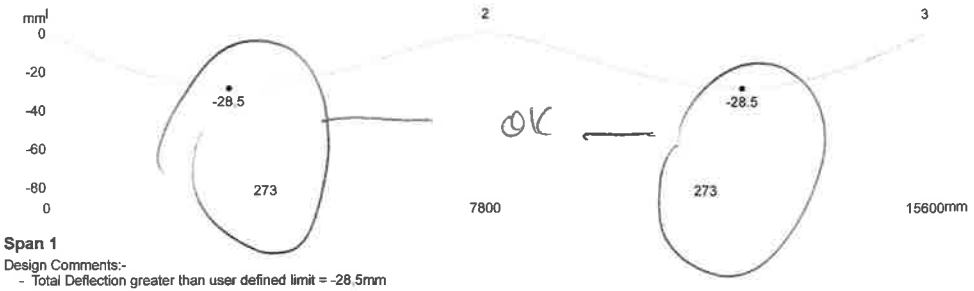
Transfer

Short Term

Incremental



Total Long Term



Span 1

Design Comments:-
- Total Deflection greater than user defined limit = -28.5mm

Span 2

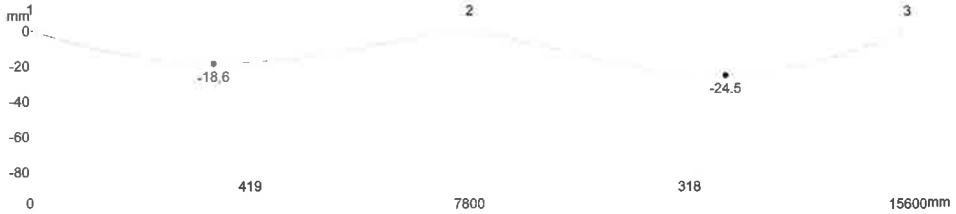
Design Comments:-
- Total Deflection greater than user defined limit = -28.5mm

Live Load on Even Spans

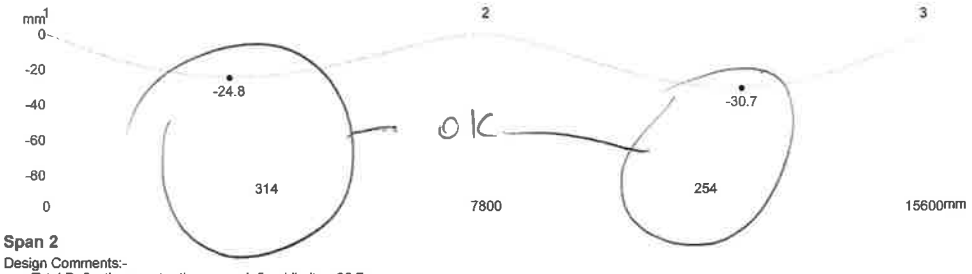
Transfer

Short Term

Incremental



Total Long Term



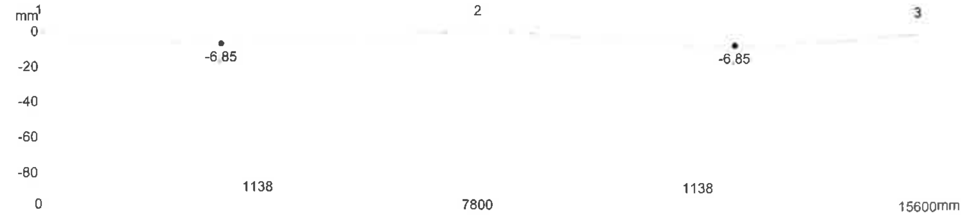
Span 2

Design Comments:-
- Total Deflection greater than user defined limit = -30.7mm

SL13

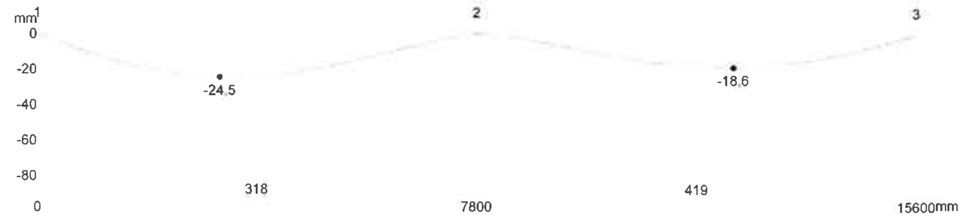
Live Load on Odd Spans

Transfer

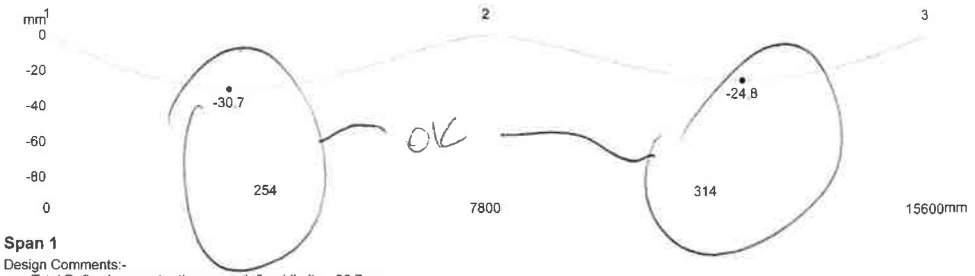


Short Term

Incremental



Total Long Term



Span 1

Design Comments:-
- Total Deflection greater than user defined limit = -30.7mm

Detailed Reinforcement

Span 1

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
100	0	0	0	26	1200	No Steel Added	40	300	398.15	184	1200	6 N10 @ 236.6
168	0	0	0	26	1200	No Steel Added	40	300	348.47	184	1200	5 N10 @ 270.3
465	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
762	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1059	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1356	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
1653	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1950	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
2600	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
3250	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
3900	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4550	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
5200	0	0	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
5850	40	300	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
6147	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
6444	24	241.8	146.51	26	1200	2 N12 @ 925.5	0	0	0	184	1200	No Steel Added
6741	20	223.6	313.26	26	1200	3 N12 @ 432.9	0	0	0	184	1200	No Steel Added
7038	20	208	517.99	26	1200	5 N12 @ 261.8	0	0	0	184	1200	No Steel Added
7335	16	196.6	746.48	26	1200	7 N12 @ 181.7	0	0	0	184	1200	No Steel Added
7632	16	181.2	956.63	26	1200	9 N12 @ 141.7	0	0	0	184	1200	No Steel Added
7799	12	143.8	956.63	26	1200	9 N12 @ 141.7	0	0	0	184	1200	No Steel Added

Shear Reinforcement				
	Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 2

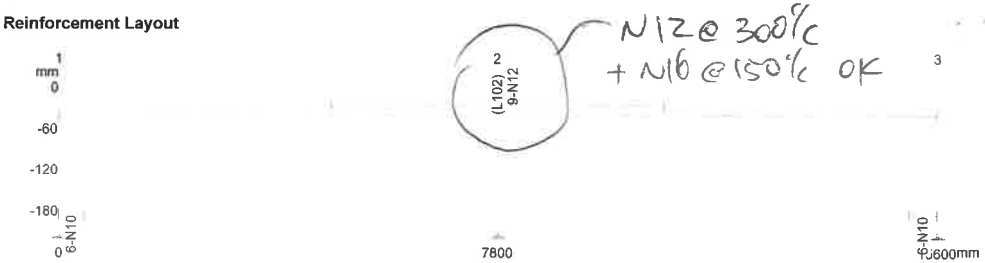
	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
1	12	143.8	956.64	26	1200	9 N12 @ 141.7	0	0	0	184	1200	No Steel Added
168	16	181.2	956.64	26	1200	9 N12 @ 141.7	0	0	0	184	1200	No Steel Added
465	16	196.6	746.48	26	1200	7 N12 @ 181.7	0	0	0	184	1200	No Steel Added
762	20	208	517.99	26	1200	5 N12 @ 261.8	0	0	0	184	1200	No Steel Added
1059	20	223.6	313.26	26	1200	3 N12 @ 432.9	0	0	0	184	1200	No Steel Added
1356	24	241.8	146.51	26	1200	2 N12 @ 925.5	0	0	0	184	1200	No Steel Added
1653	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
1950	40	300	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
2600	0	0	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
3250	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
3900	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4550	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
5200	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
5850	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
6147	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
6444	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
6741	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
7038	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
7335	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
7632	0	0	0	26	1200	No Steel Added	40	300	348.47	184	1200	5 N10 @ 270.3
7700	0	0	0	26	1200	No Steel Added	40	300	398.15	184	1200	6 N10 @ 236.6

SL14

Shear Reinforcement				
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Reinforcement Layout



Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

SL15

Project Name: 168 Prospect Road
Project Number: 1702160
Frame Description: Slab 3S2
Designer: FK
K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\3S2.rpf

RAPT - Version: 6.2.2.2
Reinforced And Post-Tensioned Concrete Analysis & Design Package
Copyright(C) 1988 - 2010 PCDC Pty. Ltd. All Rights Reserved

FIELDERS KINGFLOR® COMPOSITE STEEL FORMWORK

Licensee
TMK Consulting Engineers
105 Waymouth Street
Adelaide SA 5000
318662120608UPN3

Input

General

Design Code	List	Australia - AS3600*SAVED*
Material	List	Australia - Australian Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Slab
Panel Type	List	Internal
Strip Type	List	One way - Full Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	32MPa
Concrete - Columns	List	40MPa
Top Reinforcement Cover	mm	20
Bottom Reinforcement Cover	mm	20
Self Weight Definition	List	Program Calculated
Pattern Live Load	Y/N	Y
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	5300	140	1200	1200
2	5300	140	1200	1200
3	5300	140	1200	1200
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse prestress (P/A)
	A	List	mm	MPa
1	1	Knife-Edge	1200	
2	2	Knife-Edge	1200	
3	3	Knife-Edge	1200	
4	4	Knife-Edge	1200	

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Extra Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1. Self Weight - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Description A
1	1	0	3.36	4	0	3.36	

2. Extra Dead Load - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Description A
1	1	0	0.5	4	0	0.5	

2. Extra Dead Load - Point

Load	Reference column	Distance to Load from reference column mm	Load kN	Load Length mm	Description A
1	2	2900	12.8	100	

3. Live Load - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Live Load reduction #.#	Description A
1	1	0	2	4	0	2	1	

3. Live Load - Point

Load	Reference column	Distance to Load from reference column mm	Load kN	Load Length mm	Live Load reduction #.#	Description A
1	2	2900	8	100	0	

Load Combinations : Ultimate

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Live Load	1.2	1.2	1.5
2	Live Load	0.9	0.9	1.5
3	Dead Load	1.35	1.35	0

Load Combinations : Short Term Service

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Live Load	1	1	0.7

Load Combinations : Permanent Service

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Live Load	1	1	0.4

Load Combinations : Deflection

Load Combination	Description A	1. Self Weight #.#	2. Extra Dead Load #.#	3. Live Load #.#
1	Short Term - Deflection	1	1	0.7
2	Permanent - Deflection	1	1	0.4

3S2 Suspended Slab

SL16

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
3	Initial - Deflection	1	0	0

Load Combinations : Transfer Prestress

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Transfer	1	0	0

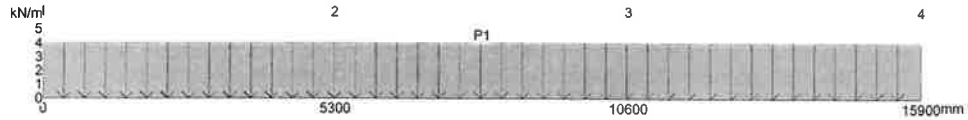
Load Combinations : Pre Existing

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3 Live Load
	A	#.#	#.#	#.#
1	Pre Existing	1	0	0

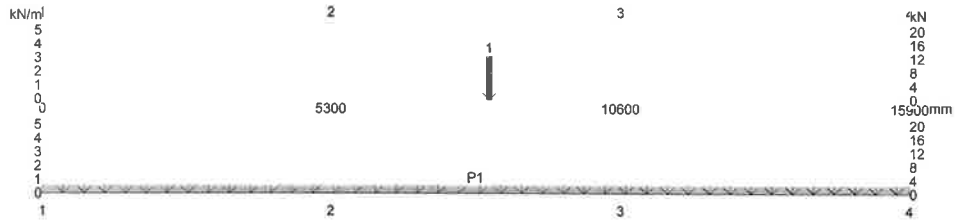
Load Combinations : Construction

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Construction	1	0	0

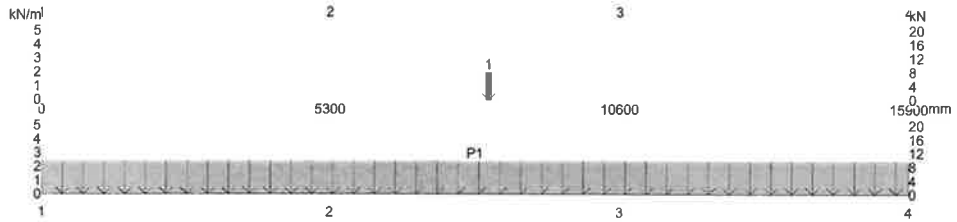
Load Case 1 : 1. Self Weight



Load Case 2 : 2. Extra Dead Load



Load Case 3 : 3. Live Load



Reinforcement

Reinforcement Use	Reinforcement Type	Preferred Bar Size	Number of Legs
	List	List	#
Flexural Bar	N 500MPa		
Flexural Mesh	F 450MPa		
Shear Option 1	N 500MPa	10	2

Reinforcement Use	Reinforcement Type	Preferred Bar Size	Number of Legs
	List	List	#
Shear Option 2	N 500MPa	12	2
Shear Option 3	N 500MPa	16	2
Punching Shear	N 500MPa	10	1

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	99	0			N	N
Span Reinforcement	300	99		0	0	N	N

Design Zones : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Top Cover at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Top Cover at Right end	Maximum Bar Size	Minimum Bar Size	Preferred bar size	Minimum Number of Bars
	List		mm	mm	mm		mm	mm	mm	List	List	List	#
1	Bar	1	0	0	20	4	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

Design Zones : Bottom

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Bottom Cover at left end	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Bottom Cover at Right End	Maximum Bar Size	Minimum Bar Size	Preferred bar size	Minimum Number of Bars
	List		mm	mm	mm		mm	mm	mm	List	List	List	#
1	Bar	1	0	0	20	4	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

User Defined : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Top Cover at left end	% Development of Left End of Bar in Tension	% Development of Left End of Bar in Compression	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Top Cover at Right end	% Development of Right End of Bar in Tension
	List		mm	mm	mm	%	%		mm	mm	mm	%
1	L 500MPa	1	0	0	35	0	0	4	0	0	35	0

Layer Number	% Development of Right End of Bar in Compression %	Bar Size List	Mesh full width of Design Cross-section Y/N	Width of mesh mm	% in Flange %	Layer attached after the PreExisting Load Case Y/N
1	0	102	Y	0	0	N

or N12 @ 300

User Defined : Metal Decking

Layer Number	Metal Deck Type	Left End Reference Column	Distance to Left End of Metal Deck	Distance to Start of Concrete Void from Start of Sheet	Right End Reference Column	Distance to Right End of Metal Deck	Distance to End of Concrete Void from End of Sheet	Sheet Thickness	Number of Sheets	Description
	List	#	mm	mm	#	mm	mm	List	#	A
	KF57	3	0	0	4	0	0	1.0mm	4	
	KF57	1	0	0	2	0	0	1.0mm	4	
	KF57	2	0	0	3	0	0	1.0mm	4	

SL17

Reinforcement Design Zones

Reinforcement Design Zones User Defined

Design Data

Capacity Reduction factor (phi) for Flexure	#.#	0.8
Capacity Reduction factor (phi) for Shear	#.#	0.7
Material Factor for Concrete in Flexure	#.#	1
Material Factor for Concrete in Shear	#.#	1
Material Factor for Reinforcement	#.#	1
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.4
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	N
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment
Moment Diagram Offset For Flexure Calculations	List	Code Default
Limit Reinforcement Strain	Y/N	N
Beam Shear Critical Section Location	List	Code Critical Section

Maximum Service Stress Change - Prestressed Sections	MPa	150
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	N

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	25
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Incremental Deflection Warning Limit - Maximum Deflection	mm	25
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	25.6
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#	1
Pattern Live Load for Ultimate Strength	Y/N	Y
Pattern Live Load for Crack Control	Y/N	Y

Pattern Live Load For Deflections	Y/N	Y
Pattern Live Load for Deflection Permanent Load Combination	Y/N	N

Material Properties

Concrete

Description	32MPa	40MPa
Characteristic Compressive Strength	32	40
Mean Compressive Strength	37.22	45.9
Lower Characteristic Tensile Strength	3.39	3.79
Upper Characteristic Tensile Strength	5.43	6.07
Concrete Weight	2447	2447
Design Concrete Modulus	29443.8	32919.2
Mean Concrete Modulus	31754.7	35263.5
Ultimate Concrete Modulus	29443.8	32919.2
Basic Shrinkage Strain	850	850
Basic Creep Factor	3.4	2.5
Concrete Strain Limit	0.003	0.003

Reinforcement Bar

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
N	Deformed	500	2e5	N	0.05	540	90	-1	-1	-1	-1	Y	

Nominal Bar Size A	Bar Diameter mm	Bar Area mm2	Bar Inertia mm4	Bar Weight kg/m	Stock Length mm
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
24	24	452	16292.6	3.55	12000
28	28	616	30184	4.83	12000
32	32	804	51492.6	6.31	12000
36	36	1020	82481.1	7.99	12000
40	40	1260	1.257e5	9.86	12000

Reinforcement Mesh

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
L	Deformed	500	2e5	L	0.015	515	90	-1	-1	-1	-1	Y	

Nominal Mesh Size A	Main Bar Diameter mm	Main Bar Area mm2/m	Main Bar Spacing mm	Main Bar Inertia mm4	Cross bar Diameter mm	Cross bar Area mm2/m	Cross Bar Spacing mm	Mesh Weight kg/m2	Stock Length mm
62	6	141	200	0	6	141	200	0	0
72	7	179	200	0	7	179	200	0	0
82	8	227	200	0	8	227	200	0	0
92	9	290	200	0	9	290	200	0	0
102	10	354	200	0	10	354	200	0	0
81	8	454	100	0	8	454	100	0	0
718	7	358	100	0	8	227	200	0	0
818	8	454	100	0	8	227	200	0	0
918	9	581	100	0	8	227	200	0	0
1018	10	709	100	0	8	227	200	0	0
1118	11	899	100	0	8	227	200	0	0
1218	12	1112	100	0	8	227	200	0	0

Metal Decking

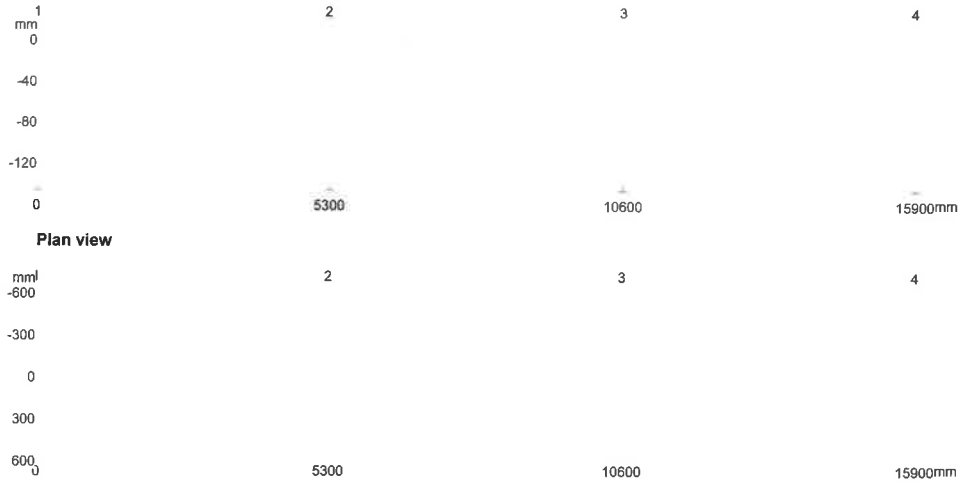
Sheet Designation	Yield Stress	Youngs Modulus	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexexure	Material Factor Shear	Capacity Reduction Factor Flexuse	Capacity Reduction Factor Shear	Flexural Rebar For Shear	Description
KF57	550	2e5	0.035	600	90	-1	-1	-1	-1	Y	

Nominal Size	Sheet Thickness	Sheet Width	Sheet Height	Number of Rib Spaces	Sheet Centroid from Bottom	Sheet Area	Sheet Inertia	Mechanical Resistance	Sheet Weight
A	mm	mm	mm	#	mm	mm2	mm4	kN/m2	kg/m
.75mm	0.8	300	58	1	14.5	358.5	1.449e5	476	0
.9mm	0.9	300	58	1	14.5	430.2	1.799e5	580	0

S18

Nominal Size	Sheet Thickness	Sheet Width	Sheet Height	Number of Rib Spaces	Sheet Centroid from Bottom	Sheet Area	Sheet Inertia	Mechanical Resistance	Sheet Weight
A	mm	mm	mm	#	mm	mm2	mm4	kN/m2	kg/m
1.0mm	1	300	58	1	14.5	477.9	1.999e5	645	0

Elevation view



Plan view

Warnings

Input

Warning:Live Load Reduction factor is very small. Check if it is appropriate.

Output

Warning:SPAN Reinforcing Bar spacing There have been problems in determining a bar size to satisfy the design spacing requirements. See Detailed Reinforcement Design Comments.
Warning:Incremental Deflection span/deflection ratio in at least one span is less than defined limit.
Warning:Total Deflection span/deflection ratio in at least one span is less than defined limit.

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	8.55	0.37	5.09
Elastic Rotation	#.#	1.72e-3	-2.28e-4	1.03e-3
Elastic Axial Shortening	mm	0	0	0

Col No. 2		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	23.5	10.1	13.99
Elastic Rotation	##	-5.74e-4	8.83e-4	-3.42e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 3		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	23.5	11.6	13.99
Elastic Rotation	##	5.74e-4	-9.9e-4	3.42e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 4		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	8.55	0.27	5.09
Elastic Rotation	##	-1.72e-3	2.82e-4	-1.03e-3
Elastic Axial Shortening	mm	0	0	0

Load Combinations

Column Actions

Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	12.48	12.48	18.33	18.33	7.07	19.1
Elastic Rotation	#.#	2.21e-3	2.21e-3	3.33e-3	3.33e-3	8.32e-4	3.74e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	43.39	43.39	61.31	61.31	33.29	63.22
Elastic Rotation	##	0	0	-1.41e-4	-1.41e-4	-5.42e-4	2e-4
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 3		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	44.9	44.9	63.12	63.12	34.65	65.02
Elastic Rotation	##	-1.77e-4	-1.77e-4	0	0	4.45e-4	-3.29e-4
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 4		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	12.38	12.38	18.21	18.21	6.98	18.98
Elastic Rotation	##	-2.16e-3	-2.16e-3	-3.27e-3	-3.27e-3	-7.84e-4	-3.68e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Ultimate Flexure

Moment: Moment 1, Moment 2

SL19

Shear Shear 1 Shear 2

Flexural Design
Ultimate

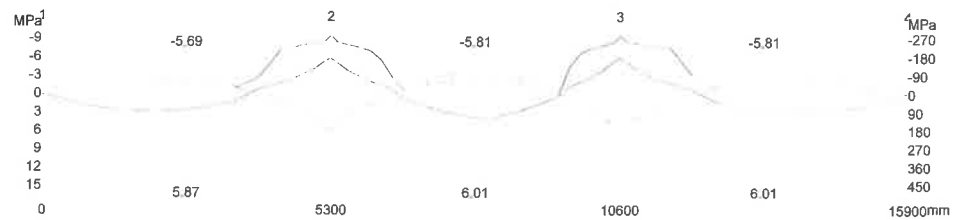
Reinforcement Top Total Bottom Total Top Ultimate Bottom Ultimate Min Top Min Bot

Capacity Minimum Ultimate Design Initial Final

Neutral Axis Depth Initial Final

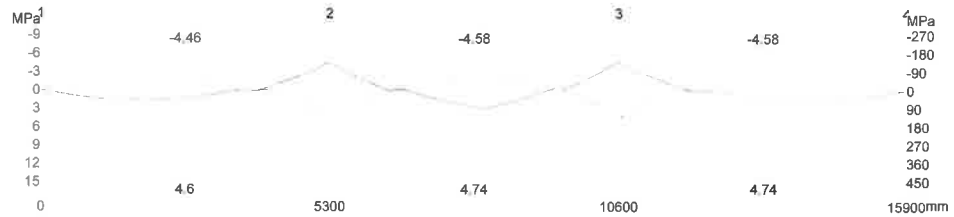
Service

Maximum Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

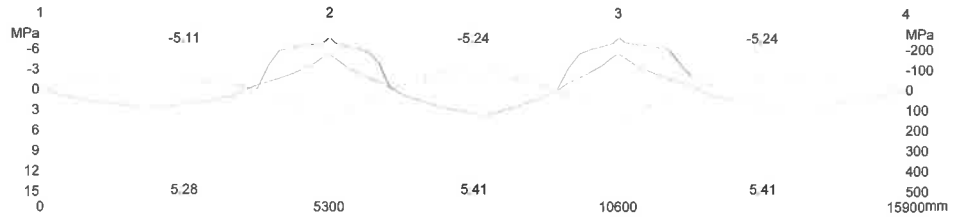
Reversal Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Permanent

Maximum Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Reversal Moment Condition

Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Shear Design
Beam
Span 1

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
100	18.37	1.88	0	114	286.27	1200	0	0	0	612.86	0	0	0	0	
112	18.26	2.1	0	114	286.27	1200	63.56	99999	63.56	612.86	0	0	0	0	No shear steel

S20

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
314	16.41	5.6	0	125.5	0	1200	84.33	99999	84.33	674.69	0	0	0	0	No shear steel
516	14.56	8.73	0	125.5	0	1200	88.58	99999	88.58	674.69	0	0	0	0	No shear steel
718	12.9	10.83	0	125.5	0	1200	92.47	99999	92.47	674.69	0	0	0	0	No shear steel
920	11.05	13.25	0	125.5	0	1200	96.05	99999	96.05	674.69	0	0	0	0	No shear steel
1122	9.2	15.3	0	125.5	0	1200	99.38	99999	99.38	674.69	0	0	0	0	No shear steel
1325	7.9	15.35	0	125.5	0	1200	102.52	99999	102.52	674.69	0	0	0	0	No shear steel
1766	3.99	15.71	0	125.5	0	1200	94.16	99999	94.16	674.69	0	0	0	0	No shear steel
2207	-4.19	11.39	0	125.5	0	1200	101.42	99999	101.42	674.69	0	0	0	0	No shear steel
2650	-7.92	11.16	0	125.5	0	1200	107.8	99999	107.8	674.69	0	0	0	0	No shear steel
3091	-11.16	9.25	0	125.5	0	1200	101.45	99999	101.45	674.69	0	0	0	0	No shear steel
3532	-14.68	5.26	0	125.5	0	1200	94.19	99999	94.19	674.69	0	0	0	0	No shear steel
3975	-18.74	-2.14	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
4177	-20.32	-4.97	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
4379	-22.17	-9.26	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
4581	-24.02	-13.93	0	114	90.09	1200	77.3	99999	77.3	612.86	0	0	0	0	No shear steel
4783	-25.79	-18.59	0	114	214.05	1200	83.06	99999	83.06	612.86	0	0	0	0	No shear steel
4985	-27.64	-23.98	0	114	350.12	1200	88.59	99999	88.59	612.86	0	0	0	0	No shear steel
5188	-29.5	-29.78	0	114	476.06	1200	93.15	99999	93.15	612.86	0	0	0	0	No shear steel
5299	-30.51	-33.11	0	114	476.06	1200	0	0	0	612.86	0	0	0	0	

Design Comments:-
- Shear areas and spacings adjusted for Fitment hook location as per AS3600 cl 8.2.12.4, hooks at: Top of Fitment (.8 for tension at top surface only)

Span 2

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1	32.68	-33.11	0	114	476	1200	0	0	0	612.86	0	0	0	0	
112	31.67	-29.54	0	114	476	1200	93.15	99999	93.15	612.86	0	0	0	0	No shear steel
314	29.82	-23.33	0	114	341.63	1200	88.26	99999	88.26	612.86	0	0	0	0	No shear steel
516	27.97	-17.49	0	114	195.26	1200	82.24	99999	82.24	612.86	0	0	0	0	No shear steel
718	26.23	-12.42	0	114	65.38	1200	76.04	99999	76.04	612.86	0	0	0	0	No shear steel
920	24.38	-7.31	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
1122	22.53	-2.57	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
1325	21.04	0.71	0	125.5	0	1200	102.52	99999	102.52	674.69	0	0	0	0	No shear steel
1766	17.01	9.1	0	125.5	0	1200	94.16	99999	94.16	674.69	0	0	0	0	No shear steel
2207	13.65	14.24	0	125.5	0	1200	101.42	99999	101.42	674.69	0	0	0	0	No shear steel
2650	10.61	17.55	0	125.5	0	1200	107.8	99999	107.8	674.69	0	0	0	0	No shear steel
2850	8.78	19.49	0	125.5	0	1200	105.01	99999	105.01	674.69	0	0	0	0	No shear steel
2900	-6.01	17.95	0	125.5	0	1200	104.29	99999	104.29	674.69	0	0	0	0	No shear steel
2950	-14.03	19.43	0	125.5	0	1200	103.56	99999	103.56	674.69	0	0	0	0	No shear steel
3462	-18.18	11.09	0	125.5	0	1200	95.42	99999	95.42	674.69	0	0	0	0	No shear steel
3975	-22.73	2.31	0	125.5	0	1200	102.52	99999	102.52	674.69	0	0	0	0	No shear steel
4177	-24.21	-1.29	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
4379	-26.06	-6.36	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
4581	-27.91	-11.82	0	114	56.81	1200	75.6	99999	75.6	612.86	0	0	0	0	No shear steel
4783	-29.65	-17.23	0	114	194.51	1200	82.21	99999	82.21	612.86	0	0	0	0	No shear steel
4985	-31.5	-23.4	0	114	349.11	1200	88.55	99999	88.55	612.86	0	0	0	0	No shear steel
5188	-33.36	-29.98	0	114	491.7	1200	93.68	99999	93.68	612.86	0	0	0	0	No shear steel
5299	-34.37	-33.74	0	114	491.7	1200	0	0	0	612.86	0	0	0	0	

Span 3

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1	30.63	-33.75	0	114	491.79	1200	0	0	0	612.86	0	0	0	0	
112	29.62	-30.4	0	114	491.79	1200	93.69	99999	93.69	612.86	0	0	0	0	No shear steel
314	27.77	-24.61	0	114	365.74	1200	89.18	99999	89.18	612.86	0	0	0	0	No shear steel
516	25.92	-19.19	0	114	228.74	1200	83.7	99999	83.7	612.86	0	0	0	0	No shear steel
718	24.15	-14.5	0	114	103.75	1200	77.98	99999	77.98	612.86	0	0	0	0	No shear steel
920	22.3	-9.81	0	114	1.88	1200	72.61	99999	72.61	612.86	0	0	0	0	No shear steel
1122	20.45	-5.49	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
1325	18.86	-2.62	0	100	0	1200	67.06	99999	67.06	537.6	0	0	0	0	No shear steel
1766	14.82	4.81	0	125.5	0	1200	94.16	99999	94.16	674.69	0	0	0	0	No shear steel
2207	11.3	8.86	0	125.5	0	1200	101.42	99999	101.42	674.69	0	0	0	0	No shear steel
2650	8.04	10.84	0	125.5	0	1200	107.8	99999	107.8	674.69	0	0	0	0	No shear steel
3091	4.32	11.12	0	125.5	0	1200	101.45	99999	101.45	674.69	0	0	0	0	No shear steel
3532	-3.86	15.51	0	125.5	0	1200	94.19	99999	94.19	674.69	0	0	0	0	No shear steel
3975	-7.78	15.19	0	125.5	0	1200	102.52	99999	102.52	674.69	0	0	0	0	No shear steel
4177	-9.07	15.17	0	125.5	0	1200	99.4	99999	99.4	674.69	0	0	0	0	No shear steel
4379	-10.92	13.15	0	125.5	0	1200	96.07	99999	96.07	674.69	0	0	0	0	No shear steel

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
4581	-12.77	10.76	0	125.5	0	1200	92.49	99999	92.49	674.69	0	0	0	0	No shear steel
4783	-14.43	8.69	0	125.5	0	1200	88.6	99999	88.6	674.69	0	0	0	0	No shear steel
4985	-16.28	5.58	0	125.5	0	1200	84.35	99999	84.35	674.69	0	0	0	0	No shear steel
5188	-18.14	2.09	0	114	286.27	1200	63.56	99999	63.56	612.86	0	0	0	0	No shear steel
5200	-18.25	1.87	0	114	286.27	1200	0	0	0	612.86	0	0	0	0	

Punching

Column Head Critical Section

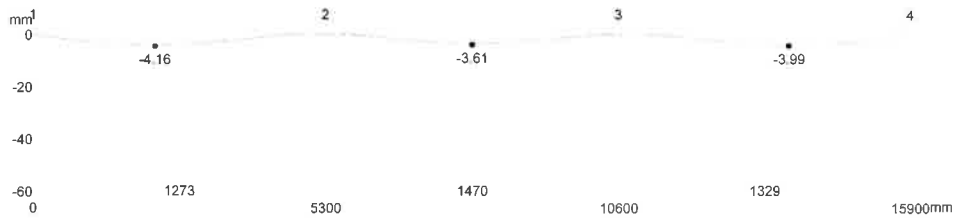
Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	phi Vuo	phi Vu	phi Vumin	phi Vumax	side beam	Moment Transfer	Asw/s reqd	result
A	#.#	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	kN	A	A	mm2/mm	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!

Deflections

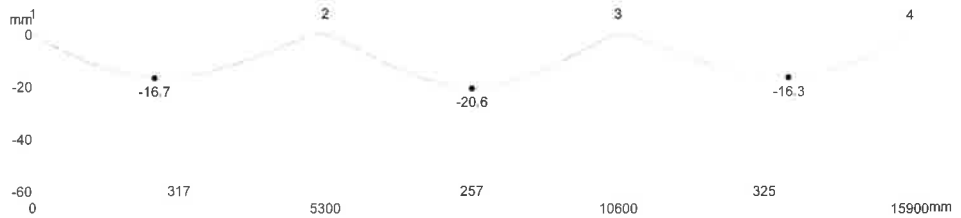
Live Load on All Spans

Transfer

Short Term

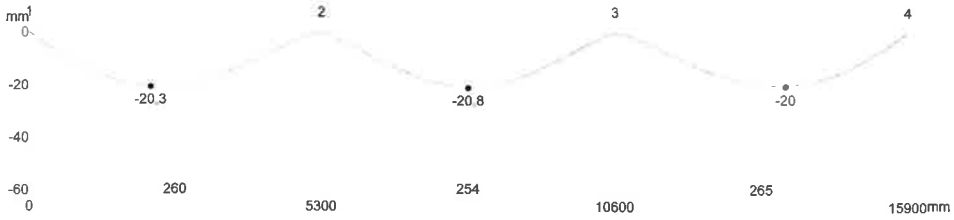


Incremental

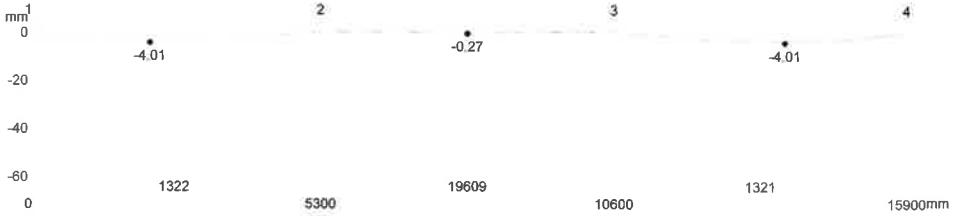


121

Total Long Term

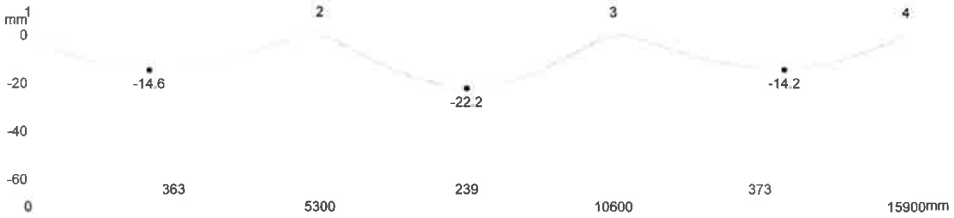


Live Load on Even Spans
Transfer

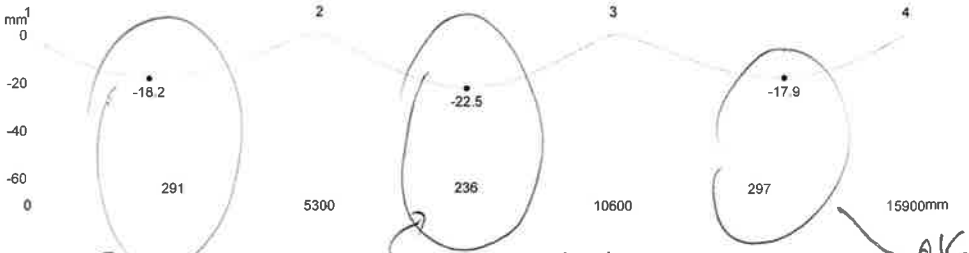


Short Term

Incremental



Total Long Term



OK

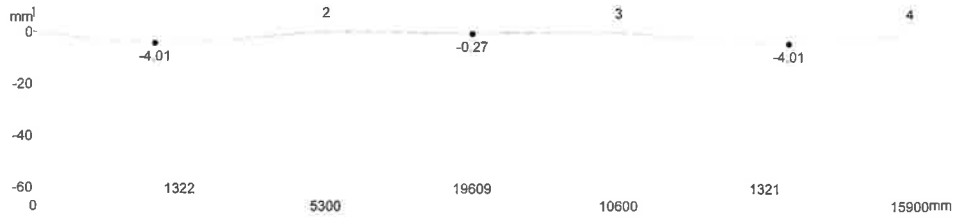
OK. modelled as 140 thick but no set down here so slab actually 180 thick in this span.

OK

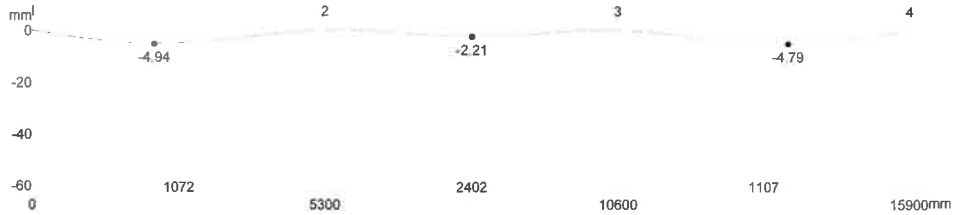
Span 2

Design Comments:-
- Incremental Span/Deflection ratio less than user defined limit = 239
- Total Span/Deflection ratio less than user defined limit = 236

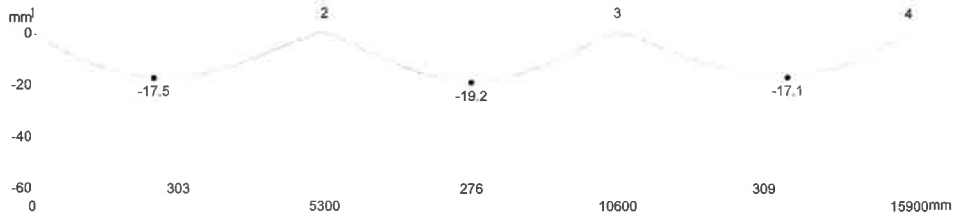
Live Load on Odd Spans
Transfer



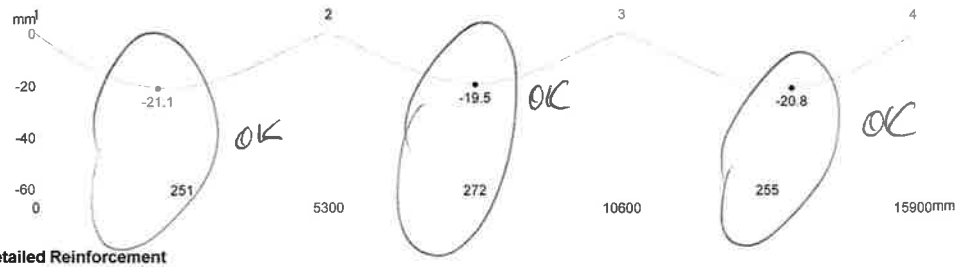
Short Term



Incremental



Total Long Term



OK

OK

OK

Detailed Reinforcement
Span 1

	Top Reinforcement							Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A		Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
100	0	0	0	26	1200	No Steel Added		40	280	286.27	114	1200	4 N10 @ 329.1
112	0	0	0	26	1200	No Steel Added		40	280	286.27	114	1200	4 N10 @ 329.1
314	0	0	0	26	1200	No Steel Added		40	280	0	114	1200	No Steel Added
516	0	0	0	26	1200	No Steel Added		40	280	0	114	1200	No Steel Added

SL22

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
718	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
920	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1122	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1325	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1766	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2207	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2650	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3091	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3532	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3975	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4177	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
4379	24	230.1	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
4581	20	220.9	90.09	26	1200	1 N12 @ 999	0	0	0	114	1200	No Steel Added
4783	20	202.8	214.05	26	1200	2 N12 @ 633.5	0	0	0	114	1200	No Steel Added
4985	16	194.2	350.12	26	1200	4 N12 @ 387.3	0	0	0	114	1200	No Steel Added
5188	16	180.8	476.06	26	1200	5 N12 @ 284.8	0	0	0	114	1200	No Steel Added
5299	12	145.7	476.06	26	1200	5 N12 @ 284.8	0	0	0	114	1200	No Steel Added

Shear Reinforcement				
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 1 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 2

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
1	12	145.7	476	26	1200	5 N12 @ 284.9	0	0	0	114	1200	No Steel Added
112	16	184.3	476	26	1200	5 N12 @ 284.9	0	0	0	114	1200	No Steel Added
314	16	201.6	341.63	26	1200	4 N12 @ 396.9	0	0	0	114	1200	No Steel Added
516	20	216.5	195.26	26	1200	2 N12 @ 694.4	0	0	0	114	1200	No Steel Added
718	24	238.5	65.38	26	1200	1 N12 @ 999	0	0	0	114	1200	No Steel Added
920	36	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1122	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1325	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1766	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2207	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2650	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2850	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2900	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2950	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3462	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3975	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4177	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4379	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
4581	24	247.9	56.81	26	1200	1 N12 @ 999	0	0	0	114	1200	No Steel Added
4783	20	219.9	194.51	26	1200	2 N12 @ 697.1	0	0	0	114	1200	No Steel Added
4985	20	203.9	349.11	26	1200	4 N12 @ 388.4	0	0	0	114	1200	No Steel Added
5188	16	184.6	491.7	26	1200	5 N12 @ 275.8	0	0	0	114	1200	No Steel Added
5299	12	144.3	491.7	26	1200	5 N12 @ 275.8	0	0	0	114	1200	No Steel Added

Shear Reinforcement				
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 3

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
1	12	144.3	491.79	26	1200	5 N12 @ 275.7	0	0	0	114	1200	No Steel Added
112	16	179	491.79	26	1200	5 N12 @ 275.7	0	0	0	114	1200	No Steel Added
314	16	191.9	365.74	26	1200	4 N12 @ 370.8	0	0	0	114	1200	No Steel Added
516	16	199.7	228.74	26	1200	3 N12 @ 592.8	0	0	0	114	1200	No Steel Added
718	20	212	103.75	26	1200	1 N12 @ 999	0	0	0	114	1200	No Steel Added
920	20	215.1	1.88	26	1200	1 N12 @ 999	0	0	0	114	1200	No Steel Added
1122	36	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1325	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1766	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2207	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2650	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3091	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3532	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3975	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4177	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4379	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4581	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4783	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4985	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
5188	0	0	0	26	1200	No Steel Added	40	280	286.27	114	1200	4 N10 @ 329.1
5200	0	0	0	26	1200	No Steel Added	40	280	286.27	114	1200	4 N10 @ 329.1

Shear Reinforcement				
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel

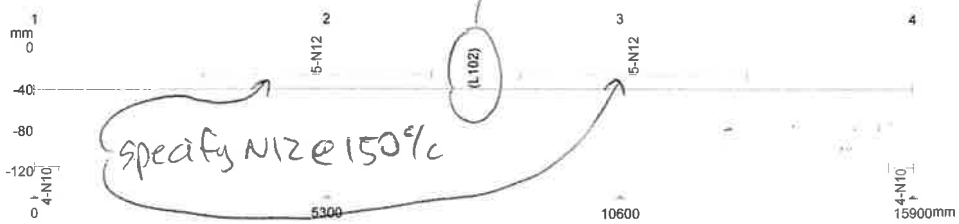
SL23

Area mm2/mm	Shear Reinforcement Spacing of Sets 2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 3 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

or N12@300c

Reinforcement Layout



Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 1 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 3 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

SL 24

Project Name: 168 Prospect Road
Project Number: 1702160
Frame Description: 2S2
Designer: FK
K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\2S2.rpf

RAPT - Version: 6.2.2.2
Reinforced And Post-Tensioned Concrete Analysis & Design Package
Copyright(C) 1988 - 2010 PCDC Pty. Ltd. All Rights Reserved

FIELDERS KINGFLOR® COMPOSITE STEEL FORMWORK

Licensee
TMK Consulting Engineers
105 Waymouth Street
Adelaide SA 5000
318662120608UPN3

Input

General

Design Code	List	Australia - AS3600*SAVED*
Material	List	Australia - Australian Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Slab
Panel Type	List	Internal
Strip Type	List	One way - Full Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	32MPa
Concrete - Columns	List	40MPa
Top Reinforcement Cover	mm	20
Bottom Reinforcement Cover	mm	20
Self Weight Definition	List	Program Calculated
Pattern Live Load	Y/N	Y
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	6600	210	1200	1200
2	6600	210	1200	1200
3	6600	210	1200	1200
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse prestress (P/A)
	A	List	mm	MPa
1	1	Knife-Edge	1200	
2	2	Knife-Edge	1200	
3	3	Knife-Edge	1200	
4	4	Knife-Edge	1200	

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Extra Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1. Self Weight - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Description A
1	1	0	5.04	4	0	5.04	

2. Extra Dead Load - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Description A
1	1	0	0.5	4	0	0.5	

2. Extra Dead Load - Point

Load	Reference column	Distance to Load from reference column mm	Load kN	Load Length mm	Description A
1	1	2000	8.5	250	
2	3	4600	8.5	250	

3. Live Load - Panel

Load	Left End reference column	Left end of load from reference column mm	Load at left end kN/m2	Right End reference column	Right end of load from reference column mm	Load at right end kN/m2	Live Load reduction ##	Description A
1	3	4600	0.25	4	0	0.25	1	
2	1	2000	2	3	4600	2	1	
3	1	0	0.25	1	2000	0.25	1	

3. Live Load - Point

Load	Reference column	Distance to Load from reference column mm	Load kN	Load Length mm	Live Load reduction ##	Description A
1	3	4600	1	250	1	
2	1	2000	1	250	1	

Load Combinations : Ultimate

Load Combination	Description A	1. Self Weight ##	2. Extra Dead Load ##	3. Live Load ##
1	Live Load	1.2	1.2	1.5
2	Live Load	0.9	0.9	1.5
3	Dead Load	1.35	1.35	0

Load Combinations : Short Term Service

Load Combination A	Description	1. Self Weight ##	2. Extra Dead Load ##	3. Live Load ##
1	Live Load	1	1	0.7

Load Combinations : Permanent Service

Load Combination A	Description	1. Self Weight ##	2. Extra Dead Load ##	3. Live Load ##
1	Live Load	1	1	0.4

2S2

SL25

Load Combinations : Deflection

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Short Term - Deflection	1	1	0.7
2	Permanent - Deflection	1	1	0.4
3	Initial - Deflection	1	0	0

Load Combinations : Transfer Prestress

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Transfer	1	0	0

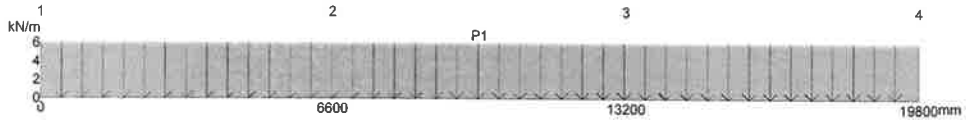
Load Combinations : Pre Existing

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Pre Existing	1	0	0

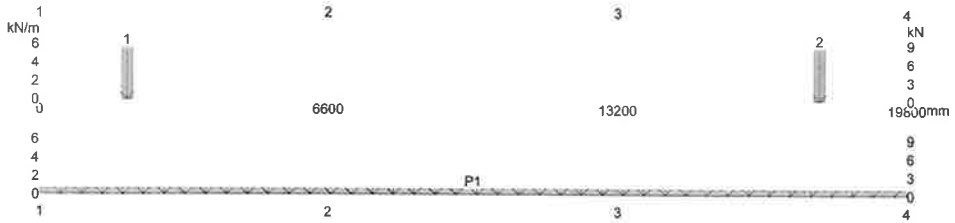
Load Combinations : Construction

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Construction	1	0	0

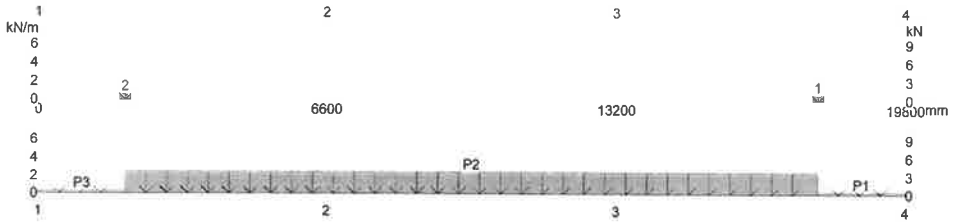
Load Case 1 : 1. Self Weight



Load Case 2 : 2. Extra Dead Load



Load Case 3 : 3. Live Load



Reinforcement

Reinforcement Use	Reinforcement Type List	Preferred Bar Size List	Number of Legs #
Flexural Bar	N 500MPa		

Reinforcement Use	Reinforcement Type List	Preferred Bar Size List	Number of Legs #
Flexural Mesh	F 450MPa		
Shear Option 1	N 500MPa	10	2
Shear Option 2	N 500MPa	12	2
Shear Option 3	N 500MPa	16	2
Punching Shear	N 500MPa	10	1

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	99	0			N	N
Span Reinforcement	300	99		0	0	N	N

Design Zones : Top

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Top Cover at left end mm	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Top Cover at Right end mm	Maximum Bar Size List	Minimum Bar Size List	Preferred bar size List	Minimum Number of Bars #
1	Bar	1	0	0	20	4	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

Design Zones : Bottom

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Bottom Cover at left end mm	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Bottom Cover at Right End mm	Maximum Bar Size List	Minimum Bar Size List	Preferred bar size List	Minimum Number of Bars #
1	Bar	1	0	0	20	4	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

User Defined : Top

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Top Cover at left end mm	% Development of Left End of Bar in Tension %	% Development of Left End of Bar in Compression %	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Top Cover at Right end mm	% Development of Right End of Bar in Tension %
1	L 500MPa	1	0	0	35	0	0	4	0	0	35	0

Layer Number	% Development of Right End of Bar in Compression %	Bar Size List	Mesh full width of Design Cross-section Y/N	Width of mesh mm	% in Flange %	Layer attached after the PreExisting Load Case Y/N
1	0	102	Y	0	0	N

Or N12@300%

User Defined : Metal Decking

Layer Number	Metal Deck Type List	Left End Reference Column #	Distance to Left End of Metal Deck mm	Distance to Start of Concrete Void from Start of Sheet mm	Right End Reference Column #	Distance to Right End of Metal Deck mm	Distance to End of Concrete Void from End of Sheet mm	Sheet Thickness List	Number of Sheets #	Description A
	KF57	2	0	0	3	0	0	1.0mm	4	
	KF57	1	0	0	2	0	0	1.0mm	4	
	KF57	3	0	0	4	0	0	1.0mm	4	

SL26

Reinforcement Design Zones

Reinforcement Design Zones User Defined

Design Data

Capacity Reduction factor (phi) for Flexure	#.#	0.8
Capacity Reduction factor (phi) for Shear	#.#	0.7
Material Factor for Concrete in Flexure	#.#	1
Material Factor for Concrete in Shear	#.#	1
Material Factor for Reinforcement	#.#	1
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.4
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	N
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment
Moment Diagram Offset For Flexure Calculations	List	Code Default
Limit Reinforcement Strain	Y/N	N
Beam Shear Critical Section Location	List	Code Critical Section

Maximum Service Stress Change - Prestressed Sections	MPa	150
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	N

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	25
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Incremental Deflection Warning Limit - Maximum Deflection	mm	25
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	25.6
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#	1
Pattern Live Load for Ultimate Strength	Y/N	Y
Pattern Live Load for Crack Control	Y/N	Y

Pattern Live Load For Deflections	Y/N	Y
Pattern Live Load for Deflection Permanent Load Combination	Y/N	N

Material Properties

Concrete

Description	32MPa	40MPa
Characteristic Compressive Strength	32	40
Mean Compressive Strength	37.22	45.9
Lower Characteristic Tensile Strength	3.39	3.79
Upper Characteristic Tensile Strength	5.43	6.07
Concrete Weight	2447	2447
Design Concrete Modulus	29443.8	32919.2
Mean Concrete Modulus	31754.7	35263.5
Ultimate Concrete Modulus	29443.8	32919.2
Basic Shrinkage Strain	850	850
Basic Creep Factor	3.4	2.5
Concrete Strain Limit	0.003	0.003

Reinforcement Bar

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
N	Deformed	500	2e5	N	0.05	540	90	-1	-1	-1	-1	Y	

Nominal Bar Size A	Bar Diameter mm	Bar Area mm2	Bar Inertia mm4	Bar Weight kg/m	Stock Length mm
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
24	24	452	16292.6	3.55	12000
28	28	616	30184	4.83	12000
32	32	804	51492.6	6.31	12000
36	36	1020	82481.1	7.99	12000
40	40	1260	1.257e5	9.86	12000

Reinforcement Mesh

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
L	Deformed	500	2e5	L	0.015	515	90	-1	-1	-1	-1	Y	

Nominal Mesh Size A	Main Bar Diameter mm	Main Bar Area mm2/m	Main Bar Spacing mm	Main Bar Inertia mm4	Cross bar Diameter mm	Cross bar Area mm2/m	Cross Bar Spacing mm	Mesh Weight kg/m2	Stock Length mm
62	6	141	200	0	6	141	200	0	0
72	7	179	200	0	7	179	200	0	0
82	8	227	200	0	8	227	200	0	0
92	9	290	200	0	9	290	200	0	0
102	10	354	200	0	10	354	200	0	0
81	8	454	100	0	8	454	100	0	0
718	7	358	100	0	8	227	200	0	0
818	8	454	100	0	8	227	200	0	0
918	9	581	100	0	8	227	200	0	0
1018	10	709	100	0	8	227	200	0	0
1118	11	899	100	0	8	227	200	0	0
1218	12	1112	100	0	8	227	200	0	0

Metal Decking

Sheet Designation	Yield Stress	Youngs Modulus	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexexure	Material Factor Shear	Capacity Reduction Factor Flexuse	Capacity Reduction Factor Shear	Flexural Rebar For Shear	Description
KF57	550	2e5	0.035	600	90	-1	-1	-1	-1	Y	

Nominal Size A	Sheet Thickness mm	Sheet Width mm	Sheet Height mm	Number of Rib Spaces #	Sheet Centroid from Bottom mm	Sheet Area mm2	Sheet Inertia mm4	Mechanical Resistance kN/m2	Sheet Weight kg/m
.75mm	0.8	300	58	1	14.5	358.5	1.449e5	476	0
.9mm	0.9	300	58	1	14.5	430.2	1.799e5	580	0

SL27

Nominal Size	Sheet Thickness	Sheet Width	Sheet Height	Number of Rib Spaces	Sheet Centroid from Bottom	Sheet Area	Sheet Inertia	Mechanical Resistance	Sheet Weight
A	mm	mm	mm	#	mm	mm2	mm4	kN/m2	kg/m
1.0mm	1	300	58	1	14.5	477.9	1.999e5	645	0

Elevation view

Plan view

Warnings

Input

No errors or warnings were found.

Output

No errors or warnings were found.

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	15.96	7.04	3.54
Elastic Rotation	#.#	1.48e-3	7.83e-4	4.65e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 2		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	43.9	7.4	17.02
Elastic Rotation	#.#	-4.93e-4	-3.95e-4	-1.46e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 3		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	43.9	7.4	17.02
Elastic Rotation	#.#	4.93e-4	3.95e-4	1.46e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 4		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0

Col No. 4		Self Weight	Extra Dead Load	Live Load
Moment Below	kNm	-0	-0	-0
Reaction	kN	15.96	7.04	3.54
Elastic Rotation	#.#	-1.48e-3	-7.83e-4	-4.65e-4
Elastic Axial Shortening	mm	0	0	0

Load Combinations

Column Actions

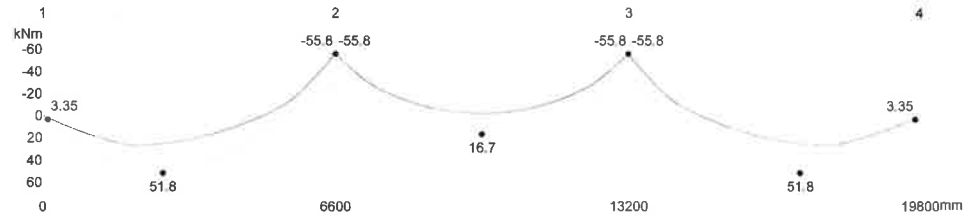
Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	25.48	25.48	32.91	32.91	19.52	33.88
Elastic Rotation	#.#	2.59e-3	2.59e-3	3.41e-3	3.41e-3	1.74e-3	3.65e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	63.22	63.22	87.1	87.1	49.85	89.28
Elastic Rotation	#.#	-9.9e-4	-9.9e-4	-1.28e-3	-1.28e-3	-1.23e-3	-1.11e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 3		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	63.22	63.22	87.1	87.1	49.85	89.28
Elastic Rotation	#.#	9.9e-4	9.9e-4	1.28e-3	1.28e-3	1.23e-3	1.11e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 4		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	25.48	25.48	32.91	32.91	19.52	33.88
Elastic Rotation	#.#	-2.59e-3	-2.59e-3	-3.41e-3	-3.41e-3	-1.74e-3	-3.65e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Ultimate Flexure

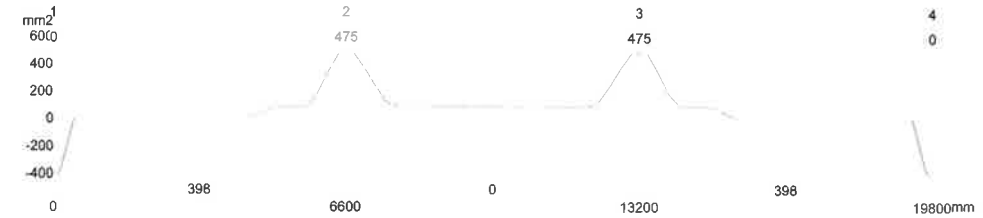


Moment Moment 1 Moment 2

SL26

Shear Shear 1 Shear 2

Flexural Design
Ultimate



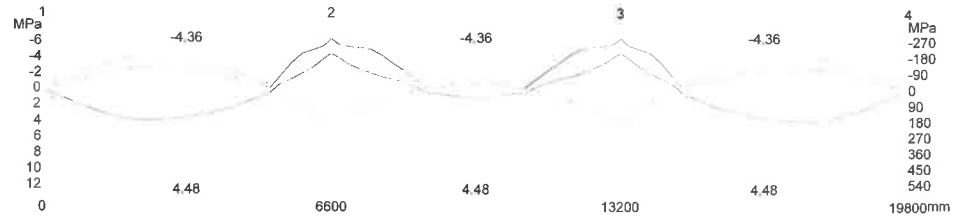
Reinforcement Top Total Bottom Total Top Ultimate Bottom Ultimate Min Top Min Bot

Capacity Minimum Ultimate Design Initial Final

Neutral Axis Depth Initial Final

Service

Maximum Moment Condition



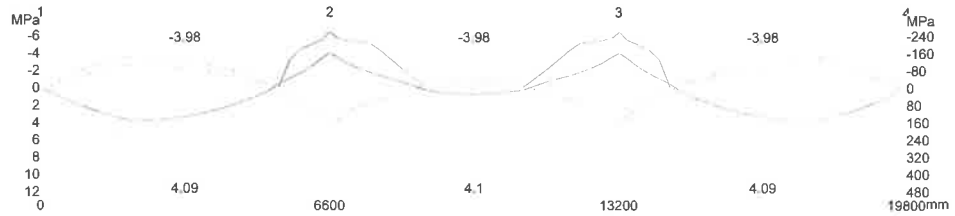
Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Reversal Moment Condition

Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Permanent

Maximum Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Reversal Moment Condition

Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Shear Design
Beam
Span 1

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
100	33.26	3.37	0	184	398.15	1200	0	0	0	989.18	0	0	0	0	
168	32.68	5.61	0	184	348.47	1200	108	99999	108	989.18	0	0	0	0	No shear steel

SL29

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
445	30.35	14.34	0	195.5	0	1200	111.53	99999	111.53	1051.01	0	0	0	0	No shear steel
722	28.01	22.42	0	195.5	0	1200	118.45	99999	118.45	1051.01	0	0	0	0	No shear steel
1000	25.7	29.76	0	195.5	0	1200	124.67	99999	124.67	1051.01	0	0	0	0	No shear steel
1325	22.96	37.67	0	195.5	0	1200	131.23	99999	131.23	1051.01	0	0	0	0	No shear steel
1650	20.31	44.37	0	195.5	0	1200	117.82	99999	117.82	1051.01	0	0	0	0	No shear steel
1875	18.41	48.73	0	195.5	0	1200	122.95	99999	122.95	1051.01	0	0	0	0	No shear steel
1999	11.57	50.59	0	195.5	0	1200	125.6	99999	125.6	1051.01	0	0	0	0	No shear steel
2000	11.51	50.6	0	195.5	0	1200	125.63	99999	125.63	1051.01	0	0	0	0	No shear steel
2001	11.45	50.61	0	195.5	0	1200	125.65	99999	125.65	1051.01	0	0	0	0	No shear steel
2125	4.29	47.52	0	195.5	0	1200	128.19	99999	128.19	1051.01	0	0	0	0	No shear steel
2712	-6.87	38.84	0	195.5	0	1200	139.05	99999	139.05	1051.01	0	0	0	0	No shear steel
3300	-13.13	36.79	0	195.5	0	1200	148.45	99999	148.45	1051.01	0	0	0	0	No shear steel
3850	-18.51	31.65	0	195.5	0	1200	139.69	99999	139.69	1051.01	0	0	0	0	No shear steel
4400	-24.23	22.55	0	195.5	0	1200	129.68	99999	129.68	1051.01	0	0	0	0	No shear steel
4950	-30.6	7.47	0	195.5	0	1200	137.19	99999	137.19	1051.01	0	0	0	0	No shear steel
5197	-33.12	1.34	0	195.5	0	1200	132.71	99999	132.71	1051.01	0	0	0	0	No shear steel
5444	-35.97	-7.2	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
5691	-38.83	-16.44	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
5938	-41.6	-25.8	0	184	171.09	1200	106.41	99999	106.41	989.18	0	0	0	0	No shear steel
6185	-44.45	-36.42	0	184	332.85	1200	115.28	99999	115.28	989.18	0	0	0	0	No shear steel
6432	-47.31	-47.76	0	184	474.88	1200	122.08	99999	122.08	989.18	0	0	0	0	No shear steel
6599	-49.25	-55.82	0	184	474.88	1200	0	0	0	989.18	0	0	0	0	

Design Comments:-
- Shear areas and spacings adjusted for Fitment hook location as per AS3600 cl 8.2.12.4, hooks at: Top of Fitment (.8 for tension at top surface only)

Span 2

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1	40.01	-55.83	0	184	475.01	1200	0	0	0	989.18	0	0	0	0	
168	38.07	-49.31	0	184	475.01	1200	122.08	99999	122.08	989.18	0	0	0	0	No shear steel
415	35.21	-40.26	0	184	360.27	1200	116.66	99999	116.66	989.18	0	0	0	0	No shear steel
662	32.35	-31.91	0	184	231.39	1200	109.89	99999	109.89	989.18	0	0	0	0	No shear steel
909	29.63	-24.88	0	184	116.32	1200	103.05	99999	103.05	989.18	0	0	0	0	No shear steel
1156	26.77	-17.92	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
1403	23.91	-11.66	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
1650	21.52	-7.82	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
2200	15.15	2.26	0	195.5	0	1200	146.23	99999	146.23	1051.01	0	0	0	0	No shear steel
2750	9.63	6.57	0	195.5	0	1200	154.28	99999	154.28	1051.01	0	0	0	0	No shear steel
3300	4.54	7.27	0	195.5	0	1200	161.57	99999	161.57	1051.01	0	0	0	0	No shear steel
3850	-9.63	6.57	0	195.5	0	1200	154.28	99999	154.28	1051.01	0	0	0	0	No shear steel
4400	-15.15	2.26	0	195.5	0	1200	146.23	99999	146.23	1051.01	0	0	0	0	No shear steel
4950	-21.52	-7.82	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
5197	-23.91	-11.66	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
5444	-26.77	-17.92	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
5691	-29.63	-24.88	0	184	116.32	1200	103.05	99999	103.05	989.18	0	0	0	0	No shear steel
5938	-32.35	-31.91	0	184	231.39	1200	109.89	99999	109.89	989.18	0	0	0	0	No shear steel
6185	-35.21	-40.26	0	184	360.27	1200	116.66	99999	116.66	989.18	0	0	0	0	No shear steel
6432	-38.07	-49.31	0	184	475.01	1200	122.08	99999	122.08	989.18	0	0	0	0	No shear steel
6599	-40.01	-55.83	0	184	475.01	1200	0	0	0	989.18	0	0	0	0	

Span 3

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1	49.25	-55.82	0	184	474.88	1200	0	0	0	989.18	0	0	0	0	
168	47.31	-47.76	0	184	474.88	1200	122.08	99999	122.08	989.18	0	0	0	0	No shear steel
415	44.45	-36.42	0	184	332.85	1200	115.28	99999	115.28	989.18	0	0	0	0	No shear steel
662	41.6	-25.8	0	184	171.09	1200	106.41	99999	106.41	989.18	0	0	0	0	No shear steel
909	38.83	-16.44	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
1156	35.97	-7.2	0	184	85.2	1200	101.03	99999	101.03	989.18	0	0	0	0	No shear steel
1403	33.12	1.34	0	195.5	0	1200	132.71	99999	132.71	1051.01	0	0	0	0	No shear steel
1650	30.6	7.47	0	195.5	0	1200	137.19	99999	137.19	1051.01	0	0	0	0	No shear steel
2200	24.23	22.55	0	195.5	0	1200	129.68	99999	129.68	1051.01	0	0	0	0	No shear steel
2750	18.51	31.65	0	195.5	0	1200	139.69	99999	139.69	1051.01	0	0	0	0	No shear steel
3300	13.13	36.79	0	195.5	0	1200	148.45	99999	148.45	1051.01	0	0	0	0	No shear steel
3887	6.87	38.83	0	195.5	0	1200	139.06	99999	139.06	1051.01	0	0	0	0	No shear steel
4475	-4.29	47.52	0	195.5	0	1200	128.19	99999	128.19	1051.01	0	0	0	0	No shear steel
4599	-11.45	50.61	0	195.5	0	1200	125.65	99999	125.65	1051.01	0	0	0	0	No shear steel
4600	-11.51	50.6	0	195.5	0	1200	125.63	99999	125.63	1051.01	0	0	0	0	No shear steel

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
4601	-11.57	50.59	0	195.5	0	1200	125.6	99999	125.6	1051.01	0	0	0	0	No shear steel
4725	-18.41	48.73	0	195.5	0	1200	122.95	99999	122.95	1051.01	0	0	0	0	No shear steel
4950	-20.31	44.37	0	195.5	0	1200	117.82	99999	117.82	1051.01	0	0	0	0	No shear steel
5275	-22.96	37.67	0	195.5	0	1200	131.23	99999	131.23	1051.01	0	0	0	0	No shear steel
5600	-25.7	29.76	0	195.5	0	1200	124.67	99999	124.67	1051.01	0	0	0	0	No shear steel
5877	-28.01	22.45	0	195.5	0	1200	118.48	99999	118.48	1051.01	0	0	0	0	No shear steel
6154	-30.34	14.37	0	195.5	0	1200	111.56	99999	111.56	1051.01	0	0	0	0	No shear steel
6432	-32.68	5.61	0	184	348.47	1200	108	99999	108	989.18	0	0	0	0	No shear steel
6500	-33.26	3.37	0	184	398.15	1200	0	0	0	989.18	0	0	0	0	

Punching

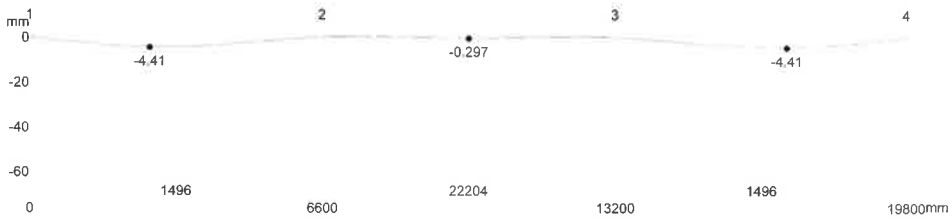
Column Head Critical Section

Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	phi Vuo	phi Vu	phi Vumin	phi Vumax	side beam	Moment Transfer	Asw/s reqd	result
A	#.#	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	kN	A	A	mm2/mm	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!

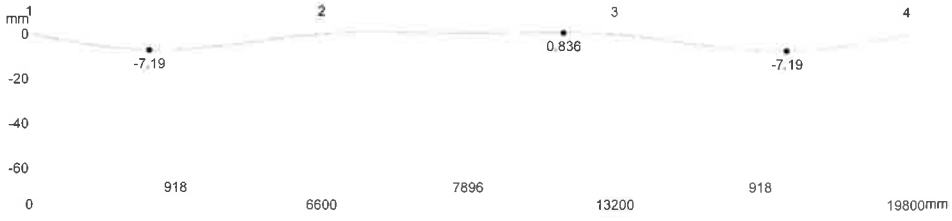
Deflections

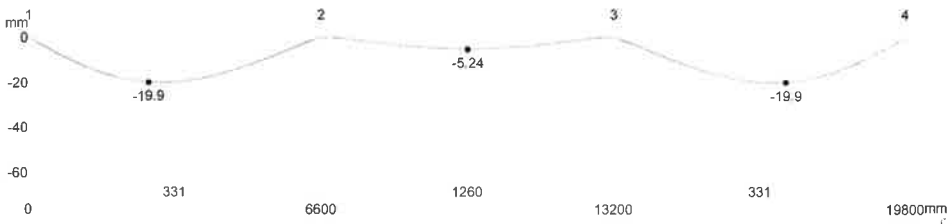
Live Load on All Spans

Transfer

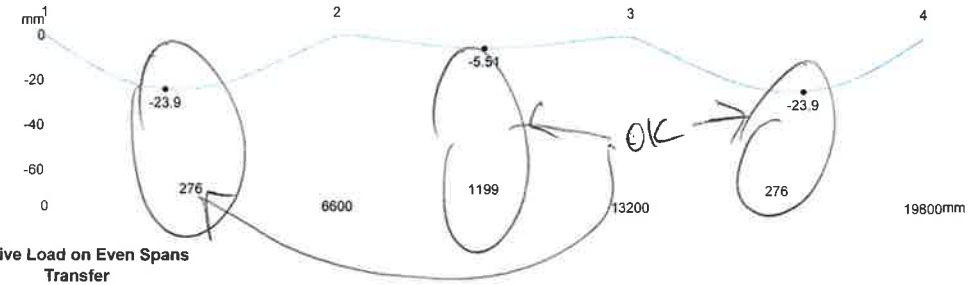


Short Term



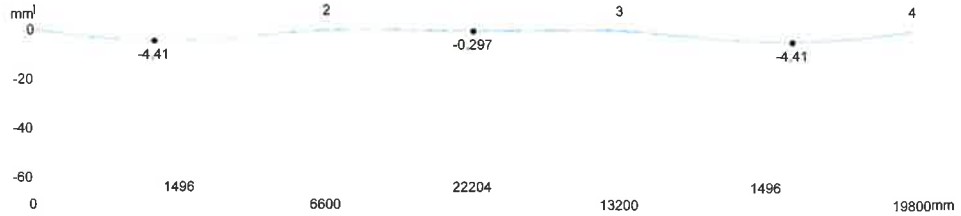


Total Long Term

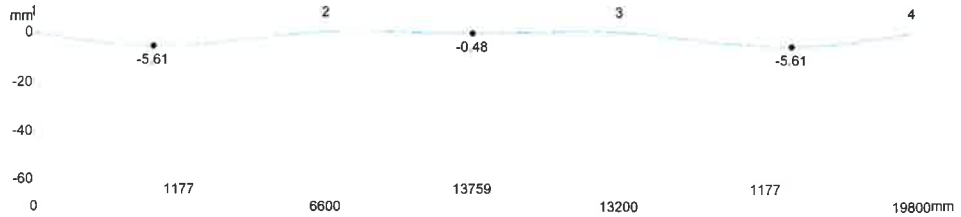


Live Load on Even Spans

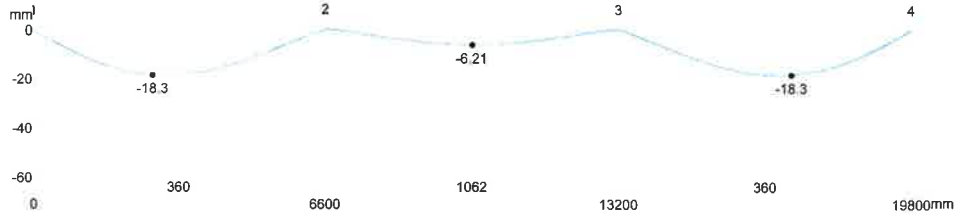
Transfer



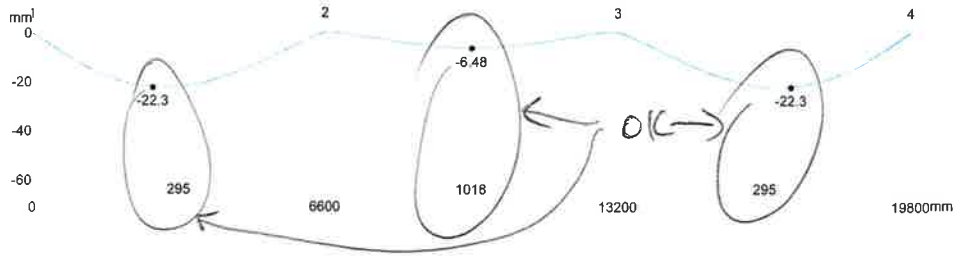
Short Term



Incremental



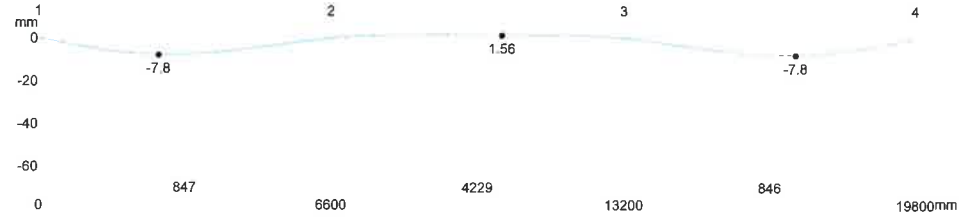
Total Long Term



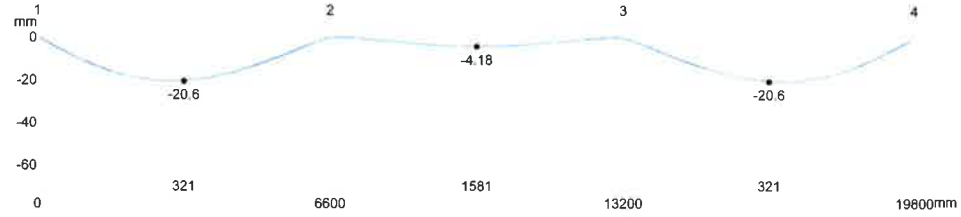
Live Load on Odd Spans

Transfer

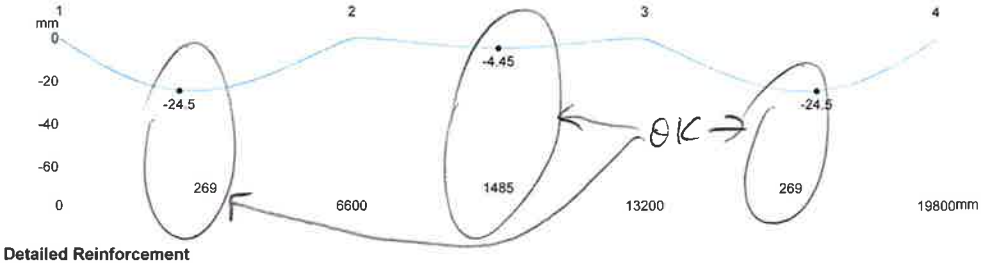
Short Term



Incremental



Total Long Term



Detailed Reinforcement

Span 1

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
100	0	0	0	26	1200	No Steel Added	40	300	398.15	184	1200	6 N10 @ 236.6
168	0	0	0	26	1200	No Steel Added	40	300	348.47	184	1200	5 N10 @ 270.3
445	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
722	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1000	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1325	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1650	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1875	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
1999	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
2000	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
2001	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added

SL31

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
2125	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
2712	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
3300	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
3850	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4400	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4950	0	0	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
5197	40	300	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
5444	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
5691	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
5938	28	252.9	171.09	26	1200	2 N12 @ 792.5	0	0	0	184	1200	No Steel Added
6185	20	225.8	332.85	26	1200	3 N12 @ 407.4	0	0	0	184	1200	No Steel Added
6432	16	199	474.88	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added
6599	12	147.3	474.88	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added

Shear Reinforcement				
	Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 2

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
1	12	147.3	475.01	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added
168	16	187.9	475.01	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added
415	20	203.9	360.27	26	1200	4 N12 @ 376.4	0	0	0	184	1200	No Steel Added
662	20	213.5	231.39	26	1200	3 N12 @ 586	0	0	0	184	1200	No Steel Added
909	20	223.2	116.32	26	1200	2 N12 @ 999	0	0	0	184	1200	No Steel Added
1156	28	263.9	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
1403	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
1650	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
2200	40	300	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
2750	0	0	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
3300	0	0	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
3850	0	0	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
4400	40	300	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
4950	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
5197	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
5444	28	263.9	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
5691	20	223.2	116.32	26	1200	2 N12 @ 999	0	0	0	184	1200	No Steel Added
5938	20	213.5	231.39	26	1200	3 N12 @ 586	0	0	0	184	1200	No Steel Added
6185	20	203.9	360.27	26	1200	4 N12 @ 376.4	0	0	0	184	1200	No Steel Added
6432	16	187.9	475.01	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
6599	12	147.3	475.01	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added

Shear Reinforcement				
	Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 3

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
1	12	147.3	474.88	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added
168	16	199	474.88	26	1200	5 N12 @ 285.5	0	0	0	184	1200	No Steel Added
415	20	225.8	332.85	26	1200	3 N12 @ 407.4	0	0	0	184	1200	No Steel Added
662	28	252.9	171.09	26	1200	2 N12 @ 792.6	0	0	0	184	1200	No Steel Added
909	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
1156	40	300	85.2	26	1200	1 N12 @ 999	0	0	0	184	1200	No Steel Added
1403	40	300	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
1650	0	0	85.2	26	1200	1 N12 @ 999	40	300	0	184	1200	No Steel Added
2200	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
2750	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
3300	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
3887	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4475	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4599	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4600	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4601	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4725	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
4950	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
5275	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
5600	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
5877	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
6154	0	0	0	26	1200	No Steel Added	40	300	0	184	1200	No Steel Added
6432	0	0	0	26	1200	No Steel Added	40	300	348.47	184	1200	5 N10 @ 270.3
6500	0	0	0	26	1200	No Steel Added	40	300	398.15	184	1200	6 N10 @ 236.6

Shear Reinforcement				
	Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel

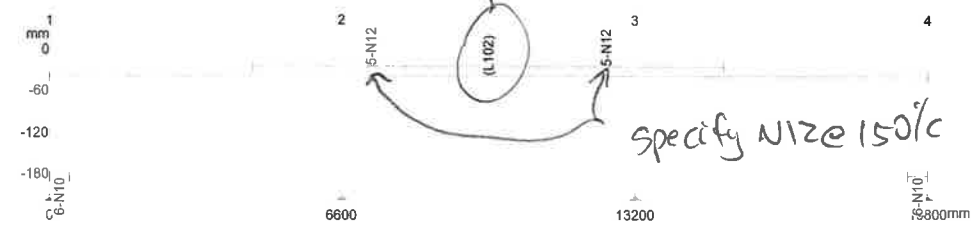
SL32

Area mm2/mm	Shear Reinforcement Spacing of Sets 2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

or N12@300

Reinforcement Layout



specify N12@150 o/c

Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

SL33

Project Name: 168 Prospect Road
Project Number: 1702160
Frame Description: 2S1
Designer: FK
K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\2S1.rpf

RAPT - Version: 6.2.2.2
Reinforced And Post-Tensioned Concrete Analysis & Design Package
Copyright(C) 1988 - 2010 PCDC Pty. Ltd. All Rights Reserved

FIELDERS KINGFLOR® COMPOSITE STEEL FORMWORK

Licensee
TMK Consulting Engineers
105 Waymouth Street
Adelaide SA 5000
318662120608UPN3

Input

General

Design Code	List	Australia - AS3600*SAVED*
Material	List	Australia - Australian Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Slab
Panel Type	List	Internal
Strip Type	List	One way - Full Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	32MPa
Concrete - Columns	List	40MPa
Top Reinforcement Cover	mm	20
Bottom Reinforcement Cover	mm	20
Self Weight Definition	List	Program Calculated
Pattern Live Load	Y/N	Y
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	7500	240	1200	1200
2	4800	240	1200	1200
3	7500	240	1200	1200
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse prestress (P/A)
	A	List	mm	MPa
1	1	Knife-Edge	1200	
2	2	Knife-Edge	1200	
3	3	Knife-Edge	1200	
4	4	Knife-Edge	1200	

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Extra Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1. Self Weight - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m2		mm	kN/m2	A
1	1	0	5.76	4	0	5.76	

2. Extra Dead Load - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m2		mm	kN/m2	A
1	1	0	0.5	4	0	0.5	

2. Extra Dead Load - Point

Load	Reference column	Distance to Load from reference column	Load	Load Length	Description
		mm	kN	mm	A
1	2	2900	12.8	100	
2	1	2000	8.5	250	
3	3	5500	8.5	250	

3. Live Load - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Live Load reduction	Description
		mm	kN/m2		mm	kN/m2	##	A
1	1	2000	2	3	5500	2	1	
2	1	0	0.25	1	2000	0.25	1	
3	3	5500	0.25	4	0	0.25	1	

3. Live Load - Point

Load	Reference column	Distance to Load from reference column	Load	Load Length	Live Load reduction	Description
		mm	kN	mm	#.#	A
1	2	2900	8	100	0	
2	1	2000	0.9	250	0	
3	3	5500	0.9	250	0	

Load Combinations : Ultimate

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	##	##	##
1	Live Load	1.2	1.2	1.5
2	Live Load	0.9	0.9	1.5
3	Dead Load	1.35	1.35	0

Load Combinations : Short Term Service

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.7

Load Combinations : Permanent Service

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.4

2S1

SL34

Load Combinations : Deflection

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Short Term - Deflection	1	1	0.7
2	Permanent - Deflection	1	1	0.4
3	Initial - Deflection	1	0	0

Load Combinations : Transfer Prestress

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Transfer	1	0	0

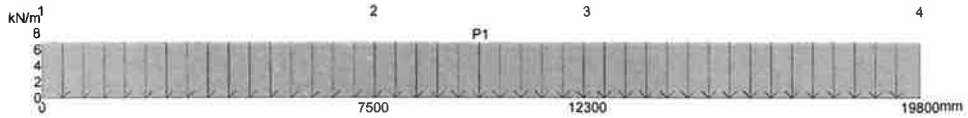
Load Combinations : Pre Existing

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Pre Existing	1	0	0

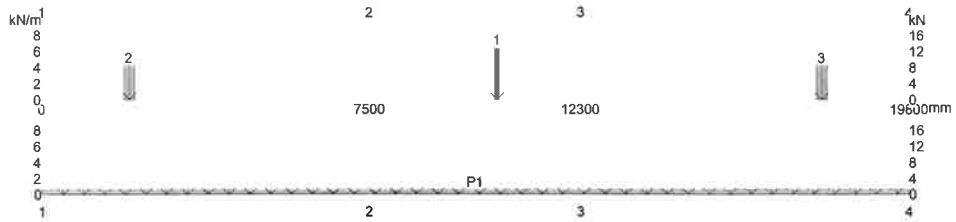
Load Combinations : Construction

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Construction	1	0	0

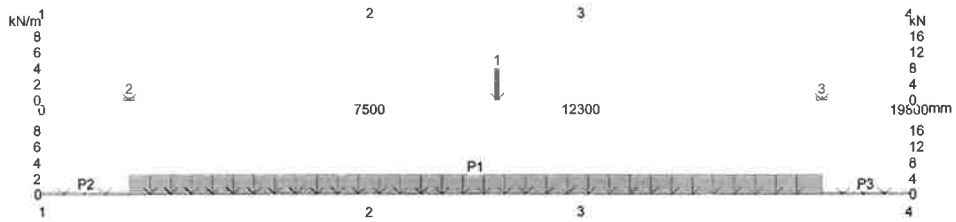
Load Case 1 : 1. Self Weight



Load Case 2 : 2. Extra Dead Load



Load Case 3 : 3. Live Load



Reinforcement

Reinforcement Use	Reinforcement Type List	Preferred Bar Size List	Number of Legs #
Flexural Bar	N 500MPa		

Reinforcement Use	Reinforcement Type List	Preferred Bar Size List	Number of Legs #
Flexural Mesh	F 450MPa		
Shear Option 1	N 500MPa	10	2
Shear Option 2	N 500MPa	12	2
Shear Option 3	N 500MPa	16	2
Punching Shear	N 500MPa	10	1

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	99	0			N	N
Span Reinforcement	300	99		0	0	N	N

Design Zones : Top

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Top Cover at left end mm	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Top Cover at Right end mm	Maximum Bar Size List	Minimum Bar Size List	Preferred bar size List	Minimum Number of Bars #
1	Bar	1	0	0	20	4	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

Design Zones : Bottom

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Bottom Cover at left end mm	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Bottom Cover at Right End mm	Maximum Bar Size List	Minimum Bar Size List	Preferred bar size List	Minimum Number of Bars #
1	Bar	1	0	0	20	4	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

User Defined : Top

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Top Cover at left end mm	% Development of Left End of Bar in Tension %	% Development of Left End of Bar in Compression %	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Top Cover at Right end mm	% Development of Right End of Bar in Tension %
1	L 500MPa	1	0	0	35	0	0	4	0	0	35	0

Layer Number	% Development of Right End of Bar in Compression %	Bar Size List	Mesh full width of Design Cross-section Y/N	Width of mesh mm	% in Flange %	Layer attached after the PreExisting Load Case Y/N
1	0	81	Y	0	0	N

NIZE 200

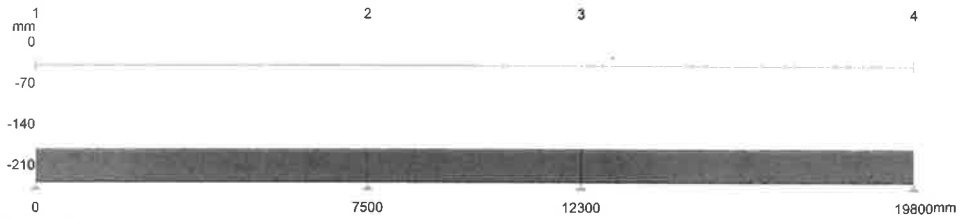
User Defined : Metal Decking

Layer Number	Metal Deck Type List	Left End Reference Column #	Distance to Left End of Metal Deck mm	Distance to Start of Concrete Void from Start of Sheet mm	Right End Reference Column #	Distance to Right End of Metal Deck mm	Distance to End of Concrete Void from End of Sheet mm	Sheet Thickness List	Number of Sheets #	Description A
	KF57	3	0	0	4	0	0	1.0mm	4	
	KF57	1	0	0	2	0	0	1.0mm	4	
	KF57	2	0	0	3	0	0	1.0mm	4	

SL35

Reinforcement Design Zones

Reinforcement Design Zones User Defined



Design Data

Capacity Reduction factor (phi) for Flexure	#.#	0.8
Capacity Reduction factor (phi) for Shear	#.#	0.7
Material Factor for Concrete in Flexure	#.#	1
Material Factor for Concrete in Shear	#.#	1
Material Factor for Reinforcement	#.#	1
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.4
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	N
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment
Moment Diagram Offset For Flexure Calculations	List	Code Default
Limit Reinforcement Strain	Y/N	N
Beam Shear Critical Section Location	List	Code Critical Section

Maximum Service Stress Change - Prestressed Sections	MPa	150
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C.	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	N

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	25
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Incremental Deflection Warning Limit - Maximum Deflection	mm	25
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	25.6
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#	1
Pattern Live Load for Ultimate Strength	Y/N	Y
Pattern Live Load for Crack Control	Y/N	Y

Pattern Live Load For Deflections	Y/N	Y
Pattern Live Load for Deflection Permanent Load Combination	Y/N	N

Material Properties

Concrete

Description	32MPa	40MPa
Characteristic Compressive Strength	32	40
Mean Compressive Strength	37.22	45.9
Lower Characteristic Tensile Strength	3.39	3.79
Upper Characteristic Tensile Strength	5.43	6.07
Concrete Weight	2447	2447
Design Concrete Modulus	29443.8	32919.2
Mean Concrete Modulus	31754.7	35263.5
Ultimate Concrete Modulus	29443.8	32919.2
Basic Shrinkage Strain	850	850
Basic Creep Factor	3.4	2.5
Concrete Strain Limit	0.003	0.003

Reinforcement Bar

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
N	Deformed	500	2e5	N	0.05	540	90	-1	-1	-1	-1	Y	

Nominal Bar Size A	Bar Diameter mm	Bar Area mm2	Bar Inertia mm4	Bar Weight kg/m	Stock Length mm
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
24	24	452	16292.6	3.55	12000
28	28	616	30184	4.83	12000
32	32	804	51492.6	6.31	12000
36	36	1020	82481.1	7.99	12000
40	40	1260	1.257e5	9.86	12000

Reinforcement Mesh

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
L	Deformed	500	2e5	L	0.015	515	90	-1	-1	-1	-1	Y	

Nominal Mesh Size A	Main Bar Diameter mm	Main Bar Area mm2/m	Main Bar Spacing mm	Main Bar Inertia mm4	Cross bar Diameter mm	Cross bar Area mm2/m	Cross Bar Spacing mm	Mesh Weight kg/m2	Stock Length mm
62	6	141	200	0	6	141	200	0	0
72	7	179	200	0	7	179	200	0	0
82	8	227	200	0	8	227	200	0	0
92	9	290	200	0	9	290	200	0	0
102	10	354	200	0	10	354	200	0	0
81	8	454	100	0	8	454	100	0	0
718	7	358	100	0	8	227	200	0	0
818	8	454	100	0	8	227	200	0	0
918	9	581	100	0	8	227	200	0	0
1018	10	709	100	0	8	227	200	0	0
1118	11	899	100	0	8	227	200	0	0
1218	12	1112	100	0	8	227	200	0	0

Metal Decking

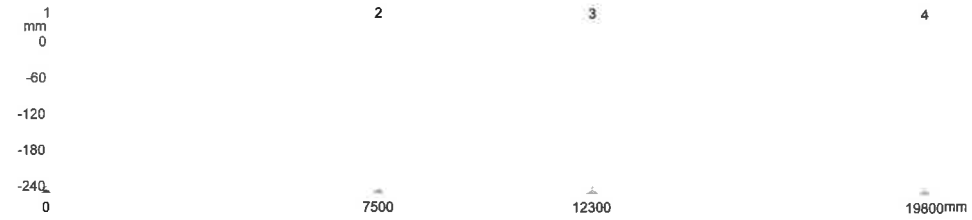
Sheet Designation	Yield Stress	Youngs Modulus	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexexure	Material Factor Shear	Capacity Reduction Factor Flexuse	Capacity Reduction Factor Shear	Flexural Rebar For Shear	Description
KF57	550	2e5	0.035	600	90	-1	-1	-1	-1	Y	

Nominal Size A	Sheet Thickness mm	Sheet Width mm	Sheet Height mm	Number of Rib Spaces #	Sheet Centroid from Bottom mm	Sheet Area mm2	Sheet Inertia mm4	Mechanical Resistance kN/m2	Sheet Weight kg/m
.75mm	0.8	300	58	1	14.5	358.5	1.449e5	476	0
.9mm	0.9	300	58	1	14.5	430.2	1.799e5	580	0

526

Nominal Size	Sheet Thickness	Sheet Width	Sheet Height	Number of Rib Spaces	Sheet Centroid from Bottom	Sheet Area	Sheet Inertia	Mechanical Resistance	Sheet Weight
A	mm	mm	mm	#	mm	mm2	mm4	kN/m2	kg/m
1.0mm	1	300	58	1	14.5	477.9	1.999e5	645	0

Elevation view



Plan view

Warnings

Input

Warning:Live Load Reduction factor is very small. Check if it is appropriate.
Warning:Live Load Reduction factor is very small. Check if it is appropriate.
Warning:Live Load Reduction factor is very small. Check if it is appropriate.

Output

Warning:Total deflection in at least one span is greater than defined limit.

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	21.74	7.15	4.05
Elastic Rotation	#.#	1.88e-3	5.71e-4	5.01e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 2		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	46.68	12.2	15.51
Elastic Rotation	#.#	-9.85e-4	-1.22e-4	-2.86e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 3		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	46.68	15.27	15.51
Elastic Rotation	#.#	9.85e-4	0	2.86e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 4		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	21.74	7.06	4.05
Elastic Rotation	#.#	-1.88e-3	-5.5e-4	-5.01e-4
Elastic Axial Shortening	mm	0	0	0

Load Combinations

Column Actions

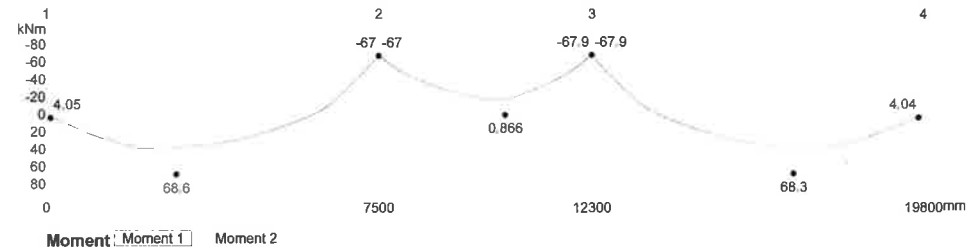
Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	31.73	31.73	40.75	40.75	25.56	40.98
Elastic Rotation	#.#	2.8e-3	2.8e-3	3.69e-3	3.69e-3	2.11e-3	3.74e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	69.73	69.73	93.92	93.92	56.33	97.8
Elastic Rotation	#.#	-1.31e-3	-1.31e-3	-1.76e-3	-1.76e-3	-1.34e-3	-1.6e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

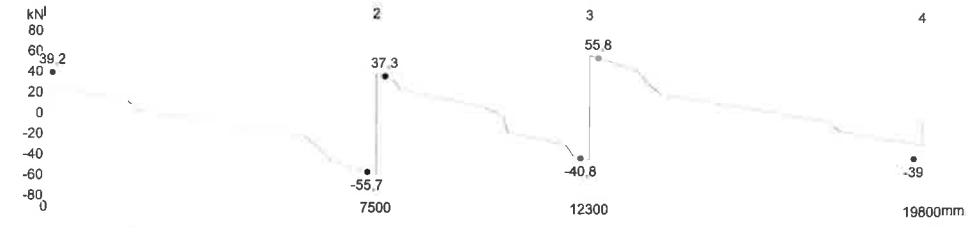
Col No. 3		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	72.81	72.81	97.6	97.6	59.09	101.49
Elastic Rotation	#.#	1.27e-3	1.27e-3	1.71e-3	1.71e-3	1.3e-3	1.55e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 4		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	31.63	31.63	40.63	40.63	25.47	40.86
Elastic Rotation	#.#	-2.78e-3	-2.78e-3	-3.66e-3	-3.66e-3	-2.09e-3	-3.71e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Ultimate Flexure

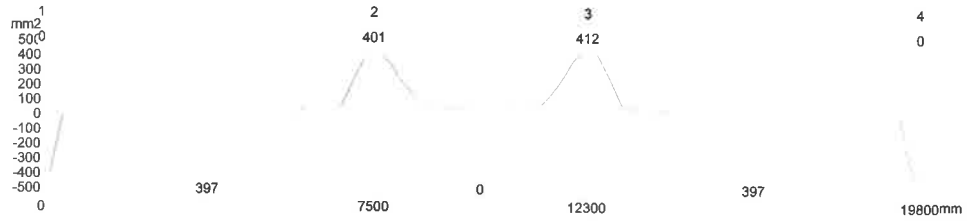


SC37

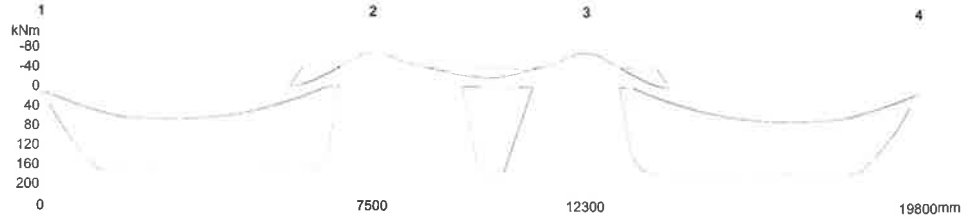


Shear Shear 1 Shear 2

Flexural Design
Ultimate



Reinforcement Top Total Bottom Total Top Ultimate Bottom Ultimate Min Top Min Bot

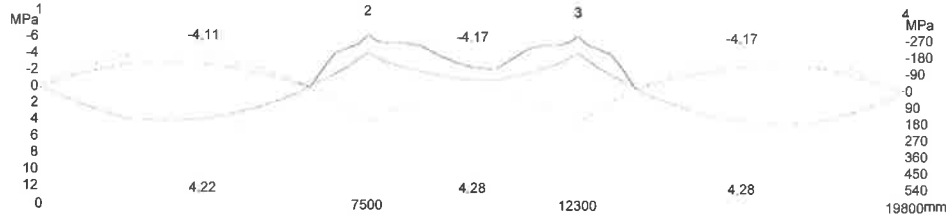


Capacity Minimum Ultimate Design Initial Final

Neutral Axis Depth Initial Final

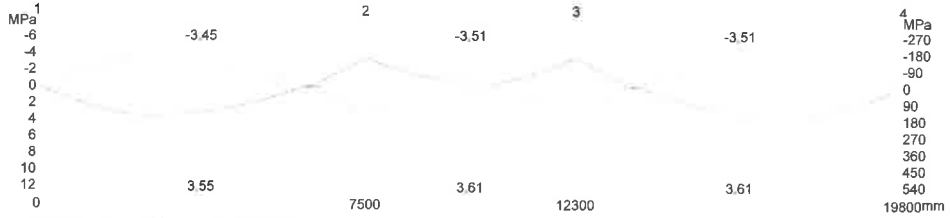
Service

Maximum Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

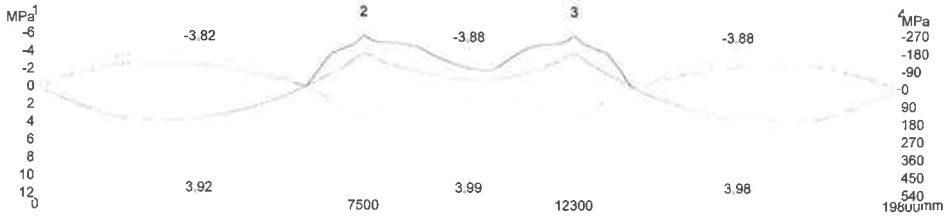
Reversal Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

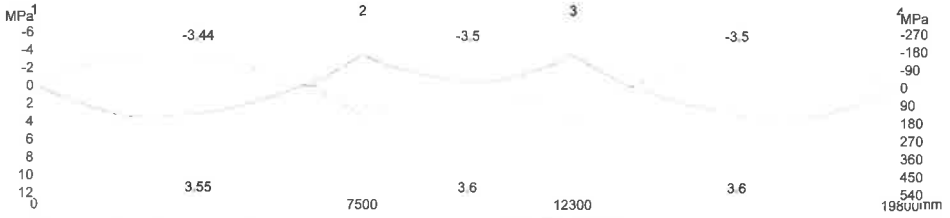
Permanent

Maximum Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Reversal Moment Condition



Gross Stress Top Gross Stress Bottom Cracked Compression Reinforcement Tension

Shear Design
Beam
Span 1

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets			Shear Comments
												2 legs N10	2 legs N12	2 legs N16	
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
100	40.26	4.07	0	214	397.12	1200	0	0	0	1150.46	0	0	0	0	
192	39.39	7.74	0	214	385.1	1200	133.61	99999	133.61	1150.46	0	0	0	0	No shear steel

SL38

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
461	36.84	17.99	0	225.5	0	1200	127.72	99999	127.72	1212.29	0	0	0	0	No shear steel
730	34.29	27.56	0	225.5	0	1200	134.18	99999	134.18	1212.29	0	0	0	0	No shear steel
1000	31.77	36.31	0	225.5	0	1200	140.09	99999	140.09	1212.29	0	0	0	0	No shear steel
1291	29.02	45.15	0	225.5	0	1200	145.95	99999	145.95	1212.29	0	0	0	0	No shear steel
1582	26.27	53.2	0	225.5	0	1200	125.05	99999	125.05	1212.29	0	0	0	0	No shear steel
1875	23.6	60.09	0	225.5	0	1200	132.34	99999	132.34	1212.29	0	0	0	0	No shear steel
1999	17.36	62.63	0	225.5	0	1200	135.2	99999	135.2	1212.29	0	0	0	0	No shear steel
2000	17.31	62.64	0	225.5	0	1200	135.22	99999	135.22	1212.29	0	0	0	0	No shear steel
2001	17.26	62.66	0	225.5	0	1200	135.24	99999	135.24	1212.29	0	0	0	0	No shear steel
2125	10.64	64.39	0	225.5	0	1200	137.98	99999	137.98	1212.29	0	0	0	0	No shear steel
2937	-3.81	56.03	0	225.5	0	1200	153.69	99999	153.69	1212.29	0	0	0	0	No shear steel
3750	-12.99	54.08	0	225.5	0	1200	166.74	99999	166.74	1212.29	0	0	0	0	No shear steel
4375	-19.8	48.17	0	225.5	0	1200	156.91	99999	156.91	1212.29	0	0	0	0	No shear steel
5000	-27.02	36.68	0	225.5	0	1200	145.66	99999	145.66	1212.29	0	0	0	0	No shear steel
5625	-34.9	17.33	0	225.5	0	1200	132.34	99999	132.34	1212.29	0	0	0	0	No shear steel
5905	-38.09	9.08	0	225.5	0	1200	125.39	99999	125.39	1212.29	0	0	0	0	No shear steel
6185	-41.62	-2.08	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
6465	-45.15	-14.23	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
6745	-48.59	-26.74	0	214	54.22	1200	115.39	99999	115.39	1150.46	0	0	0	0	No shear steel
7025	-52.12	-40.84	0	214	236.11	1200	126.06	99999	126.06	1150.46	0	0	0	0	No shear steel
7308	-55.69	-56.09	0	214	400.74	1200	134.36	99999	134.36	1150.46	0	0	0	0	No shear steel
7499	-58.1	-66.96	0	214	400.74	1200	0	0	0	1150.46	0	0	0	0	

Design Comments:-
- Shear areas and spacings adjusted for Fitment hook location as per AS3600 cl 8.2.12.4, hooks at: Top of Fitment (.8 for tension at top surface only)

Span 2

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1	39.67	-66.98	0	214	400.97	1200	0	0	0	1150.46	0	0	0	0	
192	37.26	-59.63	0	214	400.97	1200	134.37	99999	134.37	1150.46	0	0	0	0	No shear steel
360	35.14	-53.55	0	214	343.96	1200	131.61	99999	131.61	1150.46	0	0	0	0	No shear steel
528	33.02	-47.83	0	214	265.08	1200	127.6	99999	127.6	1150.46	0	0	0	0	No shear steel
696	31.01	-42.82	0	214	195.77	1200	123.85	99999	123.85	1150.46	0	0	0	0	No shear steel
864	28.89	-37.79	0	214	139.39	1200	120.62	99999	120.62	1150.46	0	0	0	0	No shear steel
1032	26.78	-33.11	0	214	91.87	1200	117.76	99999	117.76	1150.46	0	0	0	0	No shear steel
1200	25.01	-29.81	0	214	47.44	1200	114.96	99999	114.96	1150.46	0	0	0	0	No shear steel
1600	19.97	-20.81	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
2000	15.56	-15.17	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
2400	11.44	-11.6	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
2850	6.45	-9.43	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
2900	-12.71	-11.08	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
2950	-21.02	-11.93	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
3600	-28.58	-26.42	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
3768	-30.35	-30.32	0	214	68.29	1200	116.29	99999	116.29	1150.46	0	0	0	0	No shear steel
3936	-32.46	-35.6	0	214	123.12	1200	119.66	99999	119.66	1150.46	0	0	0	0	No shear steel
4104	-34.58	-41.23	0	214	186.79	1200	123.35	99999	123.35	1150.46	0	0	0	0	No shear steel
4272	-36.59	-46.83	0	214	263.4	1200	127.51	99999	127.51	1150.46	0	0	0	0	No shear steel
4440	-38.71	-53.16	0	214	349.7	1200	131.89	99999	131.89	1150.46	0	0	0	0	No shear steel
4608	-40.83	-59.84	0	214	412.05	1200	134.89	99999	134.89	1150.46	0	0	0	0	No shear steel
4799	-43.24	-67.87	0	214	412.05	1200	0	0	0	1150.46	0	0	0	0	

Span 3

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1	58.22	-67.85	0	214	411.86	1200	0	0	0	1150.46	0	0	0	0	
192	55.81	-56.96	0	214	411.86	1200	134.88	99999	134.88	1150.46	0	0	0	0	No shear steel
472	52.28	-41.83	0	214	248.56	1200	126.72	99999	126.72	1150.46	0	0	0	0	No shear steel
752	48.75	-27.68	0	214	66.19	1200	116.16	99999	116.16	1150.46	0	0	0	0	No shear steel
1032	45.31	-15.13	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
1312	41.78	-2.94	0	214	38.55	1200	114.38	99999	114.38	1150.46	0	0	0	0	No shear steel
1592	38.25	8.26	0	225.5	0	1200	125.32	99999	125.32	1212.29	0	0	0	0	No shear steel
1875	35.02	16.67	0	225.5	0	1200	132.34	99999	132.34	1212.29	0	0	0	0	No shear steel
2500	27.14	36.09	0	225.5	0	1200	145.66	99999	145.66	1212.29	0	0	0	0	No shear steel
3125	19.92	47.65	0	225.5	0	1200	156.91	99999	156.91	1212.29	0	0	0	0	No shear steel
3750	13.11	53.64	0	225.5	0	1200	166.74	99999	166.74	1212.29	0	0	0	0	No shear steel
4562	3.93	55.68	0	225.5	0	1200	153.71	99999	153.71	1212.29	0	0	0	0	No shear steel
5375	-10.52	64.14	0	225.5	0	1200	137.98	99999	137.98	1212.29	0	0	0	0	No shear steel
5499	-17.14	62.42	0	225.5	0	1200	135.24	99999	135.24	1212.29	0	0	0	0	No shear steel

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
5500	-17.2	62.41	0	225.5	0	1200	135.22	99999	135.22	1212.29	0	0	0	0	No shear steel
5501	-17.25	62.39	0	225.5	0	1200	135.2	99999	135.2	1212.29	0	0	0	0	No shear steel
5625	-23.48	59.87	0	225.5	0	1200	132.34	99999	132.34	1212.29	0	0	0	0	No shear steel
5916	-26.13	53.06	0	225.5	0	1200	125.11	99999	125.11	1212.29	0	0	0	0	No shear steel
6207	-28.88	45.06	0	225.5	0	1200	145.99	99999	145.99	1212.29	0	0	0	0	No shear steel
6500	-31.66	36.19	0	225.5	0	1200	140.09	99999	140.09	1212.29	0	0	0	0	No shear steel
6769	-34.17	27.5	0	225.5	0	1200	134.2	99999	134.2	1212.29	0	0	0	0	No shear steel
7038	-36.71	17.97	0	225.5	0	1200	127.74	99999	127.74	1212.29	0	0	0	0	No shear steel
7308	-39.27	7.71	0	214	385.1	1200	133.61	99999	133.61	1150.46	0	0	0	0	No shear steel
7400	-40.14	4.06	0	214	397.12	1200	0	0	0	1150.46	0	0	0	0	

Punching

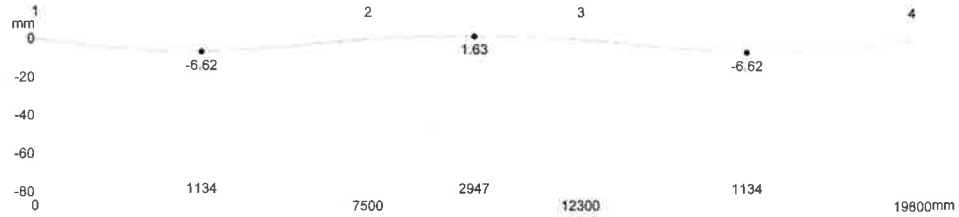
Column Head Critical Section

Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	phi Vuo	phi Vu	phi Vumin	phi Vumax	side beam	Moment Transfer	Asw/s reqd	result
A	#.#	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	kN	A	A	mm2/mm	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!

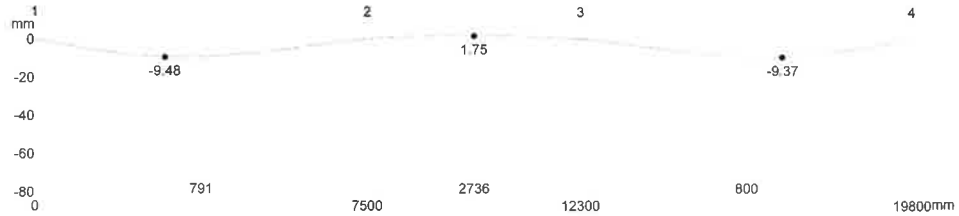
Deflections

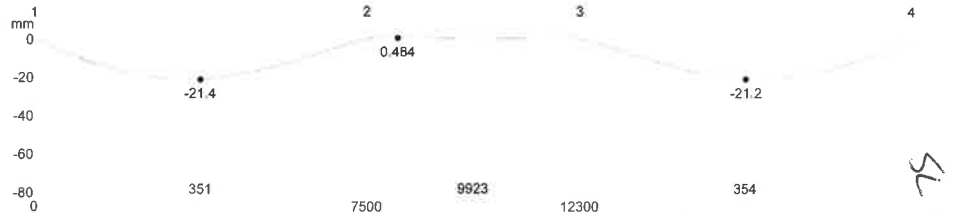
Live Load on All Spans

Transfer



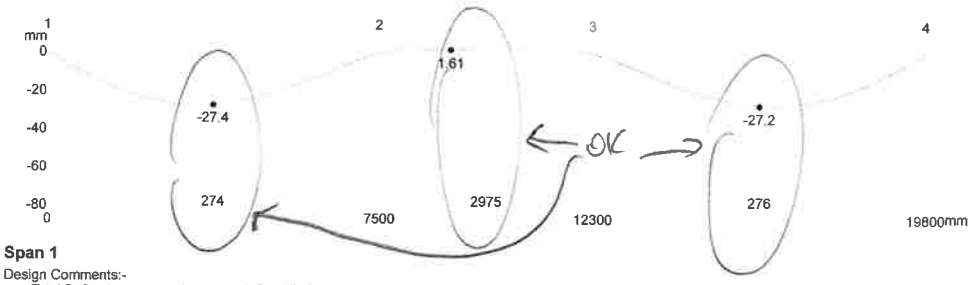
Short Term





SL 39

Total Long Term



Span 1

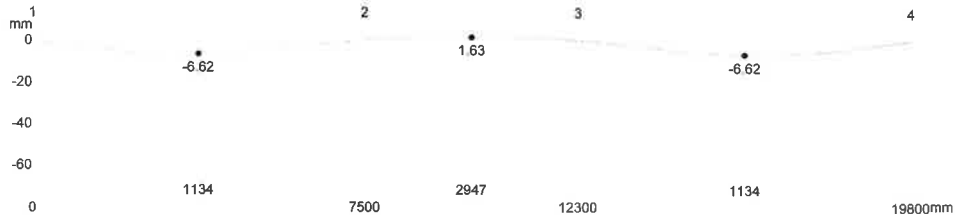
Design Comments:-
- Total Deflection greater than user defined limit = -27.4mm

Span 3

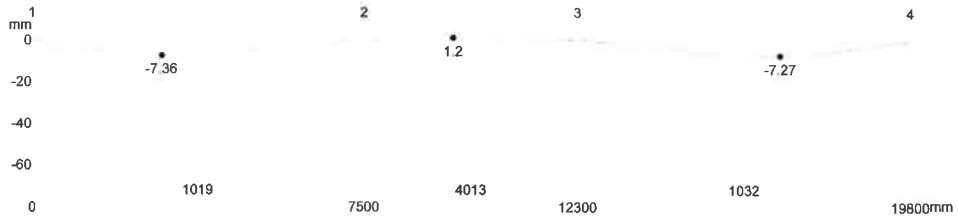
Design Comments:-
- Total Deflection greater than user defined limit = -27.2mm

Live Load on Even Spans

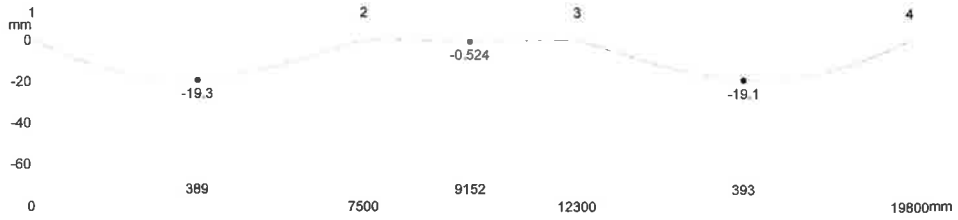
Transfer



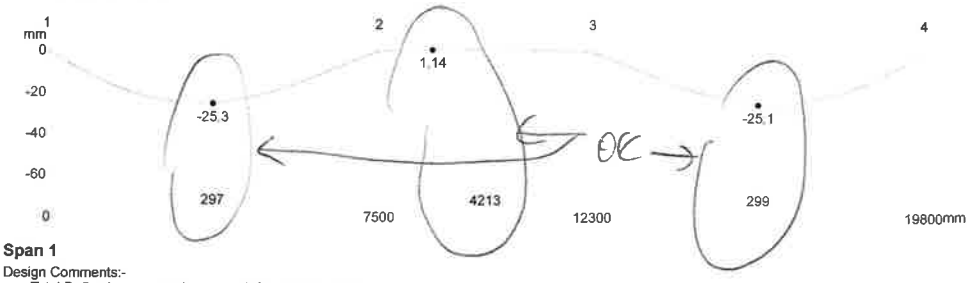
Short Term



Incremental



Total Long Term



Span 1

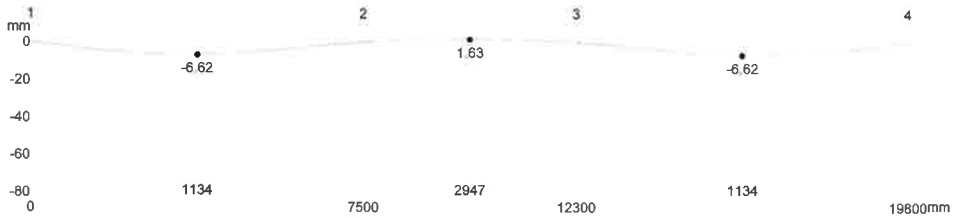
Design Comments:-
- Total Deflection greater than user defined limit = -25.3mm

Span 3

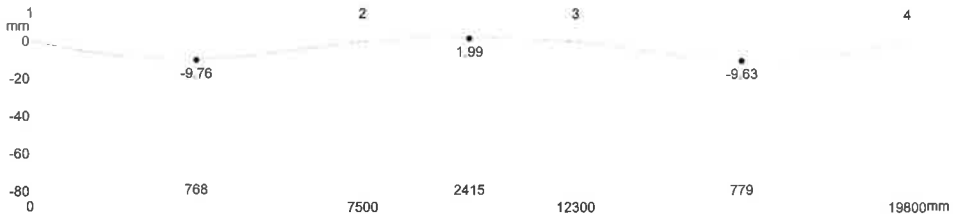
Design Comments:-
- Total Deflection greater than user defined limit = -25.1mm

Live Load on Odd Spans

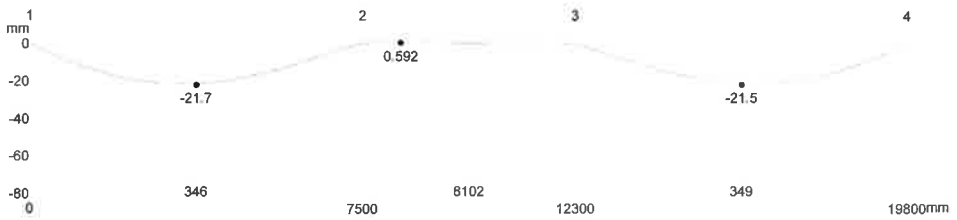
Transfer



Short Term

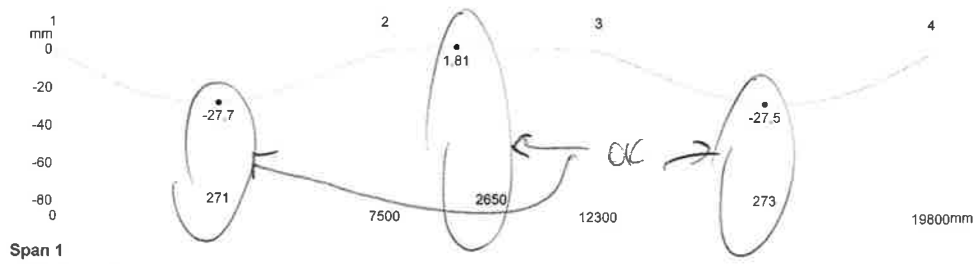


Incremental



040

Total Long Term



Span 1

Design Comments:-
- Total Deflection greater than user defined limit = -27.7mm

Span 3

Design Comments:-
- Total Deflection greater than user defined limit = -27.5mm

Detailed Reinforcement

Span 1

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
100	0	0	0	26	1200	No Steel Added	40	300	397.12	214	1200	6 N10 @ 237.2
192	0	0	0	26	1200	No Steel Added	40	300	385.1	214	1200	5 N10 @ 244.6
461	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
730	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
1000	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
1291	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
1582	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
1875	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
1999	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
2000	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
2001	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
2125	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
2937	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
3750	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
4375	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5000	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5625	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5905	0	0	38.55	26	1200	1 N10 @ 999	40	300	0	214	1200	No Steel Added
6185	40	300	38.55	26	1200	1 N10 @ 999	40	300	0	214	1200	No Steel Added
6465	40	300	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
6745	32	272.7	54.22	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
7025	24	236.4	236.11	26	1200	4 N10 @ 399	0	0	0	214	1200	No Steel Added
7308	20	204.3	400.74	26	1200	6 N10 @ 235.1	0	0	0	214	1200	No Steel Added
7499	12	146.9	400.74	26	1200	6 N10 @ 235.1	0	0	0	214	1200	No Steel Added

	Shear Reinforcement			
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel

	Shear Reinforcement			
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 2

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
1	12	146.8	400.97	26	1200	6 N10 @ 234.9	0	0	0	214	1200	No Steel Added
192	16	184.7	400.97	26	1200	6 N10 @ 234.9	0	0	0	214	1200	No Steel Added
360	16	196.4	343.96	26	1200	5 N10 @ 273.9	0	0	0	214	1200	No Steel Added
528	16	198.5	265.08	26	1200	4 N10 @ 355.4	0	0	0	214	1200	No Steel Added
696	16	198.3	195.77	26	1200	3 N10 @ 481.2	0	0	0	214	1200	No Steel Added
864	16	201.6	139.39	26	1200	2 N10 @ 675.8	0	0	0	214	1200	No Steel Added
1032	20	208.4	91.87	26	1200	2 N10 @ 999	0	0	0	214	1200	No Steel Added
1200	20	215.1	47.44	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
1600	32	277.6	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
2000	40	300	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
2400	40	300	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
2850	40	300	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
2900	40	300	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
2950	40	300	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
3600	24	244.5	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
3768	20	222.7	68.29	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
3936	20	212.9	123.12	26	1200	2 N10 @ 765.1	0	0	0	214	1200	No Steel Added
4104	20	206.8	186.79	26	1200	3 N10 @ 504.3	0	0	0	214	1200	No Steel Added
4272	20	204.8	263.4	26	1200	4 N10 @ 357.6	0	0	0	214	1200	No Steel Added
4440	16	200.9	349.7	26	1200	5 N10 @ 269.4	0	0	0	214	1200	No Steel Added
4608	16	187.1	412.05	26	1200	6 N10 @ 228.6	0	0	0	214	1200	No Steel Added
4799	12	145.5	412.05	26	1200	6 N10 @ 228.6	0	0	0	214	1200	No Steel Added

	Shear Reinforcement			
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

SL41

Design Comments:-
- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

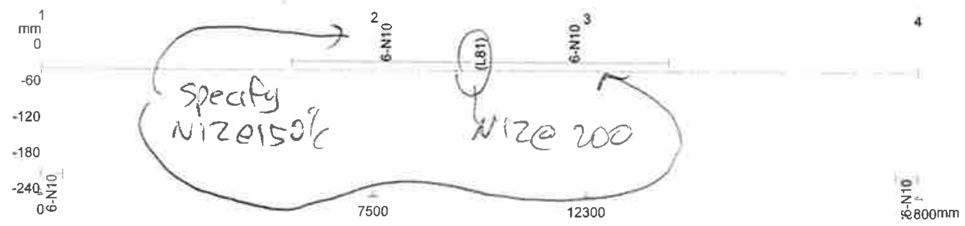
Span 3

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
1	12	145.5	411.86	26	1200	6 N10 @ 228.7	0	0	0	214	1200	No Steel Added
192	20	202.6	411.86	26	1200	6 N10 @ 228.7	0	0	0	214	1200	No Steel Added
472	24	233.8	248.56	26	1200	4 N10 @ 379	0	0	0	214	1200	No Steel Added
752	28	268.7	66.19	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
1032	40	300	38.55	26	1200	1 N10 @ 999	0	0	0	214	1200	No Steel Added
1312	40	300	38.55	26	1200	1 N10 @ 999	40	300	0	214	1200	No Steel Added
1592	0	0	38.55	26	1200	1 N10 @ 999	40	300	0	214	1200	No Steel Added
1875	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
2500	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
3125	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
3750	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
4562	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5375	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5499	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5500	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5501	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5625	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
5916	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
6207	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
6500	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
6769	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
7038	0	0	0	26	1200	No Steel Added	40	300	0	214	1200	No Steel Added
7308	0	0	0	26	1200	No Steel Added	40	300	385.1	214	1200	5 N10 @ 244.6
7400	0	0	0	26	1200	No Steel Added	40	300	397.12	214	1200	6 N10 @ 237.2

Shear Reinforcement				
	Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Reinforcement Layout



Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

SL42

Project Name: 168 Prospect Road
Project Number: 1702160
Frame Description: 1S1
Designer: FK
K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\1S1.rpf

RAPT - Version: 6.2.2.2
Reinforced And Post-Tensioned Concrete Analysis & Design Package
Copyright(C) 1988 - 2010 PCDC Pty. Ltd. All Rights Reserved

FIELDERS KINGFLOR® COMPOSITE STEEL FORMWORK

Licensee
TMK Consulting Engineers
105 Waymouth Street
Adelaide SA 5000
318662120608UPN3

Input

General

Design Code	List	Australia - AS3600*SAVED*
Material	List	Australia - Australian Materials*SAVED*
Reinforcement Type	List	Reinforced
Member Type	List	Slab
Panel Type	List	Internal
Strip Type	List	One way - Full Width
Column Stiffness	List	Equivalent Column
Concrete - Spanning Members	List	32MPa
Concrete - Columns	List	40MPa
Top Reinforcement Cover	mm	20
Bottom Reinforcement Cover	mm	20
Self Weight Definition	List	Program Calculated
Pattern Live Load	Y/N	Y
Earthquake Design	List	None
Moment Redistribution	%	0
Design Surface Levels	List	Extreme Surfaces

Span

Span	Span Length	Slab Depth	Panel Width Left	Panel Width Right
	mm	mm	mm	mm
LE	0			
1	2000	140	1200	1200
2	5400	180	1200	1200
3	5400	140	1200	1200
4	5400	180	1200	1200
5	2000	140	1200	1200
RE	0			

Columns

Column	Column Grid Reference	Support Type	Transverse Column spacing	Transverse prestress (P/A)
	A	List	mm	MPa
1	1	Knife-Edge	1200	
2	2	Knife-Edge	1200	
3	3	Knife-Edge	1200	
4	4	Knife-Edge	1200	
5	5	Knife-Edge	1200	
6	6	Knife-Edge	1200	

Transverse Beams

Column	Transverse Beam Type	Transverse Beam Depth	Transverse Beam Width
	List	mm	mm
1	beam	600	350
2	beam	600	350
3	beam	600	350
4	beam	600	350
5	beam	600	350
6	beam	600	350

Load Cases

Load Case	Load Type	Load Definition	Live Load Deflection Case	Description
	List	List	Y/N	A
1	Self Weight	Applied Loads		
2	Extra Dead Load	Applied Loads		
3	Live Load	Applied Loads	Y	

1S1

1. Self Weight - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m2		mm	kN/m2	A
1	1	0	14.4	1	350	14.4	
2	1	350	3.36	1	1825	3.36	
3	1	1825	14.4	2	175	14.4	
4	2	175	4.32	2	5225	4.32	
5	2	5225	14.4	3	175	14.4	
6	3	175	3.36	3	5225	3.36	
7	3	5225	14.4	4	175	14.4	
8	4	175	4.32	4	5225	4.32	
9	4	5225	14.4	5	175	14.4	
10	5	175	3.36	5	1650	3.36	
11	5	1650	14.4	6	0	14.4	

2. Extra Dead Load - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Description
		mm	kN/m2		mm	kN/m2	A
1	1	0	0.5	6	0	0.5	

2. Extra Dead Load - Point

Load	Reference column	Distance to Load from reference column	Load	Load Length	Description
		mm	kN	mm	A
1	4	2900	12.8	100	
2	2	0	8.5	250	

3. Live Load - Panel

Load	Left End reference column	Left end of load from reference column	Load at left end	Right End reference column	Right end of load from reference column	Load at right end	Live Load reduction	Description
		mm	kN/m2		mm	kN/m2	#.#	A
1	2	0	2	6	0	2	1	
2	1	0	0.25	2	0	0.25	1	
3	5	700	0.25	6	0	0.25	1	

3. Live Load - Point

Load	Reference column	Distance to Load from reference column	Load	Load Length	Live Load reduction	Description
		mm	kN	mm	#.#	A
1	4	2900	8	100	0	

S143

Load	Reference column	Distance to Load from reference column	Load	Load Length	Live Load reduction	Description
		mm	kN	mm	#.#	A
2	2	0	0.9	250	0	

Load Combinations : Ultimate

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1.2	1.2	1.5
2	Live Load	0.9	0.9	1.5
3	Dead Load	1.35	1.35	0

Load Combinations : Short Term Service

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.7

Load Combinations : Permanent Service

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Live Load	1	1	0.4

Load Combinations : Deflection

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Short Term - Deflection	1	1	0.7
2	Permanent - Deflection	1	1	0.4
3	Initial - Deflection	1	0	0

Load Combinations : Transfer Prestress

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Transfer	1	0	0

Load Combinations : Pre Existing

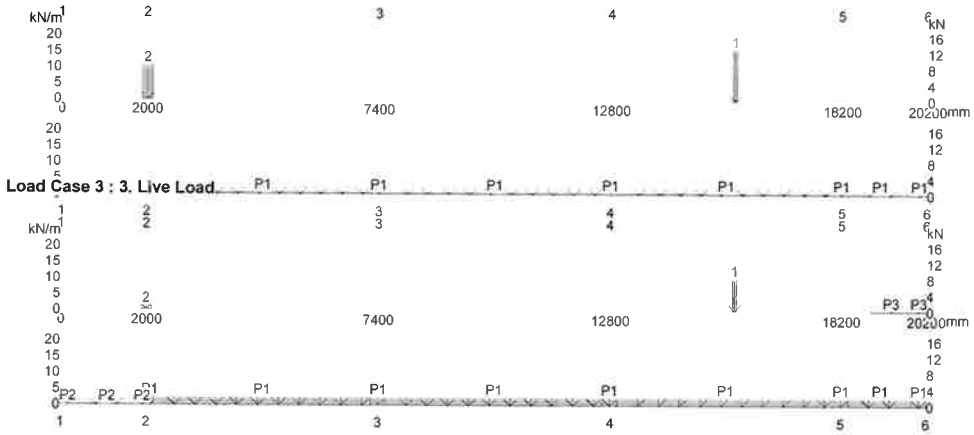
Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Pre Existing	1	0	0

Load Combinations : Construction

Load Combination	Description	1. Self Weight	2. Extra Dead Load	3. Live Load
	A	#.#	#.#	#.#
1	Construction	1	0	0

Load Case 1 : 1. Self Weight

Load Case 2 : 2. Extra Dead Load



Load Case 3 : 3. Live Load

Reinforcement

Reinforcement Use	Reinforcement Type List	Preferred Bar Size List	Number of Legs #
Flexural Bar	N 500MPa		
Flexural Mesh	F 450MPa		
Shear Option 1	N 500MPa	10	2
Shear Option 2	N 500MPa	12	2
Shear Option 3	N 500MPa	16	2
Punching Shear	N 500MPa	10	1

Reinforcement

	Maximum Bar Spacing	Minimum Bar Spacing	Minimum Continuous Reinforcement	Minimum Span Reinforcement into End Support	Minimum Span Reinforcement into Internal Support	Infill Bars	Stagger Bars
	mm	mm	#.#	#.#	#.#	Y/N	Y/N
Support Reinforcement	300	99	0			N	N
Span Reinforcement	300	99		0	0	N	N

Design Zones : Top

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Top Cover at left end mm	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Top Cover at Right end mm	Maximum Bar Size List	Minimum Bar Size List	Preferred bar size List	Minimum Number of Bars #
1	Bar	1	0	0	20	6	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

Design Zones : Bottom

Layer Number	Steel type List	Left End Reference Column	Distance to left end of bar mm	Bar stagger length at left end mm	Bottom Cover at left end mm	Right End Reference Column	Distance to right end of bar mm	Bar stagger length at right end mm	Bottom Cover at Right End mm	Maximum Bar Size List	Minimum Bar Size List	Preferred bar size List	Minimum Number of Bars #
1	Bar	1	0	0	20	6	0	0	20	24	10	12	0

Layer Number	Maximum Spacing of Bars mm	Minimum Steel area as % %	% in Flange %
1	0	0	0

SL44

User Defined : Top

Layer Number	Steel type	Left End Reference Column	Distance to left end of bar	Bar stagger length at left end	Top Cover at left end	% Development of Left End of Bar in Tension	% Development of Left End of Bar in Compression	Right End Reference Column	Distance to right end of bar	Bar stagger length at right end	Top Cover at Right end	% Development of Right End of Bar in Tension
	List		mm	mm	mm	%	%		mm	mm	mm	%
1	L 500MPa	1	0	0	35	0	0	6	0	0	35	0

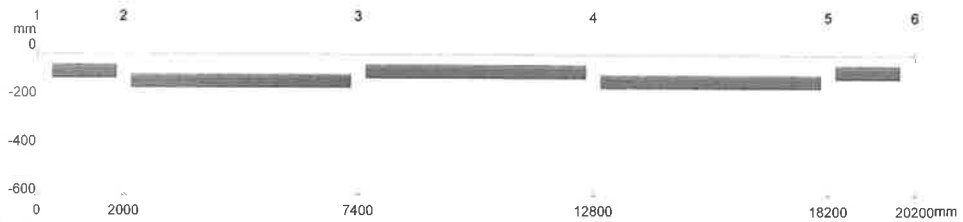
Layer Number	% Development of Right End of Bar in Compression %	Bar Size	Mesh full width of Design Cross-section Y/N	Width of mesh	% in Flange	Layer attached after the PreExisting Load Case Y/N
		List		mm	%	
1	0	81	Y	0	0	N

User Defined : Metal Decking

Layer Number	Metal Deck Type	Left End Reference Column	Distance to Left End of Metal Deck	Distance to Start of Concrete Void from Start of Sheet	Right End Reference Column	Distance to Right End of Metal Deck	Distance to End of Concrete Void from End of Sheet	Sheet Thickness	Number of Sheets	Description
	List	#	mm	mm	#	mm	mm	List	#	A
	KF57	5	175	0	6	-350	0	1.0mm	4	
	KF57	1	350	0	2	-175	0	1.0mm	4	
	KF57	4	175	0	5	-175	0	1.0mm	4	
	KF57	2	175	0	3	-175	0	1.0mm	4	
	KF57	3	175	0	4	-175	0	1.0mm	4	

Reinforcement Design Zones

Reinforcement Design Zones User Defined



Design Data

Capacity Reduction factor (phi) for Flexure	#.#	0.8
Capacity Reduction factor (phi) for Shear	#.#	0.7
Material Factor for Concrete in Flexure	#.#	1
Material Factor for Concrete in Shear	#.#	1
Material Factor for Reinforcement	#.#	1
Maximum Ratio of Neutral Axis Depth for Ductility	#.#	0.4
Ductility Check at Left End Column	Y/N	Y
Ductility Check at Right End Column	Y/N	Y
Minimum Reinforcement Strength Limit - #.## x M*	#.#	0
Flexural Critical Section - Consider Transverse Beams	Y/N	Y
Flexural Critical Section - Distance from centre of Support	#.#	-1
Beam Left Sideface Cover (Internal)	mm	25
Beam Right Sideface cover	mm	40
Prestress Minimum Reinforcement Basis	List	Program Default
Shear Enhancement at Supports	Y/N	N
Ast Value in Shear Calculations	List	Calculated
AS3600 Shear Fitment Hooks Located at	List	Top of Fitment
Moment Diagram Offset For Flexure Calculations	List	Code Default
Limit Reinforcement Strain	Y/N	N
Beam Shear Critical Section Location	List	Code Critical Section

Maximum Service Stress Change - Prestressed Sections	MPa	150
Maximum Service Stress Change - Reinforced Sections	MPa	0
Relative Humidity	%	50
Average Temperature	C.	20
Prestress Losses Calculations based on	List	Program Default
Crack Width Calculations	List	Code default
AS3600 Shrinkage and Temperature Reinforcement	List	Moderate
Degree of Restraint in Primary Direction	%	0
Degree of Restraint in Secondary Direction	%	0
Concrete Strength Gain Rate	List	N

Concrete Tensile Strength for Deflection Calculations- #.## x (Fc)n	#.#	-1
Maximum Value of Ieff/Igross for Deflection Calculations	#.#	0.6
Total Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Total Deflection Warning Limit - Maximum Deflection	mm	25
Incremental Deflection Warning Limit - Maximum Span/Deflection	#.#	250
Incremental Deflection Warning Limit - Maximum Deflection	mm	25
Time of Loading in days	#.#	10
Age Adjustment Factor	#.#	0.76
Concrete Strength at Time of Loading	MPa	25.6
Loaded Period in years	#.#	30
Tension stiffening Approach	List	Modified Concrete Tensile Modulus Method

Live Load Pattern Factor	#.#	1
Pattern Live Load for Ultimate Strength	Y/N	Y
Pattern Live Load for Crack Control	Y/N	Y
Pattern Live Load For Deflections	Y/N	Y
Pattern Live Load for Deflection Permanent Load Combination	Y/N	N

Material Properties

Concrete

Description	32MPa	40MPa
Characteristic Compressive Strength	32	40
Mean Compressive Strength	37.22	45.9
Lower Characteristic Tensile Strength	3.39	3.79
Upper Characteristic Tensile Strength	5.43	6.07
Concrete Weight	2447	2447
Design Concrete Modulus	29443.8	32919.2
Mean Concrete Modulus	31754.7	35263.5
Ultimate Concrete Modulus	29443.8	32919.2
Basic Shrinkage Strain	850	850
Basic Creep Factor	3.4	2.5
Concrete Strain Limit	0.003	0.003

Reinforcement Bar

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
N	Deformed	500	2e5	N	0.05	540	90	-1	-1	-1	-1	Y	

Nominal Bar Size A	Bar Diameter mm	Bar Area mm2	Bar Inertia mm4	Bar Weight kg/m	Stock Length mm
10	10	78.5	491.07	0.62	12000
12	12	113	1018.29	0.89	12000
16	16	201	3218.29	1.58	12000
20	20	314	7857.14	2.47	12000
24	24	452	16292.6	3.55	12000
28	28	616	30184	4.83	12000
32	32	804	51492.6	6.31	12000
36	36	1020	82481.1	7.99	12000
40	40	1260	1.257e5	9.86	12000

Reinforcement Mesh

Designation	Type	Yield Stress	Elastic Modulus	Ductility	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexure	Material Factor Shear	Material Capacity Reduction Factor - Flexure	Material Capacity Reduction Factor - Shear	Include as Flexural Reinforcement for Shear	Description
L	Deformed	500	2e5	L	0.015	515	90	-1	-1	-1	-1	Y	

S145

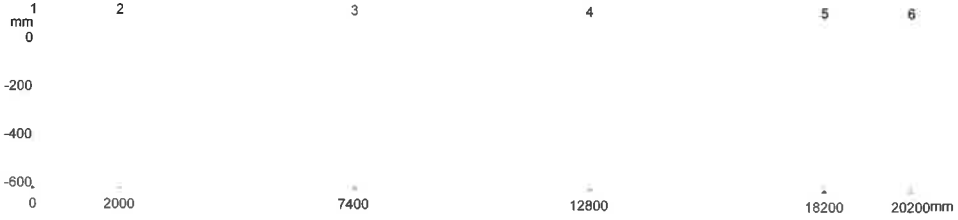
Nominal Mesh Size A	Main Bar Diameter mm	Main Bar Area mm2/m	Main Bar Spacing mm	Main Bar Inertia mm4	Cross bar Diameter mm	Cross bar Area mm2/m	Cross Bar Spacing mm	Mesh Weight kg/m2	Stock Length mm
62	6	141	200	0	6	141	200	0	0
72	7	179	200	0	7	179	200	0	0
82	8	227	200	0	8	227	200	0	0
92	9	290	200	0	9	290	200	0	0
102	10	354	200	0	10	354	200	0	0
81	8	454	100	0	8	454	100	0	0
718	7	358	100	0	8	227	200	0	0
818	8	454	100	0	8	227	200	0	0
918	9	581	100	0	8	227	200	0	0
1018	10	709	100	0	8	227	200	0	0
1118	11	899	100	0	8	227	200	0	0
1218	12	1112	100	0	8	227	200	0	0

Metal Decking

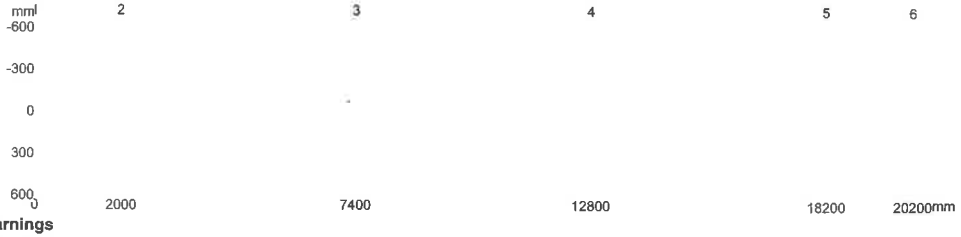
Sheet Designation	Yield Stress	Youngs Modulus	Peak Strain	Peak Stress	Design Strain Limit	Material Factor Flexexure	Material Factor Shear	Capacity Reduction Factor Flexuse	Capacity Reduction Factor Shear	Flexural Rebar For Shear	Description
KF57	550	2e5	0.035	600	90	-1	-1	-1	-1	Y	

Nominal Size A	Sheet Thickness mm	Sheet Width mm	Sheet Height mm	Number of Rib Spaces #	Sheet Centroid from Bottom mm	Sheet Area mm2	Sheet Inertia mm4	Mechanical Resistance kN/m2	Sheet Weight kg/m
.75mm	0.8	300	58	1	14.5	358.5	1.449e5	476	0
.9mm	0.9	300	58	1	14.5	430.2	1.799e5	580	0
1.0mm	1	300	58	1	14.5	477.9	1.999e5	645	0

Elevation view



Plan view



Warnings

Input

Warning:Live Load Reduction factor is very small. Check if it is appropriate.
Warning:Live Load Reduction factor is very small. Check if it is appropriate.

Output

Warning:SUPPORT Reinforcing Bar Spacing There have been problems in determining a bar size to satisfy the design spacing requirements. See Detailed Reinforcement Design Comments.
Warning:SPAN Reinforcing Bar spacing There have been problems in determining a bar size to satisfy the design spacing requirements. See Detailed Reinforcement Design Comments.

Bending Moments

Load Cases

Column Actions

Col No. 1		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	3.99	-0.03	-1.32
Elastic Rotation	#.#	-1.21e-4	0	-1.12e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 2		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	26.7	11.52	7.85
Elastic Rotation	#.#	4.71e-4	0	2.36e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 3		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	29.76	2.21	13.53
Elastic Rotation	#.#	-3.55e-4	-1.21e-4	0
Elastic Axial Shortening	mm	0	0	0

Col No. 4		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	29.76	9.57	13.36
Elastic Rotation	#.#	3.55e-4	5.98e-4	0
Elastic Axial Shortening	mm	0	0	0

Col No. 5		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	26.7	13.23	10.48
Elastic Rotation	#.#	-4.71e-4	-5.41e-4	-1.89e-4
Elastic Axial Shortening	mm	0	0	0

Col No. 6		Self Weight	Extra Dead Load	Live Load
Moment Above	kNm	-0	-0	-0
Moment Below	kNm	-0	-0	-0
Reaction	kN	3.99	-3.08	0.77
Elastic Rotation	#.#	1.21e-4	2.59e-4	0
Elastic Axial Shortening	mm	0	0	0

Load Combinations

Column Actions

Col No. 1		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	3.04	3.04	2.77	2.77	0.33	5.88
Elastic Rotation	#.#	-2.25e-4	-2.25e-4	-3.44e-4	-3.44e-4	-3.79e-4	0
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 2		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	43.72	43.72	57.65	57.65	32.01	59.97
Elastic Rotation	#.#	7.1e-4	7.1e-4	1.01e-3	1.01e-3	3.39e-4	1.14e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 3		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0

SL40

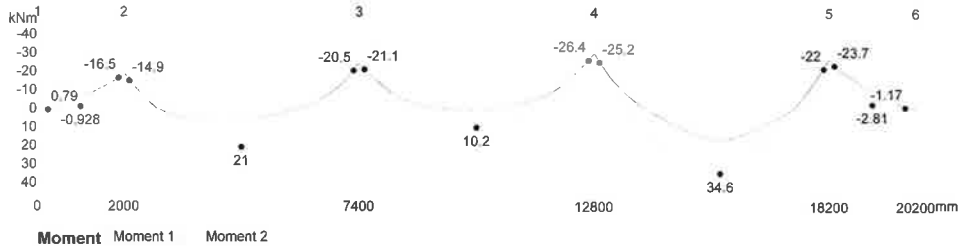
Col No. 3		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	41.44	41.44	58.65	58.65	31.61	59.86
Elastic Rotation	#.#	-5.41e-4	-5.41e-4	-7.1e-4	-7.1e-4	-7.82e-4	-6.09e-4
Elastic Axial Shortening	mm	0	0	0	0	0	0

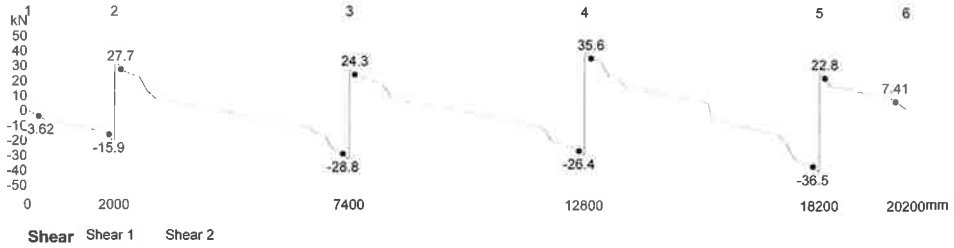
Col No. 4		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	48.67	48.67	67.22	67.22	38.23	68.67
Elastic Rotation	#.#	1.01e-3	1.01e-3	1.26e-3	1.26e-3	1.21e-3	1.18e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

Col No. 5		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	47.26	47.26	63.63	63.63	35.12	65.94
Elastic Rotation	#.#	-1.14e-3	-1.14e-3	-1.5e-3	-1.5e-3	-7.31e-4	-1.63e-3
Elastic Axial Shortening	mm	0	0	0	0	0	0

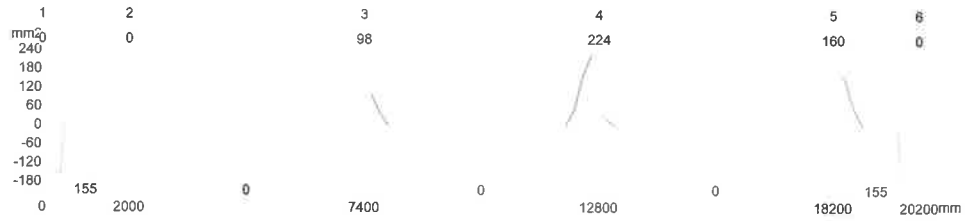
Col No. 6		Service	Service (Reversal)	Ultimate Flexure	Ultimate Flexure (Reversal)	Ultimate Shear	Ultimate Shear (Reversal)
Moment Above	kNm	0	0	0	0	0	0
Moment Below	kNm	0	0	0	0	0	0
Reaction	kN	1.45	1.45	2.25	2.25	-2.42	5.01
Elastic Rotation	#.#	4.11e-4	4.11e-4	5.22e-4	5.22e-4	5.9e-4	3.1e-4
Elastic Axial Shortening	mm	0	0	0	0	0	0

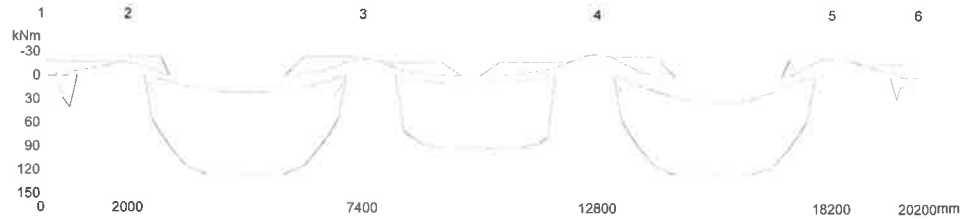
Ultimate Flexure

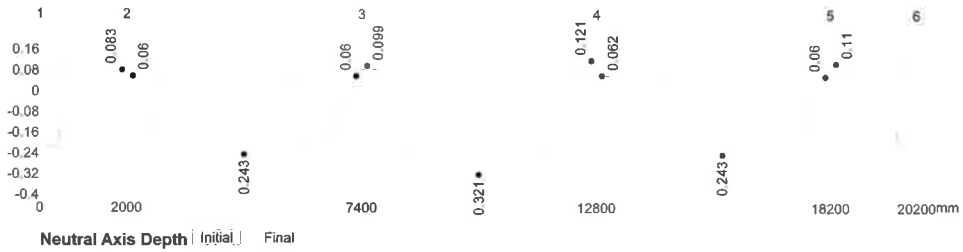




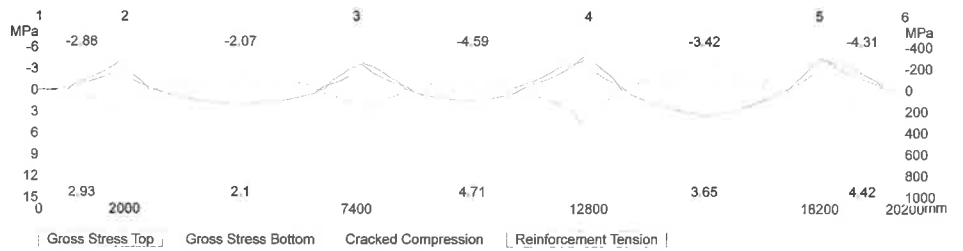
Flexural Design
Ultimate





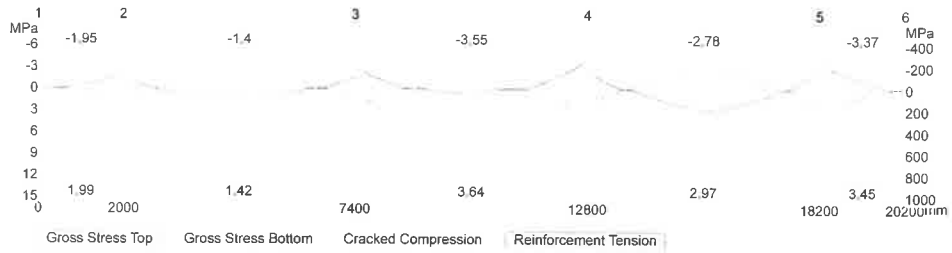


Service
Maximum Moment Condition



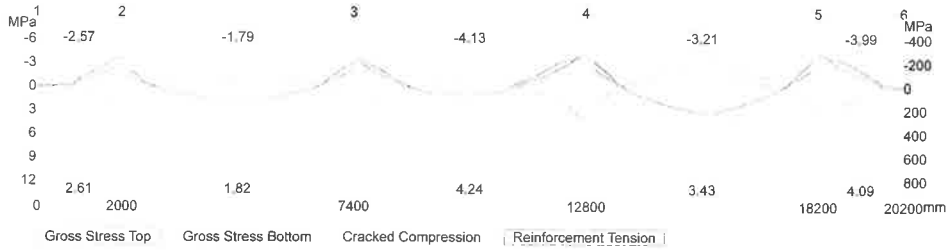
5147

Reversal Moment Condition

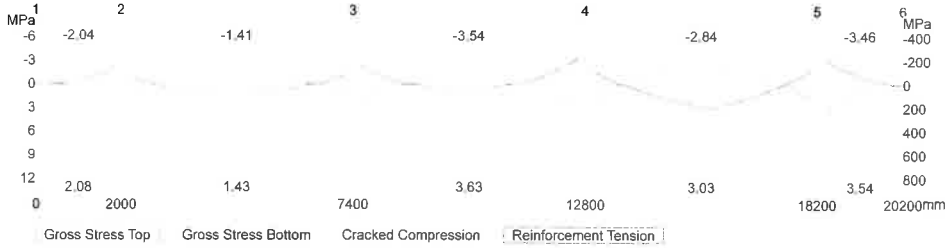


Permanent

Maximum Moment Condition



Reversal Moment Condition



Shear Design

Beam

Span 1

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets			Shear Comments
												2 legs N10	2 legs N12	2 legs N16	
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
245	-3.86	-0.29	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
349	-6.09	-0.81	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
351	-6.12	-0.82	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
425	-6.53	-1.29	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
500	-6.97	-1.76	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
666	-7.9	-2.95	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
832	-8.86	-4.35	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1000	-9.85	-5.87	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1087.5	-10.34	-6.72	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1224.5	-11.16	-8.19	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1361.5	-11.96	-9.74	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1500	-12.79	-11.45	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1564	-13.16	-12.26	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1628	-13.55	-13.12	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1692	-13.93	-14	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1756	-14.31	-14.9	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1824	-14.72	-15.88	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1826	-14.75	-15.91	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1877.5	-15.98	-16.7	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel

Design Comments:-
- Shear areas and spacings adjusted for Fitment hook location as per AS3600 cl 8.2.12.4, hooks at: Top of Fitment (.8 for tension at top surface only)

Span 2

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets			Shear Comments
												2 legs N10	2 legs N12	2 legs N16	
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
122.5	28.54	-15.13	0	141	0	1200	0	0	0	758.02	0	0	0	0	
144	27.9	-14.53	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
174	27.15	-13.7	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
176	27.11	-13.65	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
371	25.06	-8.56	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
566	23	-3.88	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
761	21.04	0.04	0	165.5	0	1200	111.07	99999	111.07	889.73	0	0	0	0	No shear steel
956	18.99	3.94	0	165.5	0	1200	114.92	99999	114.92	889.73	0	0	0	0	No shear steel
1151	16.93	7.45	0	165.5	0	1200	118.53	99999	118.53	889.73	0	0	0	0	No shear steel
1350	15.17	9.52	0	165.5	0	1200	122	99999	122	889.73	0	0	0	0	No shear steel
1800	10.42	15.28	0	165.5	0	1200	107.14	99999	107.14	889.73	0	0	0	0	No shear steel
2250	6.3	17.4	0	165.5	0	1200	116.24	99999	116.24	889.73	0	0	0	0	No shear steel
2700	-3.97	14.13	0	165.5	0	1200	124.1	99999	124.1	889.73	0	0	0	0	No shear steel
3150	-7.58	13.75	0	165.5	0	1200	116.24	99999	116.24	889.73	0	0	0	0	No shear steel
3600	-11.54	11.26	0	165.5	0	1200	107.14	99999	107.14	889.73	0	0	0	0	No shear steel
4050	-16.28	5	0	165.5	0	1200	122	99999	122	889.73	0	0	0	0	No shear steel
4245	-17.89	3.01	0	165.5	0	1200	118.6	99999	118.6	889.73	0	0	0	0	No shear steel
4440	-19.94	-0.68	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
4635	-22	-4.77	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
4830	-23.92	-8.75	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5025	-25.97	-13.61	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5224	-28.07	-18.99	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5226	-28.1	-19.04	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5256	-28.86	-19.9	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5277.5	-29.39	-20.53	0	141	0	1200	0	0	0	758.02	0	0	0	0	

Span 3

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets			Shear Comments
												2 legs N10	2 legs N12	2 legs N16	
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
122.5	24.37	-21.14	0	114	97.68	1200	83.22	99999	83.22	612.86	0	0	0	0	No shear steel
174	23.07	-19.92	0	114	97.68	1200	83.22	99999	83.22	612.86	0	0	0	0	No shear steel
176	23.04	-19.87	0	114	97.68	1200	83.22	99999	83.22	612.86	0	0	0	0	No shear steel
371	21.25	-15.55	0	114	38.98	1200	80.61	99999	80.61	612.86	0	0	0	0	No shear steel
566	19.47	-11.58	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
761	17.77	-8.25	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
956	15.99	-4.95	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1151	14.2	-2.01	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1350	12.71	-0.26	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1800	8.59	4.53	0	125.5	0	1200	91.58	99999	91.58	674.69	0	0	0	0	No shear steel
2250	5.12	6.22	0	125.5	0	1200	99.36	99999	99.36	674.69	0	0	0	0	No shear steel
2700	-4.03	5.95	0	125.5	0	1200	106.07	99999	106.07	674.69	0	0	0	0	No shear steel
3150	-7.13	5.27	0	125.5	0	1200	99.36	99999	99.36	674.69	0	0	0	0	No shear steel
3600	-10.6	2.67	0	125.5	0	1200	91.58	99999	91.58	674.69	0	0	0	0	No shear steel
4050	-14.72	-3.03	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
4245	-16.18	-5.11	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
4440	-17.96	-8.44	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
4635	-19.75	-12.12	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
4830	-21.45	-15.84	0	114	47.04	1200	80.98	99999	80.98	612.86	0	0	0	0	No shear steel
5025	-23.23	-20.2	0	114	155.96	1200	85.67	99999	85.67	612.86	0	0	0	0	No shear steel
5224	-25.05	-25	0	114	223.91	1200	88.35	99999	88.35	612.86	0	0	0	0	No shear steel
5226	-25.09	-25.05	0	114	223.91	1200	88.35	99999	88.35	612.86	0	0	0	0	No shear steel
5277.5	-26.38	-26.38	0	114	223.91	1200	88.35	99999	88.35	612.86	0	0	0	0	No shear steel

Span 4

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets			Shear Comments
												2 legs N10	2 legs N12	2 legs N16	
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
122.5	36.16	-25.18	0	154	21.33	1200	0	0	0	827.9	0	0	0	0	
144	35.62	-24.41	0	154	21.33	1200	94.87	99999	94.87	827.9	0	0	0	0	No shear steel
174	34.87	-23.35	0	154	21.33	1200	94.87	99999	94.87	827.9	0	0	0	0	No shear steel
176	34.84	-23.28	0	154	21.33	1200	94.87	99999	94.87	827.9	0	0	0	0	No shear steel
371	32.78	-16.69	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
566	30.72	-10.5	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
761	28.81	-5.19	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
956	26.75	0.23	0	165.5	0	1200	114.92	99999	114.92	889.73	0	0	0	0	No shear steel

SL48

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
1151	24.7	5.25	0	165.5	0	1200	118.53	99999	118.53	889.73	0	0	0	0	No shear steel
1350	23.05	8.65	0	165.5	0	1200	122	99999	122	889.73	0	0	0	0	No shear steel
1800	18.3	17.96	0	165.5	0	1200	107.14	99999	107.14	889.73	0	0	0	0	No shear steel
2250	14.34	23.49	0	165.5	0	1200	116.24	99999	116.24	889.73	0	0	0	0	No shear steel
2700	10.73	26.91	0	165.5	0	1200	124.1	99999	124.1	889.73	0	0	0	0	No shear steel
2850	9.15	28.4	0	165.5	0	1200	121.59	99999	121.59	889.73	0	0	0	0	No shear steel
2900	-4.97	30.15	0	165.5	0	1200	120.73	99999	120.73	889.73	0	0	0	0	No shear steel
2950	-13	29.7	0	165.5	0	1200	119.86	99999	119.86	889.73	0	0	0	0	No shear steel
3500	-18.3	23.08	0	165.5	0	1200	109.3	99999	109.3	889.73	0	0	0	0	No shear steel
4050	-23.92	13.21	0	165.5	0	1200	122	99999	122	889.73	0	0	0	0	No shear steel
4245	-25.65	9.5	0	165.5	0	1200	118.6	99999	118.6	889.73	0	0	0	0	No shear steel
4440	-27.7	4.3	0	165.5	0	1200	115	99999	115	889.73	0	0	0	0	No shear steel
4635	-29.76	-1.31	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
4830	-31.72	-6.93	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5025	-33.77	-13.31	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5224	-35.87	-20.24	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5226	-35.9	-20.31	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5256	-36.66	-21.4	0	141	0	1200	89.11	99999	89.11	758.02	0	0	0	0	No shear steel
5277.5	-37.19	-22.19	0	141	0	1200	0	0	0	758.02	0	0	0	0	

Span 5

Locat	V*	Mv*	Mdec	d	Ast	bv	phi Vuc	phi Vut	phi Vu	Phi Vumax	Asv/s	Spacing of Sets 2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm	kN	kNm	kNm	mm	mm2	mm	kN	kN	kN	kN	mm2/mm	mm	mm	mm	A
122.5	22.89	-23.95	0	114	159.91	1200	85.83	99999	85.83	612.86	0	0	0	0	No shear steel
174	21.6	-22.8	0	114	159.91	1200	85.83	99999	85.83	612.86	0	0	0	0	No shear steel
176	21.57	-22.76	0	114	159.91	1200	85.83	99999	85.83	612.86	0	0	0	0	No shear steel
240	20.98	-21.39	0	114	159.91	1200	85.83	99999	85.83	612.86	0	0	0	0	No shear steel
304	20.43	-20.13	0	114	138.19	1200	84.94	99999	84.94	612.86	0	0	0	0	No shear steel
368	19.85	-18.84	0	114	106.11	1200	83.58	99999	83.58	612.86	0	0	0	0	No shear steel
432	19.26	-17.59	0	114	78.86	1200	82.4	99999	82.4	612.86	0	0	0	0	No shear steel
500	18.75	-16.47	0	114	51.49	1200	81.18	99999	81.18	612.86	0	0	0	0	No shear steel
699	16.93	-13.19	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
912.5	15.09	-9.75	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1000	14.6	-8.82	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1175	13.1	-6.8	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1337	11.85	-4.77	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1500	10.91	-3.28	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1574	10.27	-2.77	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1649	9.85	-2.02	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1651	9.83	-2	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel
1755	7.57	-1.09	0	101	0	1200	73.3	99999	73.3	542.98	0	0	0	0	No shear steel

Punching

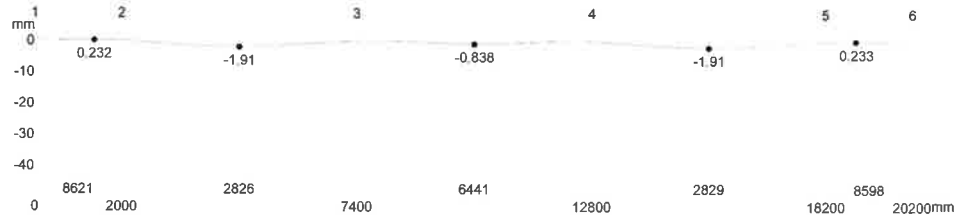
Column Head Critical Section

Column No.	Bh	a	at	u	d	fcv	P/A	Asw/s min	V*	Mv*	phi Vuo	phi Vu	phi Vumin	phi Vumax	side beam	Moment Transfer	Asw/s reqd	result
A	##	mm	mm	mm	mm	MPa	MPa	mm2/mm	kN	kNm	kN	kN	kN	kN	A	A	mm2/mm	A
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	Check Not Carried Out!

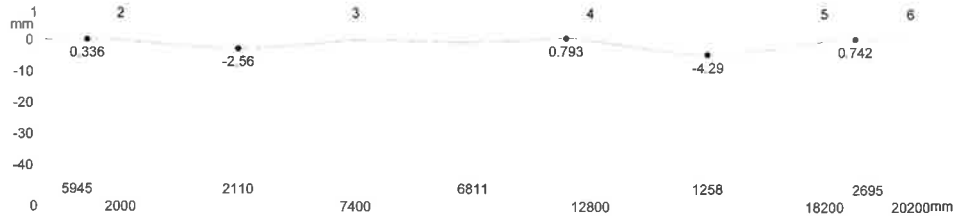
Deflections

Live Load on All Spans

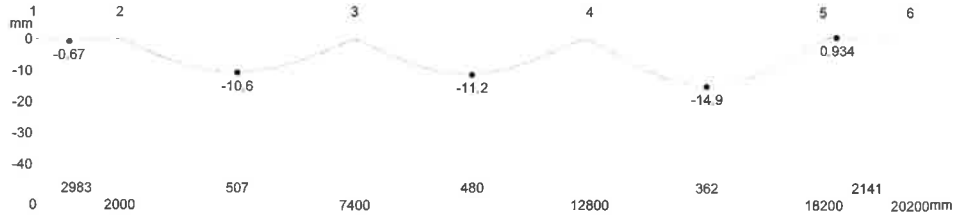
Transfer



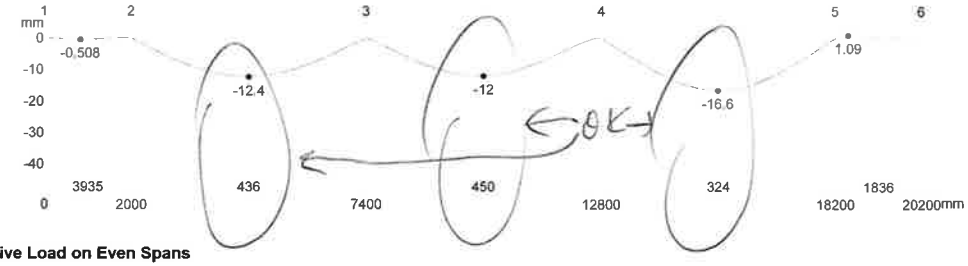
Short Term



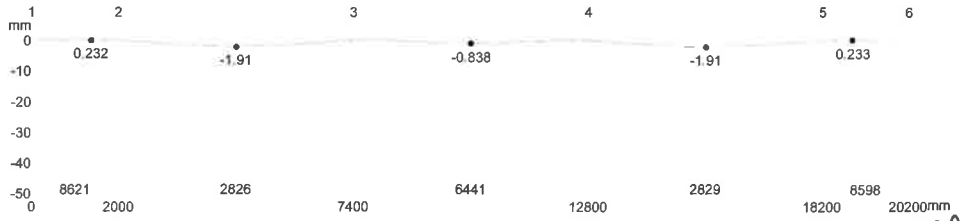
Incremental



Total Long Term

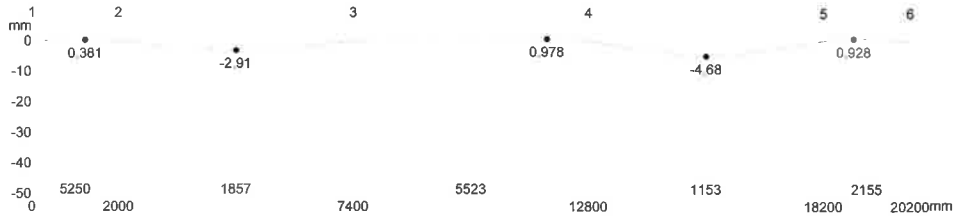


Live Load on Even Spans

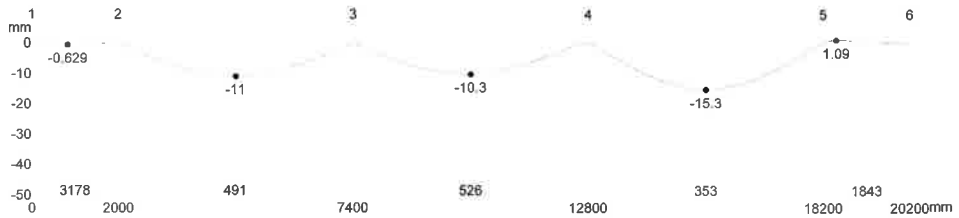


SL49

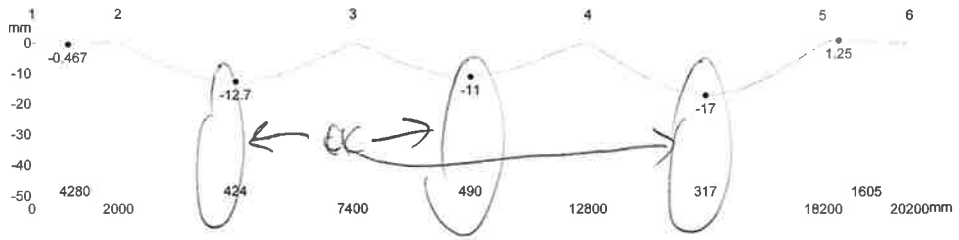
Short Term



Incremental

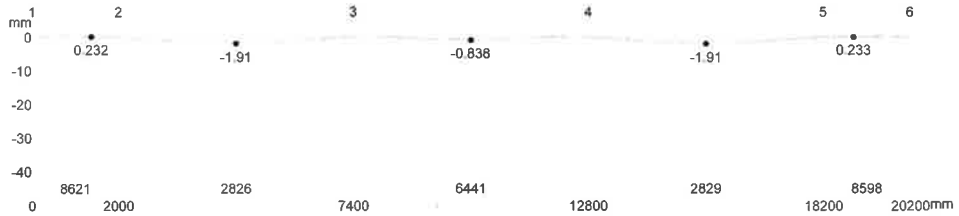


Total Long Term

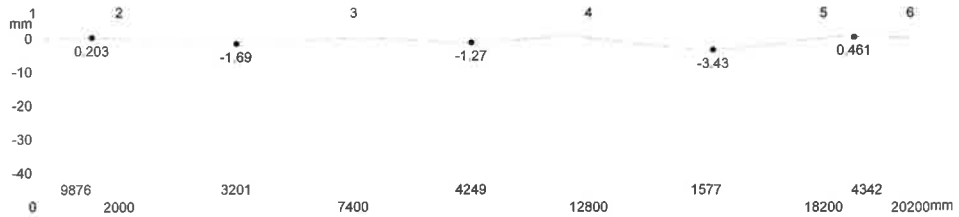


Live Load on Odd Spans

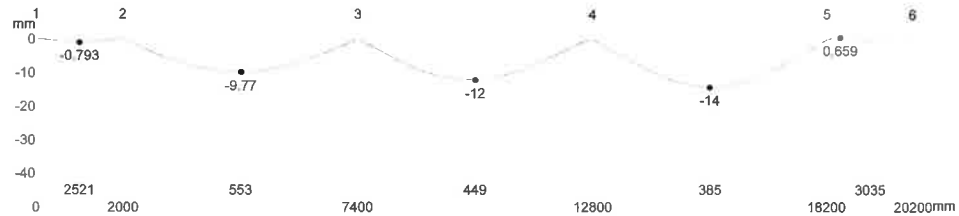
Transfer



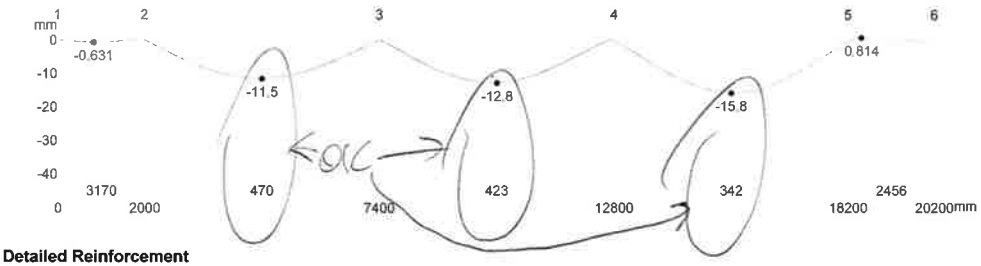
Short Term



Incremental



Total Long Term



Detailed Reinforcement

Span 1

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
245	0	0	0	26	1200	No Steel Added	40	280	155.48	114	1200	2 N10 @ 605.9
349	40	280	0	26	1200	No Steel Added	40	280	155.48	114	1200	2 N10 @ 605.9
351	40	280	0	26	1200	No Steel Added	40	280	155.48	114	1200	2 N10 @ 605.9
425	40	280	0	26	1200	No Steel Added	40	280	155.48	114	1200	2 N10 @ 605.9
500	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
666	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
832	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1000	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1087.5	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1224.5	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1361.5	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1500	32	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1564	28	267.4	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1628	28	250.4	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1692	24	228.3	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1756	20	209.6	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1824	16	188.7	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1826	16	188.1	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1877.5	16	171.3	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added

Shear Reinforcement				
	Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel

S150

	Shear Reinforcement			
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	No shear steel

Design Comments:-
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 1 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 2

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
122.5	36	297.8	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
144	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
174	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
176	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
371	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
566	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
761	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
956	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
1151	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
1350	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
1800	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
2250	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
2700	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
3150	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
3600	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4050	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4245	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4440	40	300	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4635	40	300	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4830	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5025	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5224	28	257	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5226	28	256.2	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5256	24	244	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5277.5	24	235.4	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added

	Shear Reinforcement			
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 3 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Span 3

	Top Reinforcement						Bottom Reinforcement					
Locat	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd	Max Size	Max Space	Area	Depth	Section Width	Rebar Reqd
mm	mm	mm	mm2	mm	mm	A	mm	mm	mm2	mm	mm	A
122.5	16	175.6	97.68	26	1200	2 N10 @ 964.4	0	0	0	114	1200	No Steel Added
174	16	193.9	97.68	26	1200	2 N10 @ 964.4	0	0	0	114	1200	No Steel Added
176	16	194.6	97.68	26	1200	2 N10 @ 964.4	0	0	0	114	1200	No Steel Added
371	20	226.2	38.98	26	1200	1 N10 @ 999	0	0	0	114	1200	No Steel Added
566	32	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
761	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
956	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1151	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1350	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
1800	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2250	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
2700	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3150	0	0	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
3600	40	280	0	26	1200	No Steel Added	40	280	0	114	1200	No Steel Added
4050	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
4245	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
4440	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
4635	28	258.4	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
4830	20	212.7	47.04	26	1200	1 N10 @ 999	0	0	0	114	1200	No Steel Added
5025	16	198.8	155.96	26	1200	2 N10 @ 604	0	0	0	114	1200	No Steel Added
5224	12	169.5	223.91	26	1200	3 N10 @ 420.7	0	0	0	114	1200	No Steel Added
5226	12	168.9	223.91	26	1200	3 N10 @ 420.7	0	0	0	114	1200	No Steel Added
5277.5	12	151.6	223.91	26	1200	3 N10 @ 420.7	0	0	0	114	1200	No Steel Added

	Shear Reinforcement			
	Spacing of Sets			
Area	2 legs N10	2 legs N12	2 legs N16	Shear Comments
mm2/mm	mm	mm	mm	A
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel

Design Comments:-
- SUPPORT Reinforcing Bar Spacing - Column Grid 3 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 4 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

SL51

Span 4

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
122.5	16	174.4	21.33	26	1200	1 N10 @ 999	0	0	0	154	1200	No Steel Added
144	16	184.9	21.33	26	1200	1 N10 @ 999	0	0	0	154	1200	No Steel Added
174	16	199.2	21.33	26	1200	1 N10 @ 999	0	0	0	154	1200	No Steel Added
176	16	200.1	21.33	26	1200	1 N10 @ 999	0	0	0	154	1200	No Steel Added
371	32	279.8	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
566	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
761	40	300	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
956	40	300	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
1151	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
1350	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
1800	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
2250	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
2700	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
2850	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
2900	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
2950	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
3500	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4050	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4245	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4440	0	0	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4635	40	300	0	26	1200	No Steel Added	40	300	0	154	1200	No Steel Added
4830	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5025	40	300	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5224	20	216.4	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5226	20	215.4	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5256	16	200	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added
5277.5	16	188.8	0	26	1200	No Steel Added	0	0	0	154	1200	No Steel Added

	Shear Reinforcement Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	

Design Comments:-
- SUPPORT Reinforcing Bar Spacing - Column Grid 4 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 5 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 5 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

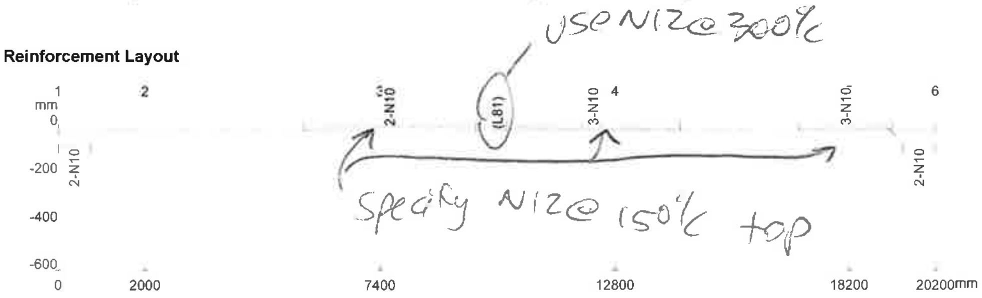
Span 5

	Top Reinforcement						Bottom Reinforcement					
Locat mm	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A	Max Size mm	Max Space mm	Area mm2	Depth mm	Section Width mm	Rebar Reqd A
122.5	12	138	159.91	26	1200	3 N10 @ 589.1	0	0	0	114	1200	No Steel Added
174	12	155.2	159.91	26	1200	3 N10 @ 589.1	0	0	0	114	1200	No Steel Added
176	12	155.8	159.91	26	1200	3 N10 @ 589.1	0	0	0	114	1200	No Steel Added
240	16	176	159.91	26	1200	3 N10 @ 589.1	0	0	0	114	1200	No Steel Added
304	16	181.9	138.19	26	1200	2 N10 @ 681.7	0	0	0	114	1200	No Steel Added
368	16	182.5	106.11	26	1200	2 N10 @ 887.8	0	0	0	114	1200	No Steel Added
432	16	184.1	78.86	26	1200	2 N10 @ 999	0	0	0	114	1200	No Steel Added
500	16	189	51.49	26	1200	1 N10 @ 999	0	0	0	114	1200	No Steel Added
699	20	221.8	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
912.5	32	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1000	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1175	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1337	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1500	40	280	0	26	1200	No Steel Added	0	0	0	114	1200	No Steel Added
1574	40	280	0	26	1200	No Steel Added	0	0	155.48	114	1200	2 N10 @ 605.9
1649	40	280	0	26	1200	No Steel Added	0	0	155.48	114	1200	2 N10 @ 605.9
1651	40	280	0	26	1200	No Steel Added	0	0	155.48	114	1200	2 N10 @ 605.9
1755	40	280	0	26	1200	No Steel Added	40	280	155.48	114	1200	2 N10 @ 605.9

	Shear Reinforcement Spacing of Sets			
Area mm2/mm	2 legs N10 mm	2 legs N12 mm	2 legs N16 mm	Shear Comments A
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel
0	0	0	0	No shear steel

Design Comments:-
- SUPPORT Reinforcing Bar Spacing - Column Grid 5 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 5 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 5 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 5 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

Reinforcement Layout



SL52

Design Comments:-

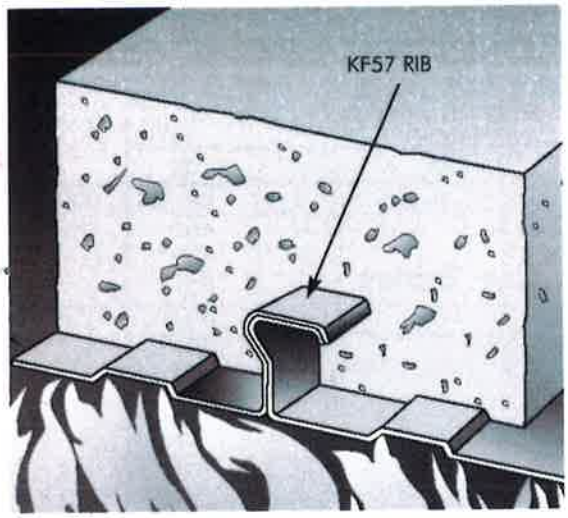
- - Column Grid 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 1 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 1 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

- - Column Grid 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 3 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 2 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 3 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 4 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 3 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 4 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 5 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 5 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- - Span 4 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SUPPORT Reinforcing Bar Spacing - Column Grid 5 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Column Grid 5 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.
- SPAN Reinforcing Bar spacing - Span 5 - Smallest preferred reinforcement size requires bar spacing larger than maximum. It will be necessary to use smaller bars than the preferred minimum size or a larger area of reinforcement than is required by design.
- - Span 5 - Required Bar Size is smaller than the Preffered Bar Size. Maintaining the same cover will require slightly less reinforcement than calculated.

5/53

SL54

No contribution from ceilings or applied passive surface treatments has been accounted for in the fire situation table.



The closed rib of Fielders KF57 profile prevents heat from entering. The thermal insulation performance of KF57 is comparable to a solid slab.

2.3 Contribution of Ribs

In testing KF57 slabs the temperatures recorded on the top portion of the ribs found that the ribs could contribute significantly to the positive bending capacity of the slab in fire conditions, thus reducing the area of additional bottom face reinforcing mesh. The resulting reductions in bottom face reinforcing mesh areas required in fire conditions are given in Table 2.4.

FRL (minutes)	Base metal thickness, BMT (mm)		
	0.60	0.75	1.00
30	209	261	348
60	199	248	331
90	228	285	381
120	217	270	361
180	267	334	446

Table 2.4 Reduction in Steel Mesh Area in Fire (mm^2/m) - KF57®

For further details on fire design of KF57 and RF55 and the Exposed Surface area to mass ratio (ESA/M) of steel beams refer to Appendix C.

351 - Fire check

SL55

Results

Project Name:

Prospect Road

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)	250			
Negative reinforcement	As- (mm2)	-			
Pattern of negative reinforcement		-			
Concrete Cover	c (mm)	20			
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)	SL92			
Number of props		2			
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)	160			
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)				

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**	Negative Reinforcement Diameter	**-**
Span Configuration Continuous Spans	**Single Spans -**	Negative Reinforcement Grade	**-**
Exposure Classification	**A1**	D,cs	**250 mm**
Ll/Ls	**-**	BONDEK II sheeting	**1 mm**
Deflection Limits of Composite Slabs	**Total <L/250**	Q live load	**2 kPa**
		G superimposed dead load	**0.5kPa**
L,eff, mm	**6700**	Q weight of stacked materials construction stage 1	**4kPa**
Formwork Deflection Limits	**Visual quality not important**	$\psi\sigma$	**0.7**
		$\psi\lambda$	**0.4**
Continuity of formwork over permanent supports	**Continuous**	Fire Design	**Required**
Crack control for shrinkage and temperature effects	**Minor**	Fire Resistance Periods	**90 min**
		Fire Reinforcement Options	**Fire Detail 2**
Crack control for flexure	**-**	Fire Reinforcement Diameter	**12mm**
Concrete Density f'c	**25kN/m3 32MPa**	Fire Reinforcement Grade	**D500N**
Band beam width Band beam total depth	**- -**	Shrinkage Reinforcement Grade	**D500L**

352 - Fire check

SL56

Results

Bondek2003 Version 2

Project Name:

Prospect Road

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)		140		
Negative reinforcement	As- (mm2)		390		
Pattern of negative reinforcement			Pattern 1		
Concrete Cover	c (mm)		20		
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)		SL62		
Number of props			1		
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)		100		
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)		- -		

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**	Negative Reinforcement Diameter	**12mm**
Span Configuration Continuous Spans	**End Spans** **Three spans**	Negative Reinforcement Grade	**D500N**
Exposure Classification	**A1**	D,cs	**140 mm**
Ll/Ls	**up to 1.2**	BONDEK II sheeting	**1 mm**
Deflection Limits of Composite Slabs	**Total <L/250**	Q live load	**2 kPa**
		G superimposed dead load	**0.5kPa**
L,eff, mm	**5000**	Q weight of stacked materials construction stage 1	**4kPa**
Formwork Deflection Limits	**Visual quality not important**	$\psi\sigma$	**0.7**
		$\psi\lambda$	**0.4**
Continuity of formwork over permanent supports	**Continuous**	Fire Design	**Required**
Crack control for shrinkage and temperature effects	**Minor**	Fire Resistance Periods	**90 min**
		Fire Reinforcement Options	**Fire Detail 2**
Crack control for flexure	**Not required**		
		Fire Reinforcement Diameter	**12mm**
Concrete Density f'c	**25kN/m3** **32MPa**	Fire Reinforcement Grade	**D500N**
Band beam width Band beam total depth	- -	Shrinkage Reinforcement Grade	**D500L**

352 - Fire Check SL51

Results

Project Name:

Prospect Road

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)			140	
Negative reinforcement	As- (mm2)			390	
Pattern of negative reinforcement				Pattern 1	
Concrete Cover	c (mm)			20	
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)			SL62	
Number of props				1	
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)			0	
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)			-	

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**
Span Configuration Continuous Spans	**Interior Spans Three spans**
Exposure Classification	**A1**
Ll/Ls	**up to 1.2**
Deflection Limits of Composite Slabs	**Total <L/250**
L,eff, mm	**5000**
Formwork Deflection Limits	**Visual quality not important**
Continuity of formwork over permanent supports	**Continuous**
Crack control for shrinkage and temperature effects	**Minor**
Crack control for flexure	**Not required**
Concrete Density f'c	**25kN/m3 32MPa**
Band beam width Band beam total depth	**- -**

Negative Reinforcement Diameter	**12mm**
Negative Reinforcement Grade	**D500N**
D,cs	**140 mm**
BONDEK II sheeting	**1 mm**
Q live load	**2 kPa**
G superimposed dead load	**0.5kPa**
Q weight of stacked materials construction stage 1	**4kPa**
$\psi\sigma$	**0.7**
$\psi\lambda$	**0.4**
Fire Design	**Required**
Fire Resistance Periods	**90 min**
Fire Reinforcement Options	**Fire Detail 2**
Fire Reinforcement Diameter	**12mm**
Fire Reinforcement Grade	**D500N**
Shrinkage Reinforcement Grade	**D500L**

SL58

Project Name:
Prospect Road

Results
351 - Fire check

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)		230		
Negative reinforcement	As- (mm2)		730		
Pattern of negative reinforcement			Pattern 1		
Concrete Cover	c (mm)		20		
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)		SL92		
Number of props			2		
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)		350		
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)		- -		

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**	Negative Reinforcement Diameter	**12mm**
Span Configuration Continuous Spans	**End Spans Two spans**	Negative Reinforcement Grade	**D500N**
Exposure Classification	**A1**	D,cs	**230 mm**
Ll/Ls	**up to 1.2**	BONDEK II sheeting	**1 mm**
Deflection Limits of Composite Slabs	**Total <L/250**	Q live load	**2 kPa**
		G superimposed dead load	**0.5kPa**
L,eff, mm	**7800**	Q weight of stacked materials construction stage 1	**4kPa**
Formwork Deflection Limits	**Visual quality not important**	$\psi\sigma$	**0.7**
		$\psi\lambda$	**0.4**
Continuity of formwork over permanent supports	**Continuous**	Fire Design	**Required**
Crack control for shrinkage and temperature effects	**Minor**	Fire Resistance Periods	**90 min**
Crack control for flexure	**Not required**	Fire Reinforcement Options	**Fire Detail 2**
		Fire Reinforcement Diameter	**12mm**
Concrete Density f'c	**25kN/m3 32MPa**	Fire Reinforcement Grade	**D500N**
Band beam width Band beam total depth	- -	Shrinkage Reinforcement Grade	**D500L**

252 - Fire Check

SL59

Results

Bondek2003 Version 2

Project Name:

Prospect Road

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)		210		
Negative reinforcement	As- (mm2)		530		
Pattern of negative reinforcement			Pattern 1		
Concrete Cover	c (mm)		20		
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)		SL82		
Number of props			2		
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)		210		
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)		- -		

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**	Negative Reinforcement Diameter	**12mm**
Span Configuration Continuous Spans	**End Spans** **Three spans**	Negative Reinforcement Grade	**D500N**
Exposure Classification	**A1**	D,cs	**210 mm**
Ll/Ls	**up to 1.2**	BONDEK II sheeting	**1 mm**
Deflection Limits of Composite Slabs	**Total <L/250**	Q live load	**2 kPa**
		G superimposed dead load	**0.5kPa**
L,eff, mm	**6600**	Q weight of stacked materials construction stage 1	**4kPa**
Formwork Deflection Limits	**Visual quality not important**	$\psi\sigma$	**0.7**
		$\psi\lambda$	**0.4**
Continuity of formwork over permanent supports	**Continuous**	Fire Design	**Required**
Crack control for shrinkage and temperature effects	**Minor**	Fire Resistance Periods	**90 min**
		Fire Reinforcement Options	**Fire Detail 2**
Crack control for flexure	**Not required**		
		Fire Reinforcement Diameter	**12mm**
Concrete Density f'c	**25kN/m3** **32MPa**	Fire Reinforcement Grade	**D500N**
Band beam width Band beam total depth	- -	Shrinkage Reinforcement Grade	**D500L**

2S2 - Fire check. SL60

Results

Project Name:

Prospect Road

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)			210	
Negative reinforcement	As- (mm2)			530	
Pattern of negative reinforcement				Pattern 1	
Concrete Cover	c (mm)			20	
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)			SL82	
Number of props				2	
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)			0	
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)			-	

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**	Negative Reinforcement Diameter	**12mm**
Span Configuration Continuous Spans	**Interior Spans Three spans**	Negative Reinforcement Grade	**D500N**
Exposure Classification	**A1**	D,cs	**210 mm**
Ll/Ls	**up to 1.2**	BONDEK II sheeting	**1 mm**
Deflection Limits of Composite Slabs	**Total <L/250**	Q live load	**2 kPa**
		G superimposed dead load	**0.5kPa**
L,eff, mm	**6600**	Q weight of stacked materials construction stage 1	**4kPa**
Formwork Deflection Limits	**Visual quality not important**	ψσ	**0.7**
		ψλ	**0.4**
Continuity of formwork over permanent supports	**Continuous**	Fire Design	**Required**
Crack control for shrinkage and temperature effects	**Minor**	Fire Resistance Periods	**90 min**
		Fire Reinforcement Options	**Fire Detail 2**
Crack control for flexure	**Not required**	Fire Reinforcement Diameter	**12mm**
Concrete Density f'c	**25kN/m3 32MPa**	Fire Reinforcement Grade	**D500N**
Band beam width Band beam total depth	**- -**	Shrinkage Reinforcement Grade	**D500L**

251 - Fire Check

SL61

Results

Project Name:

Prospect Road

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)			240	
Negative reinforcement	As- (mm2)			280	
Pattern of negative reinforcement				Pattern 1	
Concrete Cover	c (mm)			20	
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)			SL92	
Number of props				1	
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)			0	
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)			-	

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**
Span Configuration Continuous Spans	**Interior Spans** **Three spans**
Exposure Classification	**A1**
Ll/Ls	**up to 1.2**
Deflection Limits of Composite Slabs	**Total <L/250**
L,eff, mm	**5000**
Formwork Deflection Limits	**Visual quality not important**
Continuity of formwork over permanent supports	**Continuous**
Crack control for shrinkage and temperature effects	**Minor**
Crack control for flexure	**Not required**
Concrete Density f'c	**25kN/m3** **32MPa**
Band beam width Band beam total depth	**-** **-**

Negative Reinforcement Diameter	**12mm**
Negative Reinforcement Grade	**D500N**
D,cs	**240 mm**
BONDEK II sheeting	**1 mm**
Q live load	**2 kPa**
G superimposed dead load	**0.5kPa**
Q weight of stacked materials construction stage 1	**4kPa**
$\psi\sigma$	**0.7**
$\psi\lambda$	**0.4**
Fire Design	**Required**
Fire Resistance Periods	**90 min**
Fire Reinforcement Options	**Fire Detail 2**
Fire Reinforcement Diameter	**12mm**
Fire Reinforcement Grade	**D500N**
Shrinkage Reinforcement Grade	**D500L**

251 - Fire check. SL62

Results

Project Name:

Prospect Road

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)		240		
Negative reinforcement	As- (mm2)		640		
Pattern of negative reinforcement			Pattern 1		
Concrete Cover	c (mm)		20		
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)		SL92		
Number of props			2		
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)		300		
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)		- -		

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**	Negative Reinforcement Diameter	**12mm**
Span Configuration Continuous Spans	**End Spans** **Three spans**	Negative Reinforcement Grade	**D500N**
Exposure Classification	**A1**	D,cs	**240 mm**
Ll/Ls	**up to 1.2**	BONDEK II sheeting	**1 mm**
Deflection Limits of Composite Slabs	**Total <L/250**	Q live load	**2 kPa**
		G superimposed dead load	**0.5kPa**
L,eff, mm	**7500**	Q weight of stacked materials construction stage 1	**4kPa**
Formwork Deflection Limits	**Visual quality not important**	$\psi\sigma$	**0.7**
		$\psi\lambda$	**0.4**
Continuity of formwork over permanent supports	**Continuous**	Fire Design	**Required**
Crack control for shrinkage and temperature effects	**Minor**	Fire Resistance Periods	**90 min**
		Fire Reinforcement Options	**Fire Detail 2**
Crack control for flexure	**Not required**	Fire Reinforcement Diameter	**12mm**
Concrete Density f'c	**25kN/m3** **32MPa**	Fire Reinforcement Grade	**D500N**
Band beam width Band beam total depth	**-** **-**	Shrinkage Reinforcement Grade	**D500L**

151 - fire check

SL63

Results

Project Name:

Prospect Road

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)			140	
Negative reinforcement	As- (mm2)			390	
Pattern of negative reinforcement				Pattern 1	
Concrete Cover	c (mm)			20	
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)			SL62	
Number of props				1	
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)			100	
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)			-	

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**
Span Configuration Continuous Spans	**Interior Spans More than four spans**
Exposure Classification	**A1**
Ll/Ls	**up to 1.2**
Deflection Limits of Composite Slabs	**Total <L/250**
L,eff, mm	**5400**
Formwork Deflection Limits	**Visual quality not important**
Continuity of formwork over permanent supports	**Continuous**
Crack control for shrinkage and temperature effects	**Minor**
Crack control for flexure	**Not required**
Concrete Density f'c	**25kN/m3 32MPa**
Band beam width Band beam total depth	**- -**

Negative Reinforcement Diameter	**12mm**
Negative Reinforcement Grade	**D500N**
D,cs	**140 mm**
BONDEK II sheeting	**1 mm**
Q live load	**2 kPa**
G superimposed dead load	**0.5kPa**
Q weight of stacked materials construction stage 1	**4kPa**
$\psi\sigma$	**0.7**
$\psi\lambda$	**0.4**
Fire Design	**Required**
Fire Resistance Periods	**120 min**
Fire Reinforcement Options	**Fire Detail 2**
Fire Reinforcement Diameter	**12mm**
Fire Reinforcement Grade	**D500N**
Shrinkage Reinforcement Grade	**D500L**

151 - fire check

SL64

~~Results~~

Project Name:

Prospect Road

Bondek2003 Version 2

Design Output

Parameter	Notation	Spans			
		Single	End	Interior	Interior (reduced thickness)
Slab thickness	D,cs (mm)		140		
Negative reinforcement	As- (mm2)		60		
Pattern of negative reinforcement			Pattern 1		
Concrete Cover	c (mm)		20		
Reinforcement to control shrinkage and temperature effects	Ast,cr (mm2)		SL62		
Number of props			0		
Fire reinforcement (in addition to shrinkage and negative reinforcement)	A-st,f (mm2)		0		
Anchorage Reinf.: End supports: (Concrete frames only) Interior supports:	Aanch (mm2) Aanch (mm2)		- -		

Input parameters

Type of Buildings	**Steel-Frame,Masonry Wall**	Negative Reinforcement Diameter	**12mm**
Span Configuration Continuous Spans	**End Spans** **More than four spans**	Negative Reinforcement Grade	**D500N**
Exposure Classification	**A1**	D,cs	**140 mm**
Ll/Ls	**up to 1.2**	BONDEK II sheeting	**1 mm**
Deflection Limits of Composite Slabs	**Total <L/250**	Q live load	**2 kPa**
		G superimposed dead load	**0.5kPa**
L,eff, mm	**2000**	Q weight of stacked materials construction stage 1	**4kPa**
Formwork Deflection Limits	**Visual quality not important**	$\psi\sigma$	**0.7**
		$\psi\lambda$	**0.4**
Continuity of formwork over permanent supports	**Continuous**	Fire Design	**Required**
Crack control for shrinkage and temperature effects	**Minor**	Fire Resistance Periods	**120 min**
		Fire Reinforcement Options	**Fire Detail 2**
Crack control for flexure	**Not required**	Fire Reinforcement Diameter	**12mm**
Concrete Density f'c	**25kN/m3** **32MPa**	Fire Reinforcement Grade	**D500N**
Band beam width Band beam total depth	**-** **-**	Shrinkage Reinforcement Grade	**D500L**

Formed Slabs - Balconies

- Slabs modelled in ETABS for strength & deflection. Refer to ETABS extracts for deflection and bending moment contour diagrams

Deflection

Refer to ETABS extracts;

- maximum cantilever deflection for balcony slabs (200 thick) ≈ 10mm ⇒ consider ok.
- maximum midspan balcony deflection (200 thick formed slab @rear level 2) ≈ 8mm ⇒ consider ok.

⇒ 200 thick formed slabs ok for deflection to all areas

Strength

Cantilever balcony slabs - level 2 & 3 front elev

- Slabs cantilever one-way from front back to building wall line. ⇒ only concerned with negative moment.

⇒ $m^*(-ve) = 25 kNm/m$

⇒ $A_{st} = 25\times10^6 / 0.8\times500\times160\times0.9$

$= 434 mm^2/m$

⇒ N16 @ 150 c/c T&B easily ok

Balcony slab at level 1 Front elev

- slab spans 2-ways - supported at main building line and by steel columns at ground floor level.

x direction: $m^* = -10kNm/m, +5kNm/m$

y direction: $m^* = -12kNm/m, +5kNm/m$

⇒ nominally adopt N16 @ 200 c/c each way top & bottom:

$\phi M_{cap} = 0.8\times500\times1000\times140\times0.9 = 50.4 kNm/m$

⇒ ok.

Checked : .....

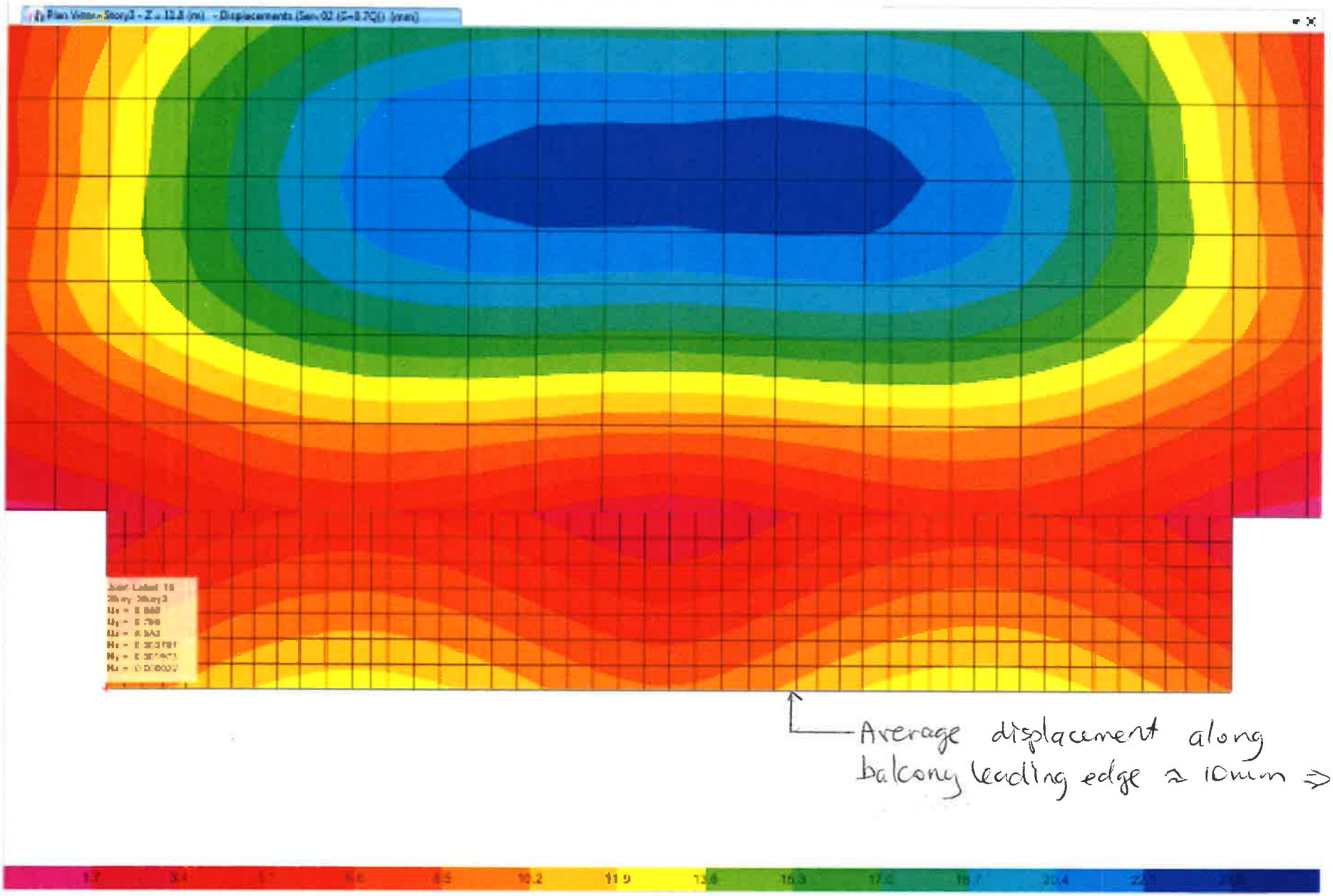
Date : ..../..../....

Balcony slab at rear level 2

- Formed slab spanning in two directions, supported by steel beams on 3 sides and two steel columns along rear edge.

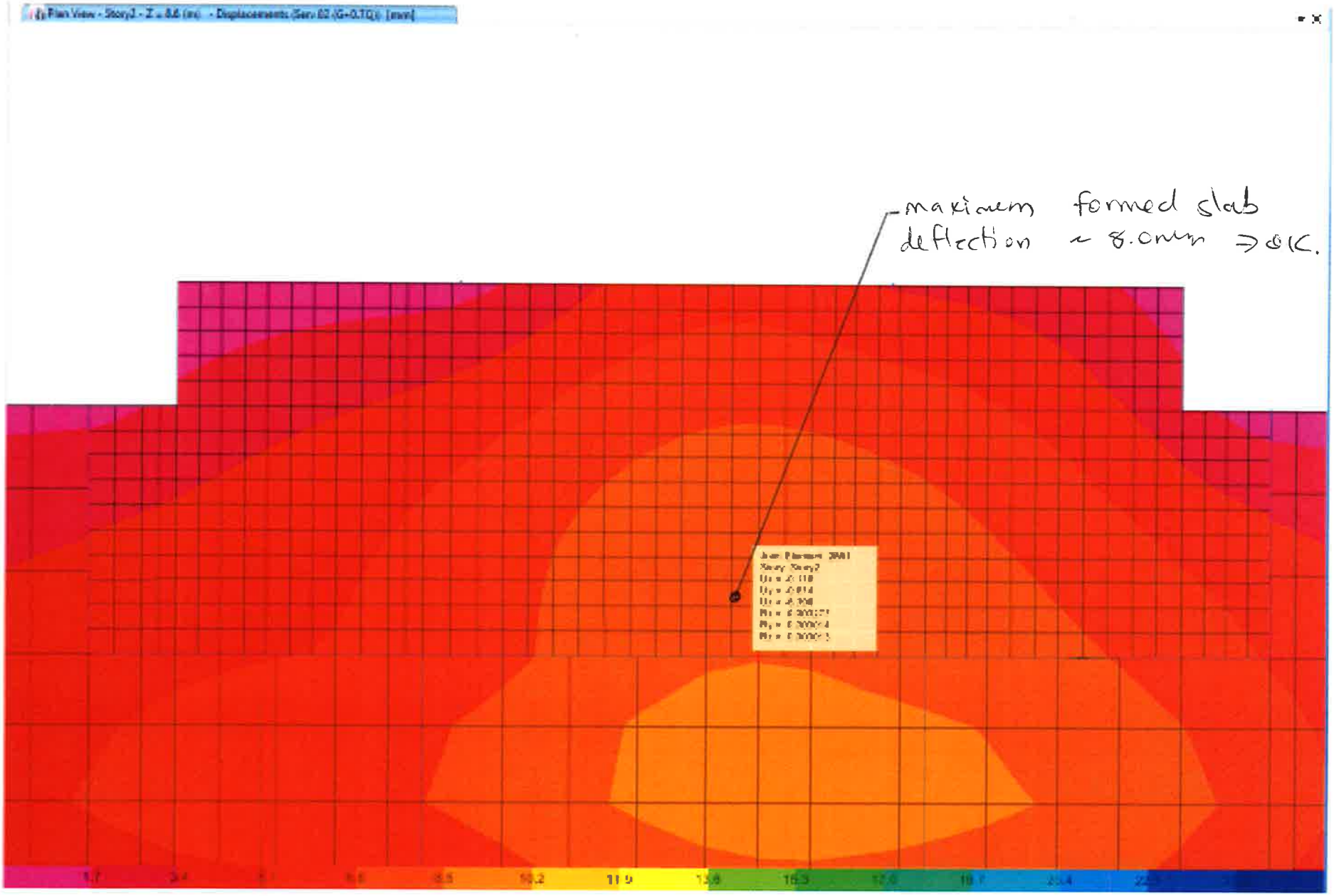
$M^*_x = -35 kN.m/m$, $+22 kN.m/m$
$M^*_y = -10 kN.m/m$, $+21 kN.m/m$

$\Rightarrow$ nominally adopt N16@200 c/c each way top & bottom
$\phi M_{cap} = 50.4 kN.m/m$
$\Rightarrow$ OK.

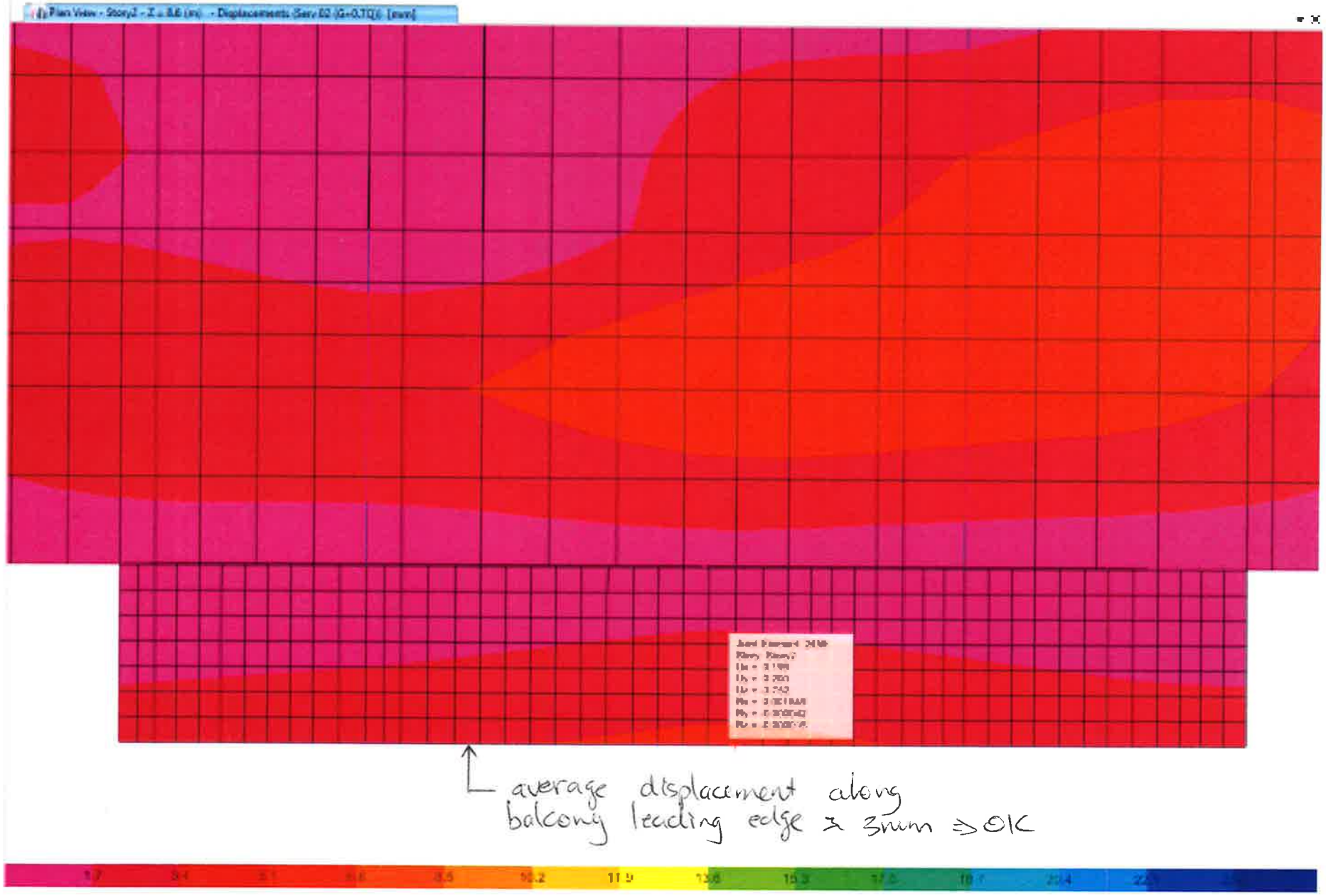


ETABS MODEL – SERVICEABILITY DISPLACEMENTS LEVEL 3 FORMED BALCONY SLAB

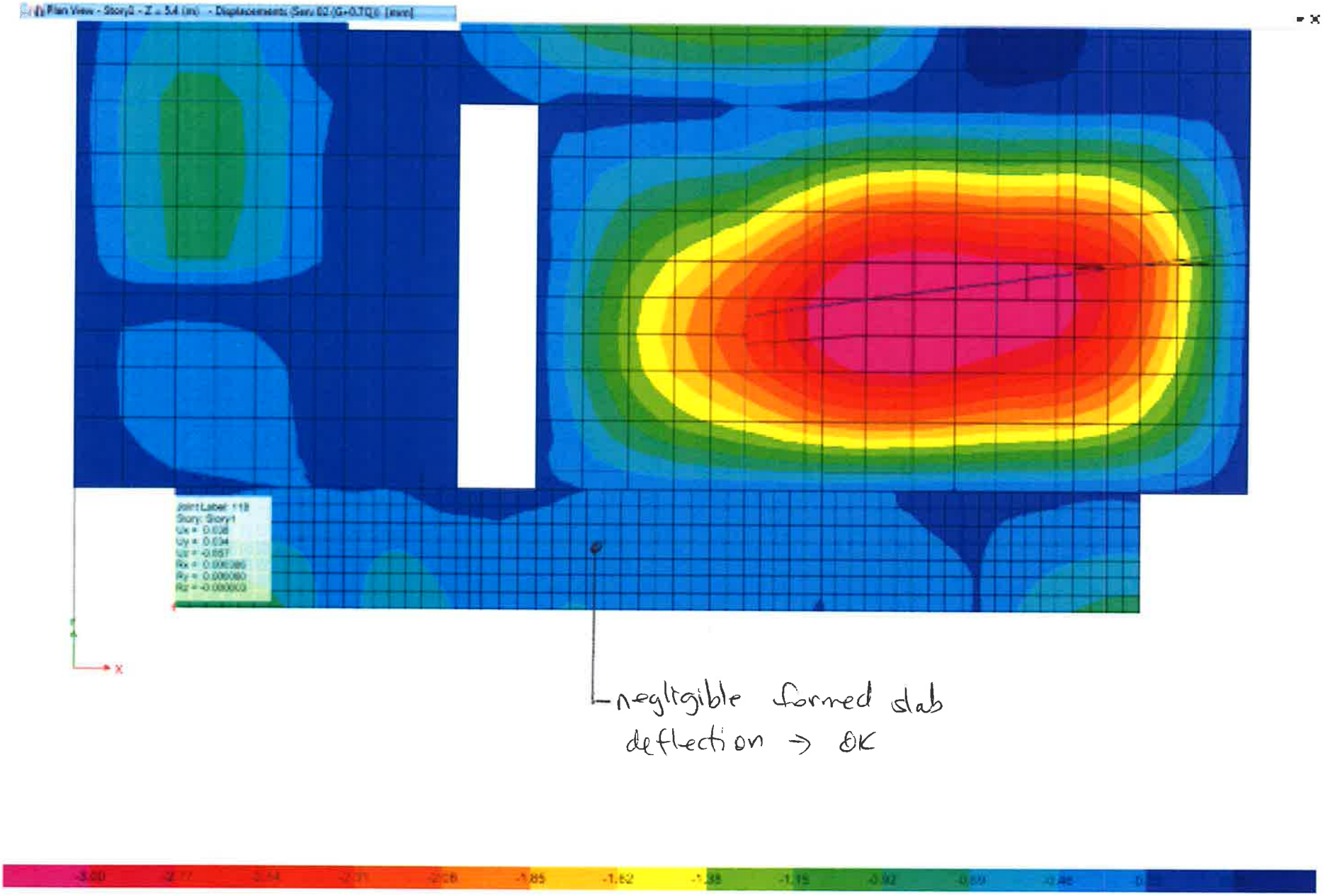
L975



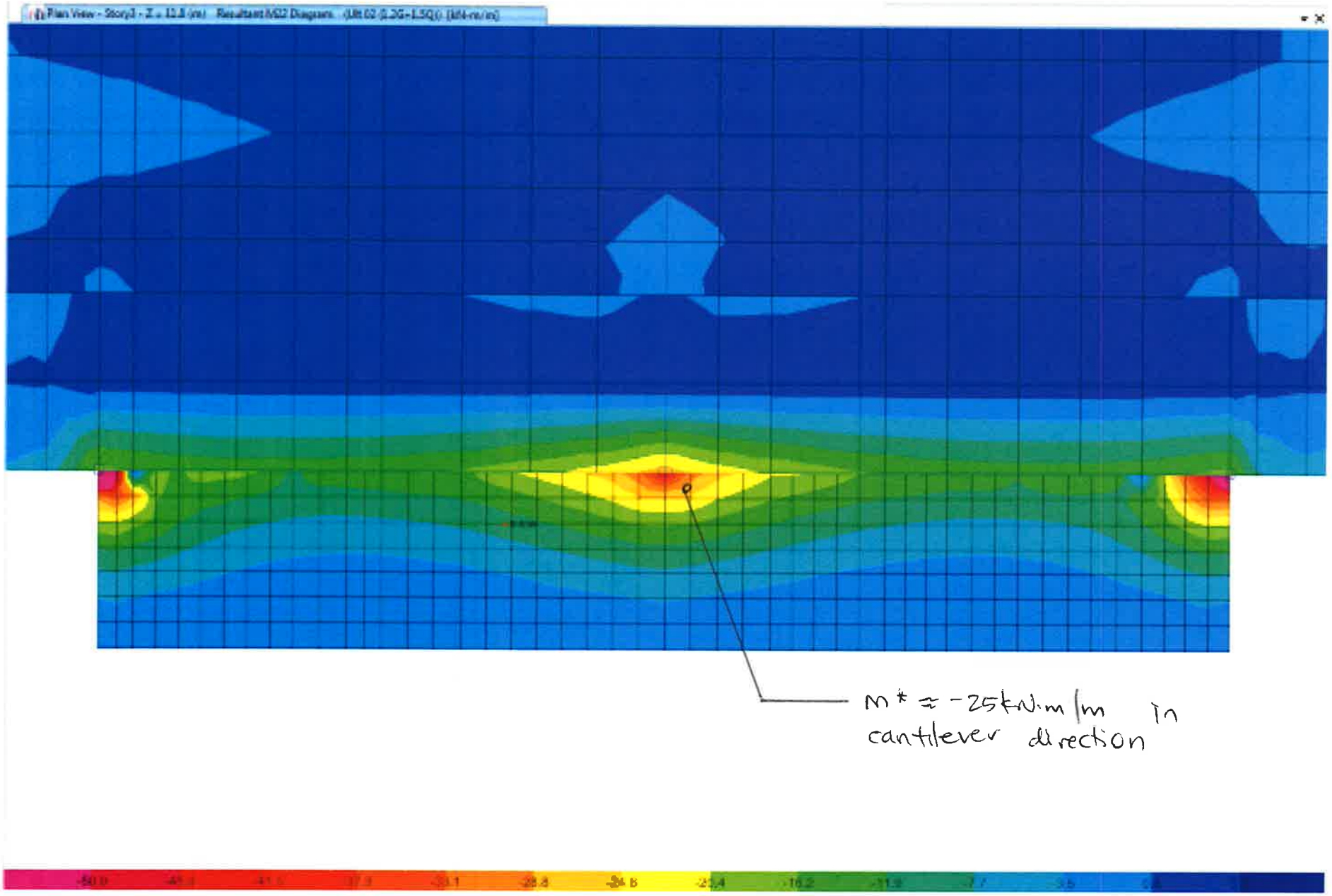
ETABS MODEL – SERVICEABILITY DISPLACEMENTS LEVEL 2 FORMED BALCONY SLAB (REAR)



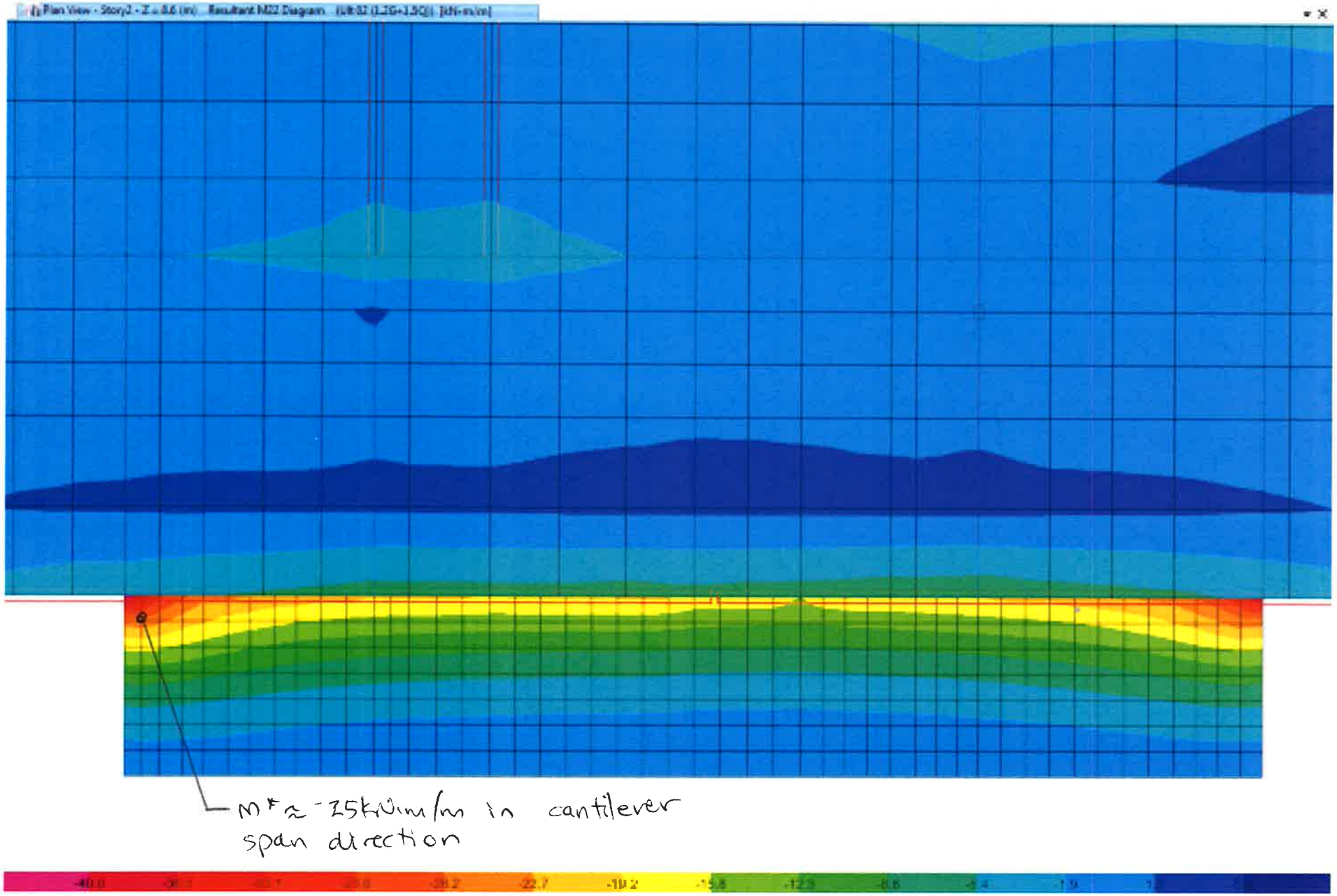
ETABS MODEL – SERVICEABILITY DISPLACEMENTS LEVEL 2 FORMED BALCONY SLAB (FRONT)



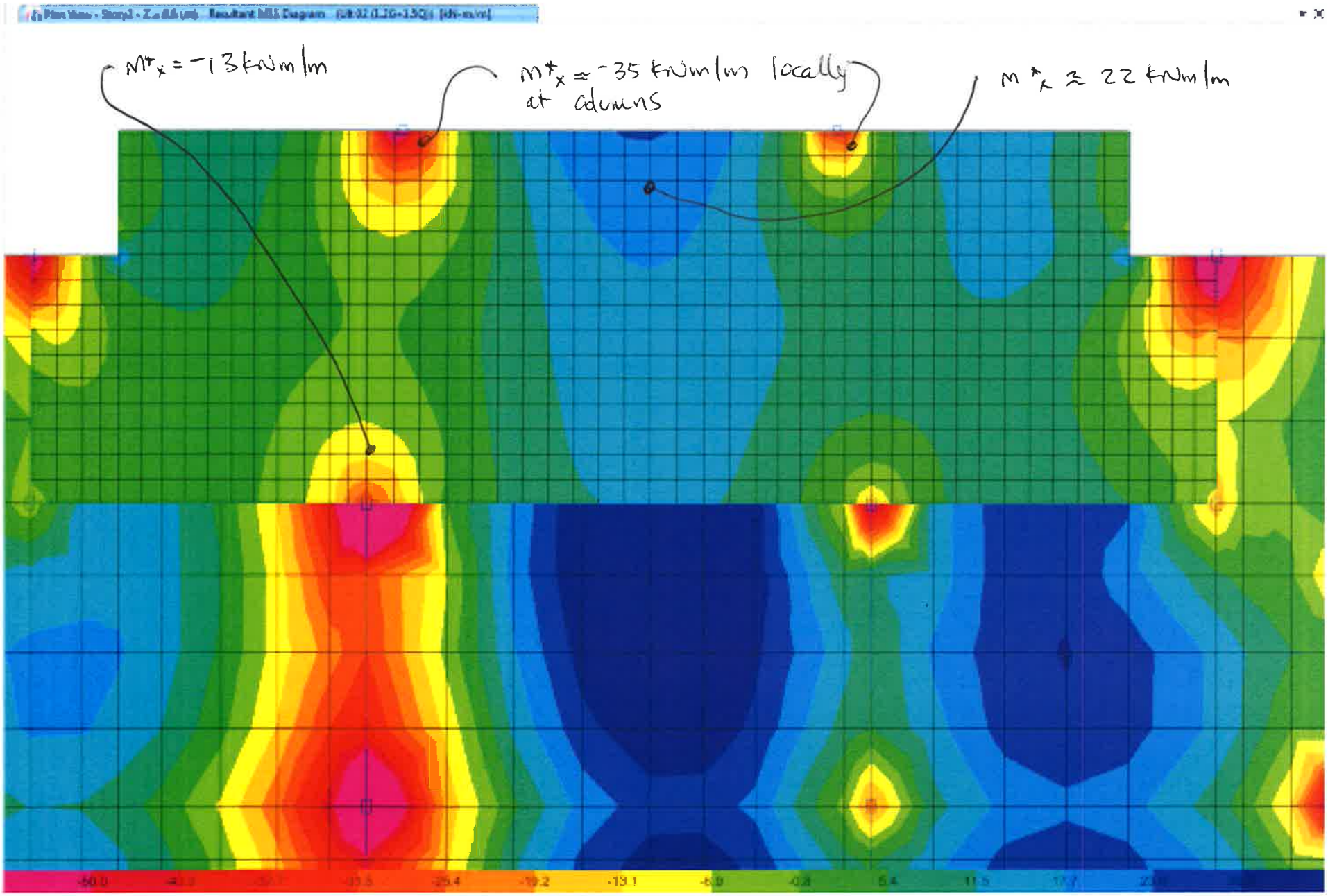
ETABS MODEL – SERVICEABILITY DISPLACEMENTS LEVEL 1 FORMED BALCONY SLAB



ETABS MODEL – LEVEL 3 FORMED BALCONY SLABS ULTIMATE BENDING MOMENTS (kN.m/m)

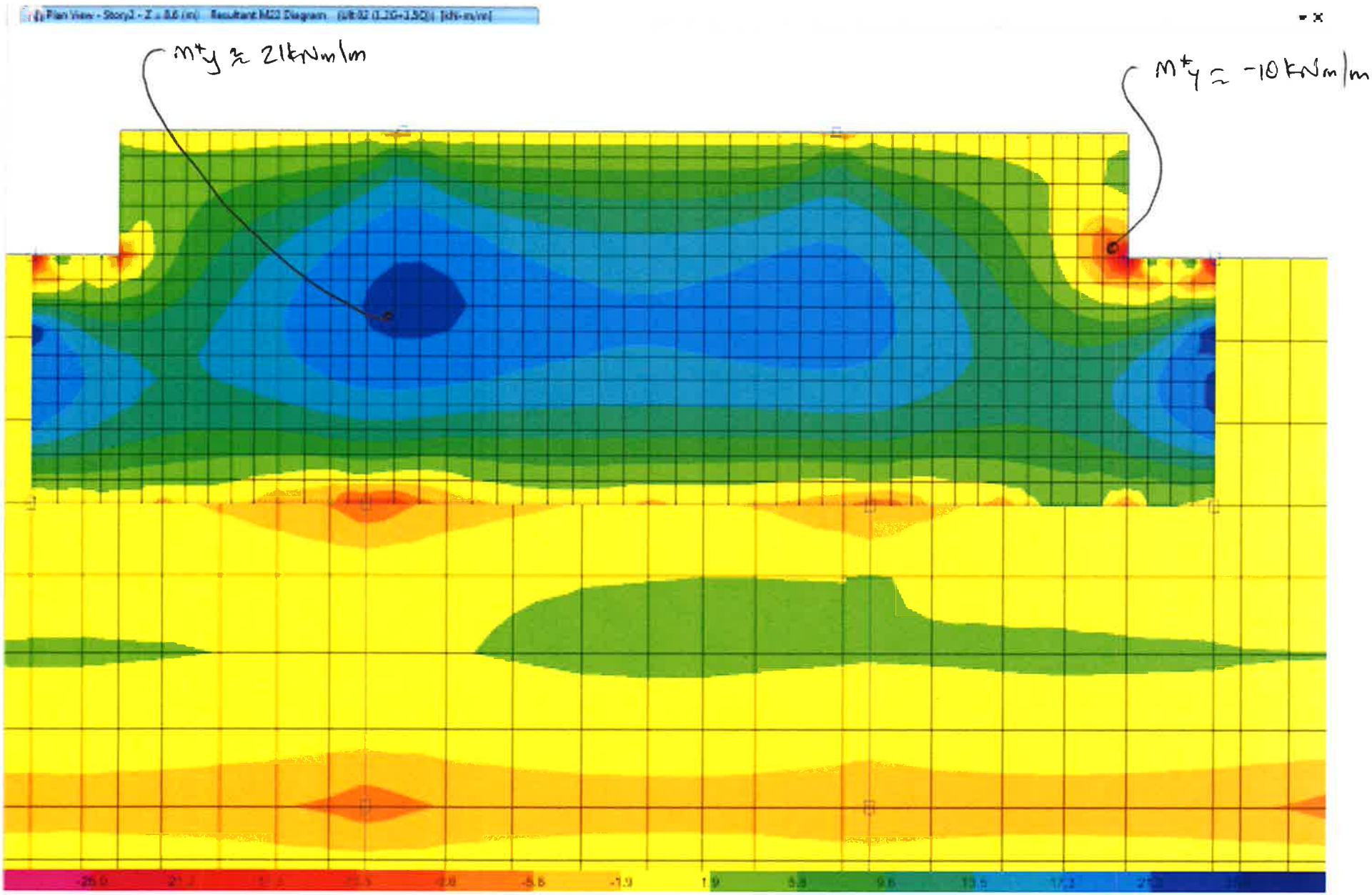


ETABS MODEL – LEVEL 2 FORMED BALCONY SLABS ULTIMATE BENDING MOMENTS (kN.m/m) (FRONT)



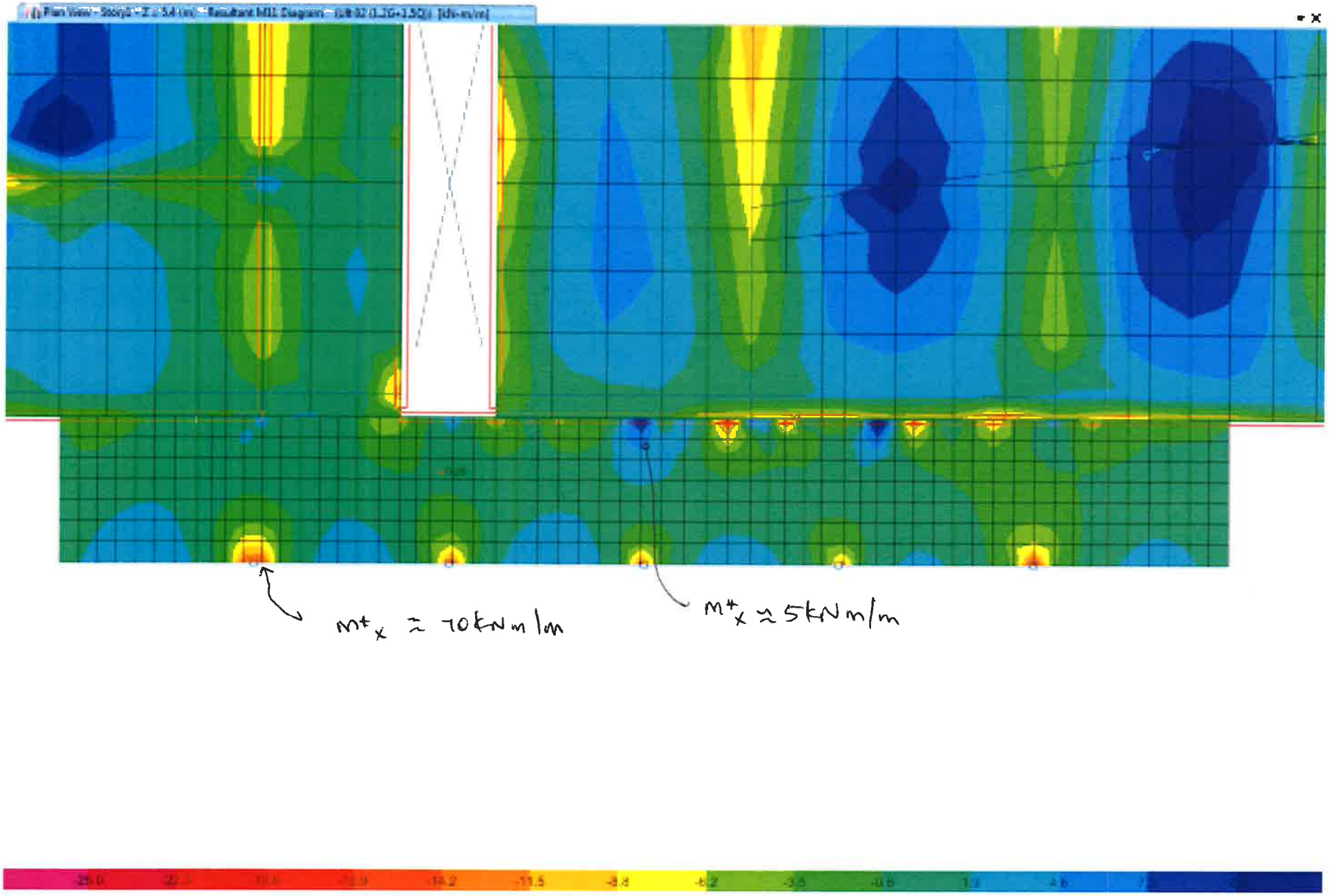
ETABS MODEL – LEVEL 2 FORMED BALCONY SLABS ULTIMATE BENDING MOMENTS XDIR (kN.m/m) (REAR)

SL73



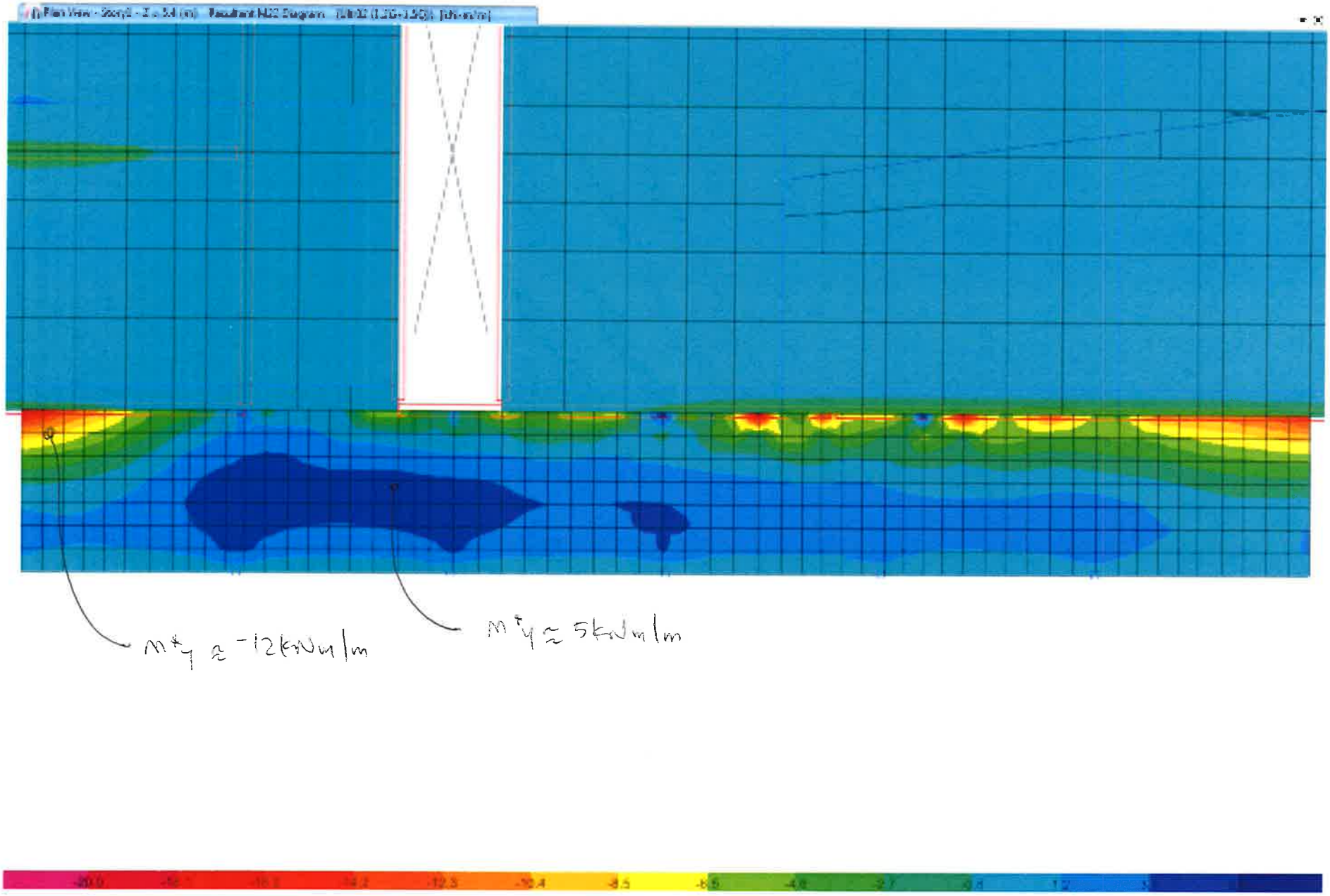
ETABS MODEL – LEVEL 2 FORMED BALCONY SLABS ULTIMATE BENDING MOMENTS YDIR (kN.m/m) (REAR)

5774



ETABS MODEL – LEVEL 1 FORMED BALCONY SLABS ULTIMATE BENDING MOMENTS XDIR (kN.m/m)

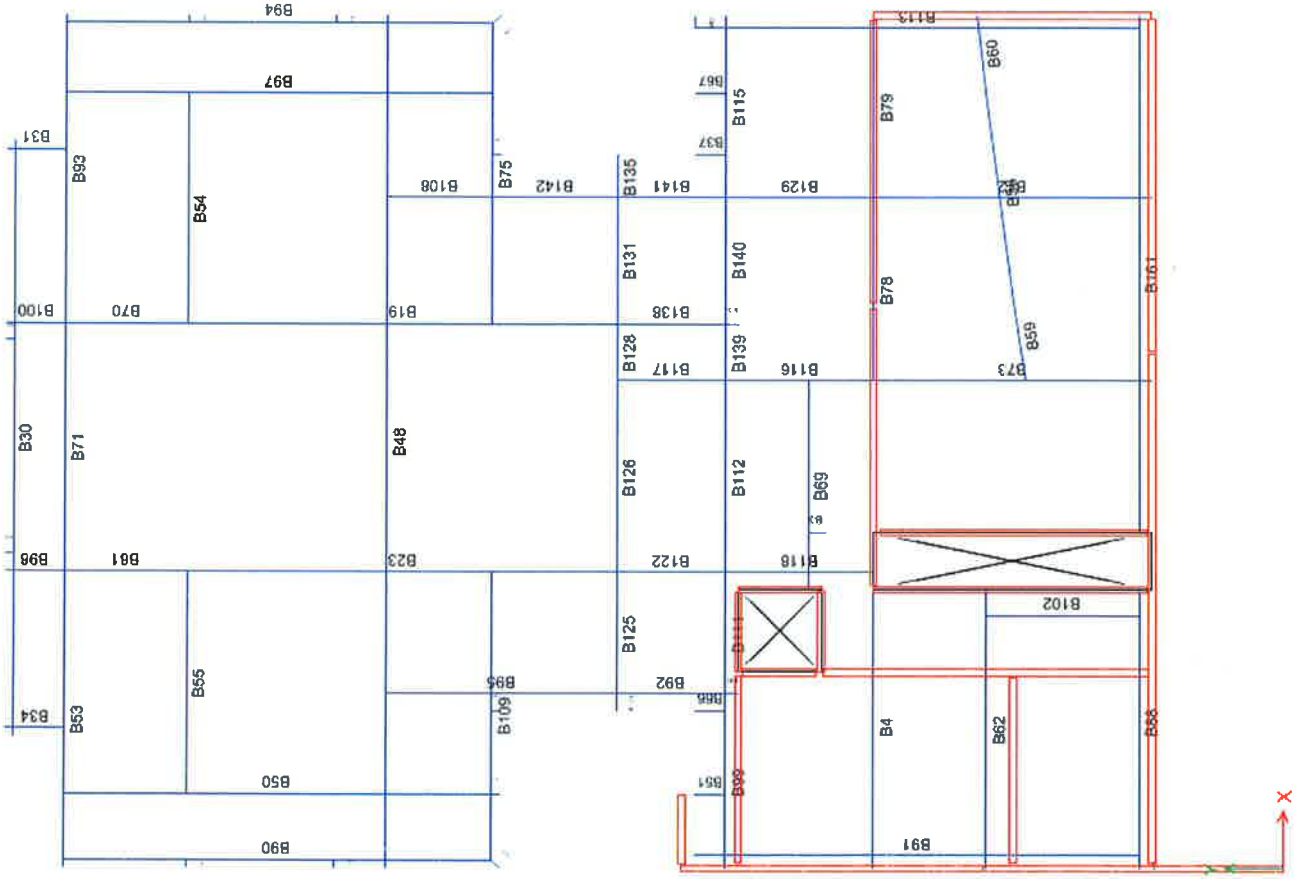
SL75



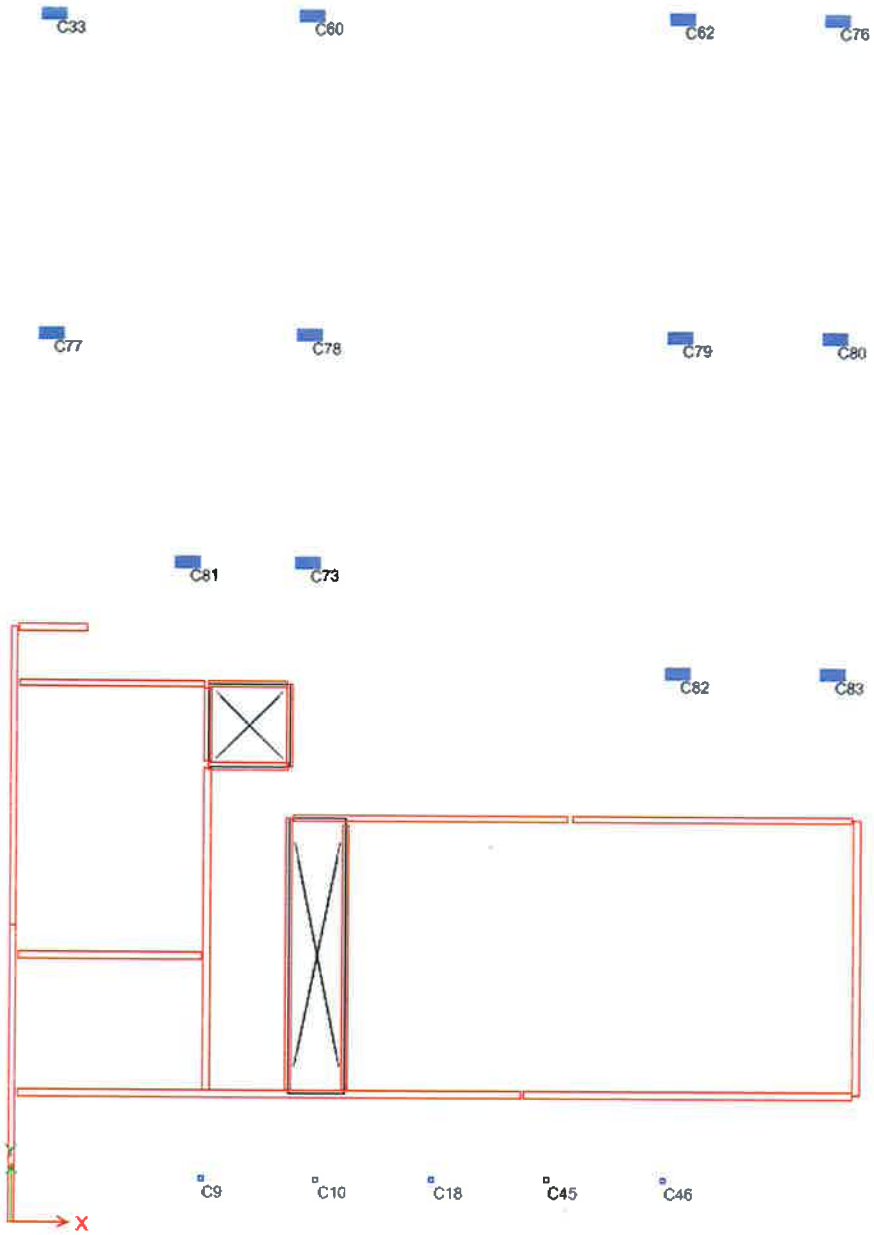
ETABS MODEL – LEVEL 1 FORMED BALCONY SLABS ULTIMATE BENDING MOMENTS YDIR (kN.m/m)

Reinforced Concrete transfer structure Calculations

TR1

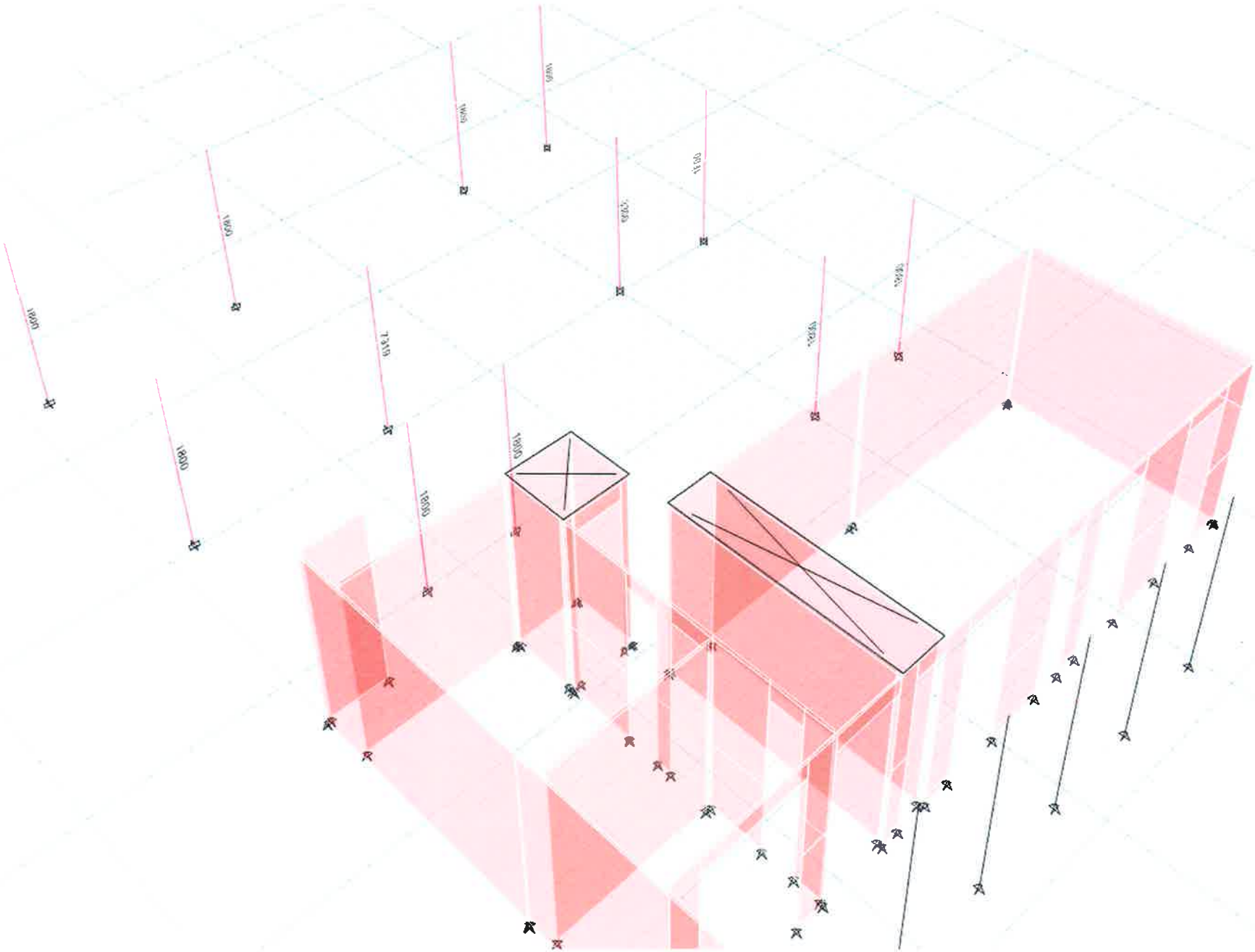


ETABS MODEL – LEVEL 1 CONCRETE BEAM LAYOUT

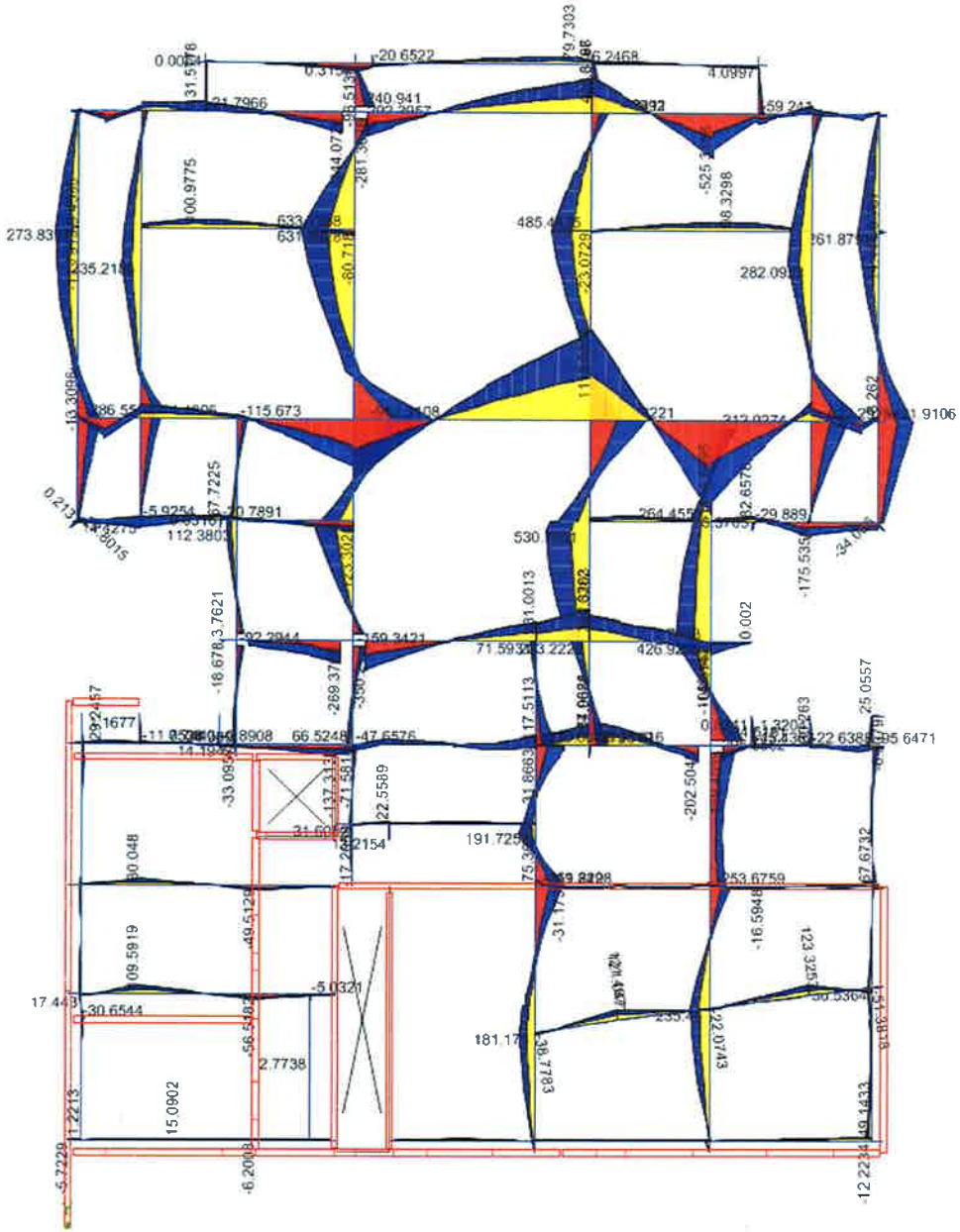


ETABS MODEL – GROUND LEVEL CONCRETE COLUMN LAYOUT

TR2



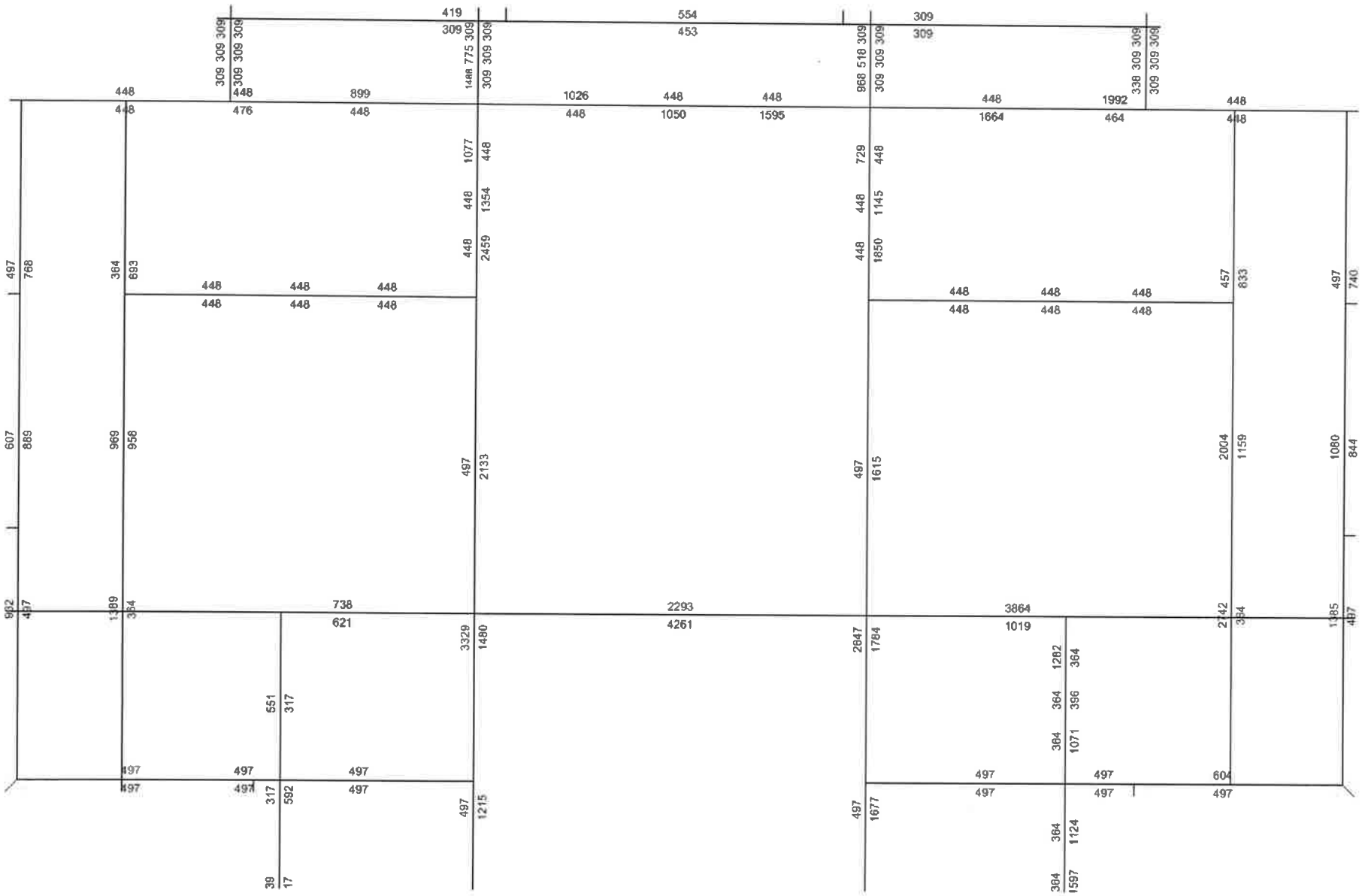
ETABS MODEL – GROUND FLOOR COLUMNS LONGITUDINAL STEEL REQUIREMENT (mm^2)



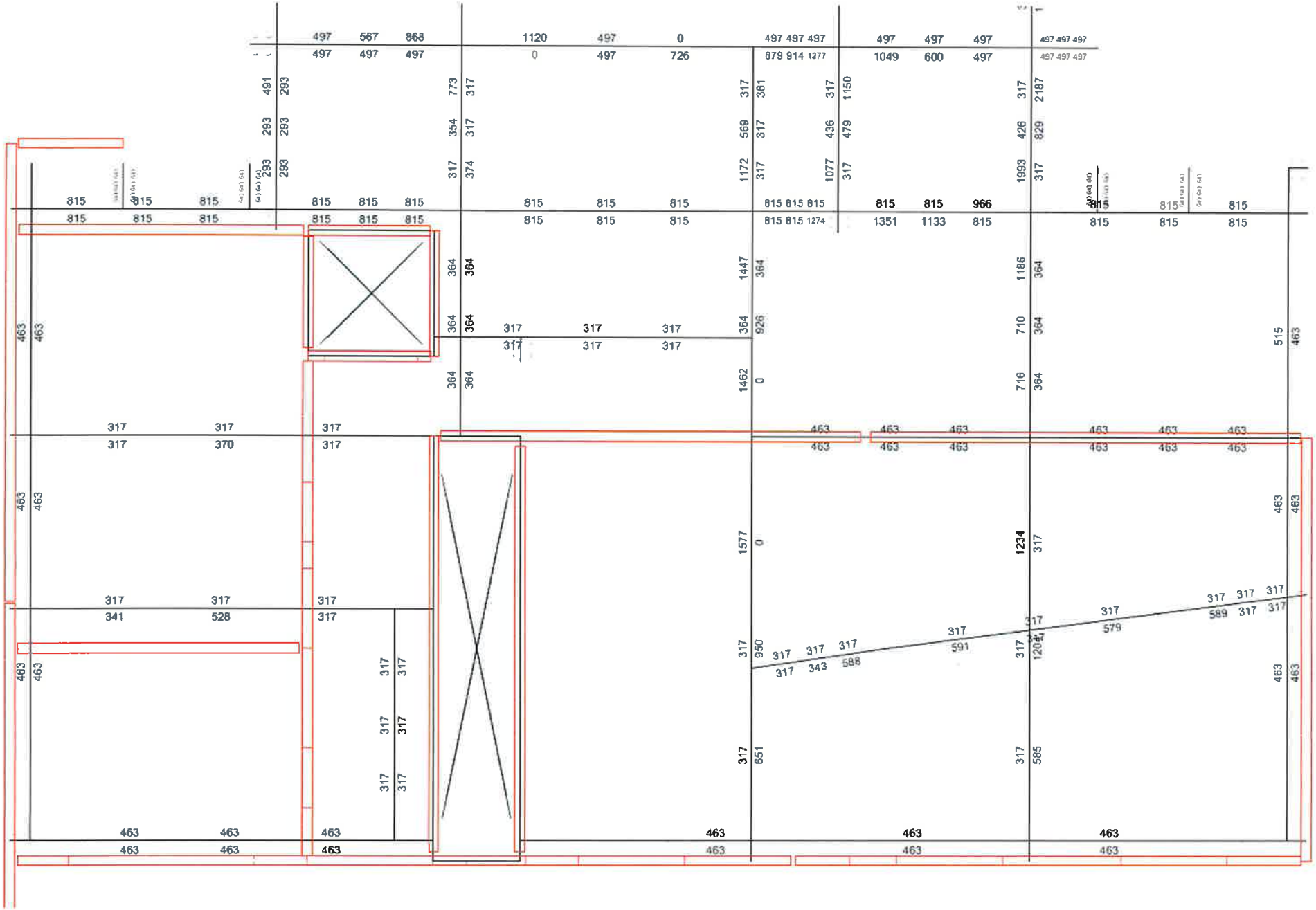
ETABS MODEL – LEVEL 1 CONCRETE BEAM LAYOUT ULTIMATE BENDING MOMENT ENVELOPE (kN.m/m)

PR4

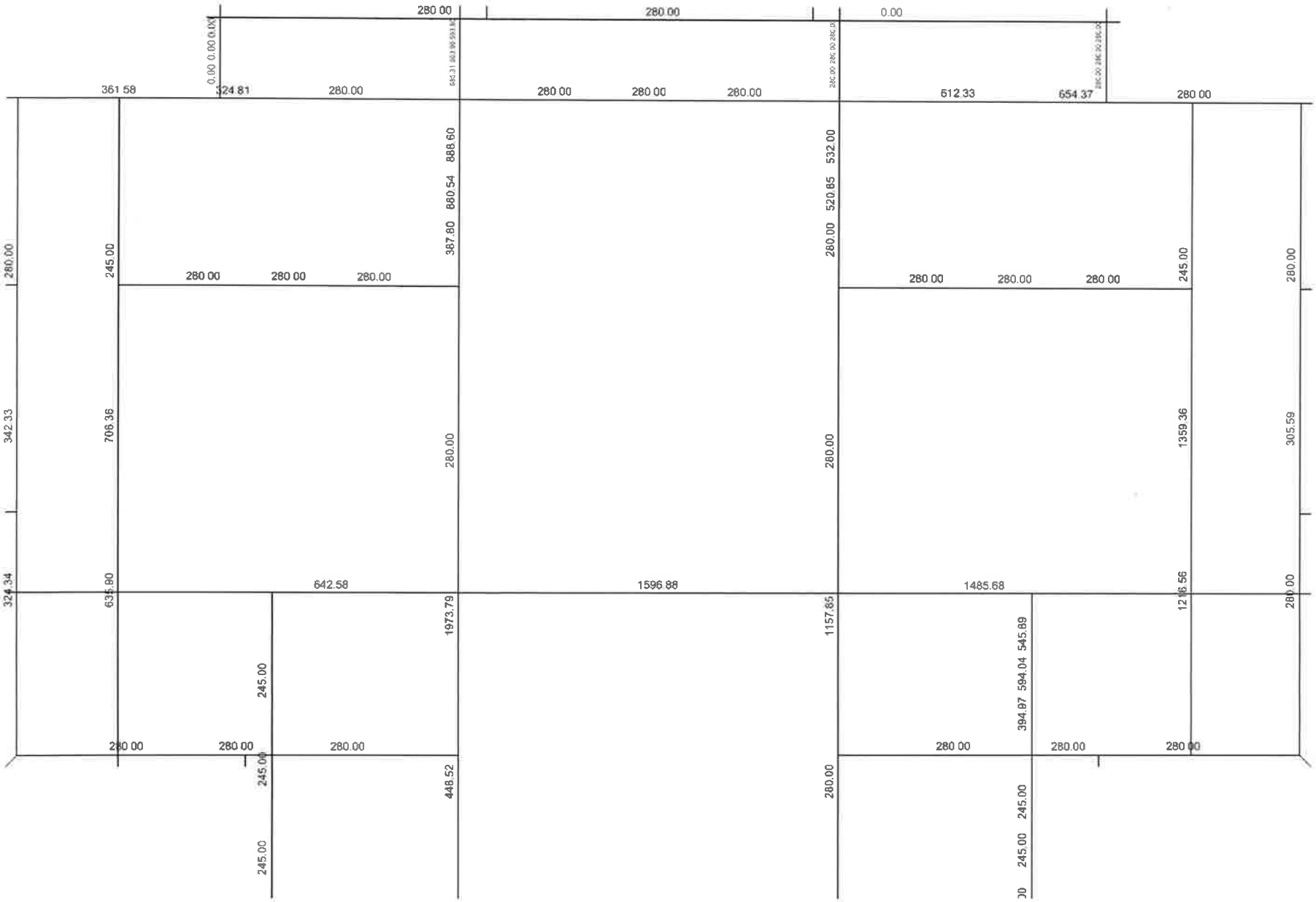
ETABS MODEL – LEVEL 1 CONCRETE BEAM LAYOUT ULTIMATE SHEAR ENVELOPE (kN/m)



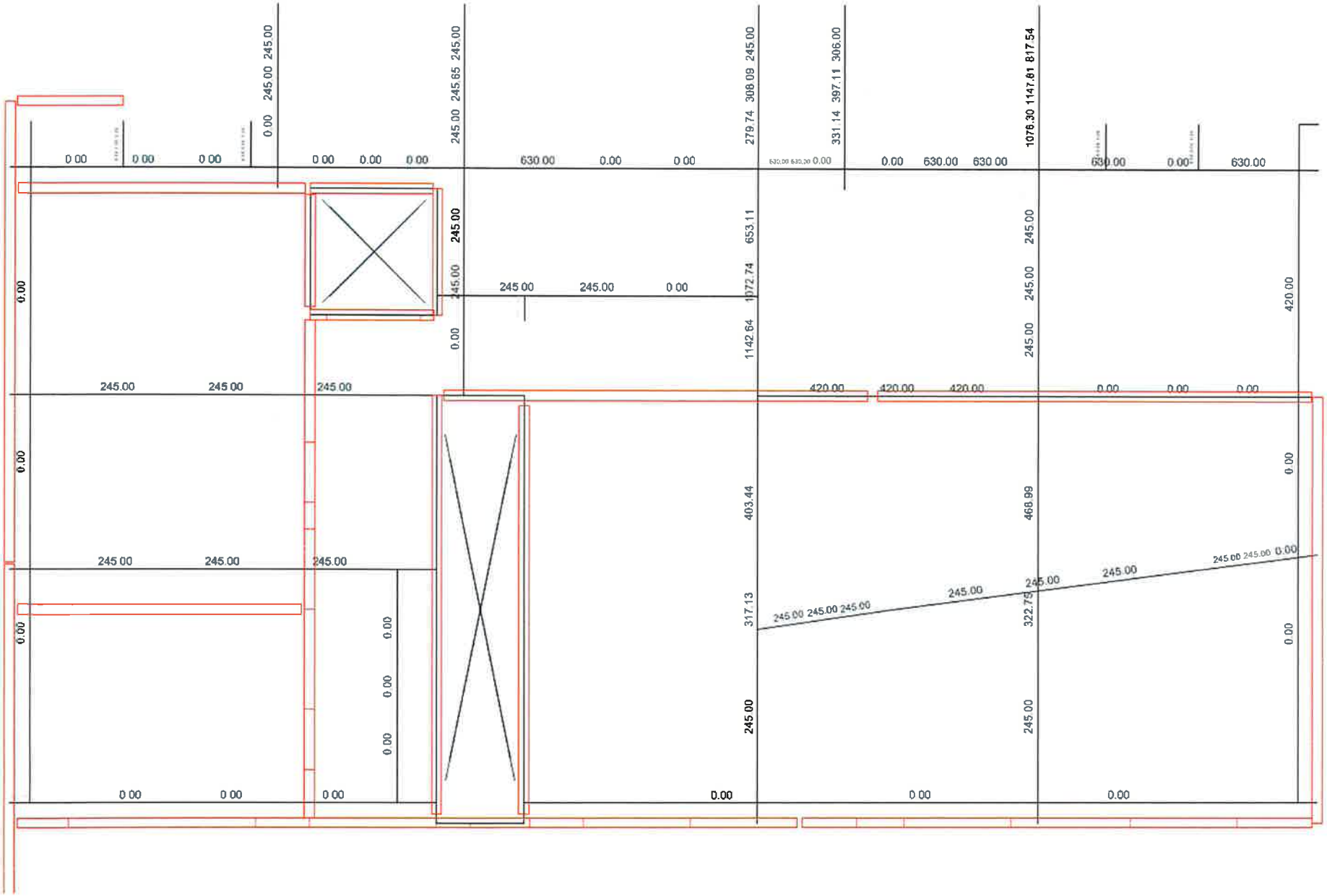
ETABS MODEL – LEVEL 1 CONCRETE BEAM FLEXURAL STEEL REQUIREMENT (mm^2)



ETABS MODEL – LEVEL 1 CONCRETE BEAM FLEXURAL STEEL REQUIREMENT (mm^2)



ETABS MODEL – LEVEL 1 CONCRETE BEAM TRANSVERSE STEEL REQUIREMENT (mm^2)



ETABS MODEL – LEVEL 1 CONCRETE BEAM TRANSVERSE STEEL REQUIREMENT (mm^2)

ETABS TABLE: Ground Floor Concrete Column PMM Envelope

Label	Story	Section	Location	P	M Major	M Minor	PMM Combo	PMM Ratio or Rebar %
				kN	kN-m	kN-m		
C73	Story1	RC COL 300x600 C40	Top	630.3849	48.1128	6.4279	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C73	Story1	RC COL 300x600 C40	Bottom	649.6831	-33.0681	-3.2067	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C33	Story1	RC COL 300x600 C40	Top	353.5138	18.3473	-22.2167	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C33	Story1	RC COL 300x600 C40	Bottom	376.4171	-11.2925	11.5383	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C60	Story1	RC COL 300x600 C40	Top	647.1233	38.9375	-33.7622	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C60	Story1	RC COL 300x600 C40	Bottom	666.8033	-26.4497	22.513	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C62	Story1	RC COL 300x600 C40	Top	542.4515	-58.7101	-23.4366	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C62	Story1	RC COL 300x600 C40	Bottom	565.3548	26.1908	13.9223	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C76	Story1	RC COL 300x600 C40	Top	193.9637	-5.8189	-20.0544	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C76	Story1	RC COL 300x600 C40	Bottom	216.867	-6.506	12.1874	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C77	Story1	RC COL 300x600 C40	Top	579.9732	27.7629	6.0781	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C77	Story1	RC COL 300x600 C40	Bottom	602.8765	-18.0863	-1.8885	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C78	Story1	RC COL 300x600 C40	Top	2031.799	105.8172	30.477	Ult 02 (1.2G+1.5Q)	4.40%
C78	Story1	RC COL 300x600 C40	Bottom	2059.283	-51.4838	-30.8892	Ult 02 (1.2G+1.5Q)	4.40%
C79	Story1	RC COL 300x600 C40	Top	1716.9059	-130.1341	-38.6095	Ult 02 (1.2G+1.5Q)	1.83%
C79	Story1	RC COL 300x600 C40	Bottom	1740.8272	79.5473	26.1124	Ult 02 (1.2G+1.5Q)	1.83%
C80	Story1	RC COL 300x600 C40	Top	414.3375	-14.8165	-7.8769	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C80	Story1	RC COL 300x600 C40	Bottom	437.2408	13.1172	6.6421	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C81	Story1	RC COL 300x600 C40	Top	192.212	-5.7664	4.7526	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C81	Story1	RC COL 300x600 C40	Bottom	211.5102	-6.3453	-2.0981	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C82	Story1	RC COL 300x600 C40	Top	613.0303	-25.6195	20.471	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C82	Story1	RC COL 300x600 C40	Bottom	632.9647	18.9889	-10.9439	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C83	Story1	RC COL 300x600 C40	Top	196.0587	-5.8818	4.4153	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%
C83	Story1	RC COL 300x600 C40	Bottom	218.962	-6.5689	-0.2686	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1%

TR10

ETABS TABLE: Level 1 Concrete Beam Flexure Envelope

Label	Story	Section	Location	(-) Moment	(-) Combo	As Top	(+) Moment	(+) Combo	As Bot
				kN-m		mm²	kN-m		mm²
B19	Story1	RC BEAM 400X850 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	509.9449	Ult 02 (1.2G+1.5Q)	1677
B19	Story1	RC BEAM 400X850 C32	Middle	-767.8221	Ult 02 (1.2G+1.5Q)	2647	520.6847	Ult 02 (1.2G+1.5Q)	1784
B19	Story1	RC BEAM 400X850 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	484.4435	Ult 02 (1.2G+1.5Q)	1615
B23	Story1	RC BEAM 400X850 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	370.761	Ult 02 (1.2G+1.5Q)	1215
B23	Story1	RC BEAM 400X850 C32	Middle	-952.3108	Ult 02 (1.2G+1.5Q)	3329	447.9567	Ult 02 (1.2G+1.5Q)	1480
B23	Story1	RC BEAM 400X850 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	631.8028	Ult 02 (1.2G+1.5Q)	2133
B37	Story1	LINK	End-I	-25.9511	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B37	Story1	LINK	Middle	-12.1966	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B37	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0.5189	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B48	Story1	RC BEAM 500X850 C32	End-I	-230.1286	Ult 02 (1.2G+1.5Q)	738	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	621
B48	Story1	RC BEAM 500X850 C32	Middle	-687.6743	Ult 02 (1.2G+1.5Q)	2293	1214.5658	Ult 02 (1.2G+1.5Q)	4261
B48	Story1	RC BEAM 500X850 C32	End-J	-1114.8095	Ult 02 (1.2G+1.5Q)	3864	312.1862	Ult 02 (1.2G+1.5Q)	1019
B54	Story1	RC BEAM 400x760 C32	End-I	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	448	33.6218	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448
B54	Story1	RC BEAM 400x760 C32	Middle	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	448	63.7912	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448
B54	Story1	RC BEAM 400x760 C32	End-J	-2.0377	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	1.02	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	448
B55	Story1	RC BEAM 400x760 C32	End-I	0	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	448	53.34	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448
B55	Story1	RC BEAM 400x760 C32	Middle	0	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	448	10.5231	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448
B55	Story1	RC BEAM 400x760 C32	End-J	-48.0496	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	0	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	448
B58	Story1	RC BEAM 350X600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	121.4671	Ult 02 (1.2G+1.5Q)	591
B58	Story1	RC BEAM 350X600 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	41.5643	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B58	Story1	RC BEAM 350X600 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	120.5011	Ult 02 (1.2G+1.5Q)	579
B59	Story1	RC BEAM 350X600 C32	End-I	-11.8096	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B59	Story1	RC BEAM 350X600 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	70.4594	Ult 02 (1.2G+1.5Q)	343
B59	Story1	RC BEAM 350X600 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	121.0477	Ult 02 (1.2G+1.5Q)	588
B60	Story1	RC BEAM 350X600 C32	End-I	0	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	317	123.3253	Ult 02 (1.2G+1.5Q)	589
B60	Story1	RC BEAM 350X600 C32	Middle	-27.4899	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	317
B60	Story1	RC BEAM 350X600 C32	End-J	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	317	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	317
B62	Story1	RC BEAM 350X600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	71.8	Ult 02 (1.2G+1.5Q)	341
B62	Story1	RC BEAM 350X600 C32	Middle	-40.8868	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	109.5255	Ult 02 (1.2G+1.5Q)	528
B62	Story1	RC BEAM 350X600 C32	End-J	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	317	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	317
B78	Story1	RC BEAM 600X500 C32	End-I	-16.1418	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B78	Story1	RC BEAM 600X500 C32	Middle	-9.2195	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B78	Story1	RC BEAM 600X500 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	31.7231	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B79	Story1	RC BEAM 600X500 C32	End-I	-9.0459	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B79	Story1	RC BEAM 600X500 C32	Middle	-12.3374	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B79	Story1	RC BEAM 600X500 C32	End-J	-4.1107	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	5.111	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	463
B46	Story1	LINK	End-I	-3.7013	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B46	Story1	LINK	Middle	0			0		
B46	Story1	LINK	End-J	-10.5442	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B49	Story1	LINK	End-I	-2.8463	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B49	Story1	LINK	Middle	0			0		
B49	Story1	LINK	End-J	-15.6605	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543

R-11

B56	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0.0316	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B56	Story1	LINK	Middle	0			0		
B56	Story1	LINK	End-J	-11.4904	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B63	Story1	LINK	End-I	-5.9578	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B63	Story1	LINK	Middle	0			0		
B63	Story1	LINK	End-J	-2.12	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B64	Story1	LINK	End-I	-15.6178	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B64	Story1	LINK	Middle	0			0		
B64	Story1	LINK	End-J	-1.2763	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B65	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	3.3213	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B65	Story1	LINK	Middle	0			0		
B65	Story1	LINK	End-J	-18.3697	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B67	Story1	LINK	End-I	-19.9677	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B67	Story1	LINK	Middle	-9.0452	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B67	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0.8382	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B87	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	12.6284	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B87	Story1	LINK	Middle	0			0		
B87	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0.1122	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B90	Story1	RC BEAM 400X850 C32	End-I	-286.5588	Ult 02 (1.2G+1.5Q)	932	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B90	Story1	RC BEAM 400X850 C32	Middle	-188.5511	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	607	273.8397	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	889
B90	Story1	RC BEAM 400X850 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	238.4512	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	768
B94	Story1	RC BEAM 400X850 C32	End-I	-421.9106	Ult 02 (1.2G+1.5Q)	1385	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B94	Story1	RC BEAM 400X850 C32	Middle	-331.7089	Ult 02 (1.2G+1.5Q)	1080	261.8791	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	844
B94	Story1	RC BEAM 400X850 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	228.9207	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	740
B97	Story1	RC BEAM 350X700 C32	End-I	-622.2978	Ult 02 (1.2G+1.5Q)	2742	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B97	Story1	RC BEAM 350X700 C32	Middle	-470.1877	Ult 02 (1.2G+1.5Q)	2004	282.0923	Ult 02 (1.2G+1.5Q)	1159
B97	Story1	RC BEAM 350X700 C32	End-J	-114.7912	Ult 02 (1.2G+1.5Q)	457	205.6471	Ult 02 (1.2G+1.5Q)	833
B50	Story1	RC BEAM 350X700 C32	End-I	-334.4806	Ult 02 (1.2G+1.5Q)	1389	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B50	Story1	RC BEAM 350X700 C32	Middle	-237.32	Ult 02 (1.2G+1.5Q)	969	235.2186	Ult 02 (1.2G+1.5Q)	958
B50	Story1	RC BEAM 350X700 C32	End-J	-39.947	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	171.9598	Ult 02 (1.2G+1.5Q)	693
B80	Story1	RC BEAM 600X500 C32	End-I	-1.4942	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B80	Story1	RC BEAM 600X500 C32	Middle	0			0		
B80	Story1	RC BEAM 600X500 C32	End-J	-0.8758	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B88	Story1	RC BEAM 600X500 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	10.8953	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B88	Story1	RC BEAM 600X500 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	1.4334	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B88	Story1	RC BEAM 600X500 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B91	Story1	RC BEAM 600X500 C32	End-I	-4.2946	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B91	Story1	RC BEAM 600X500 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	1.4937	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B91	Story1	RC BEAM 600X500 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	2.1104	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B113	Story1	RC BEAM 600X500 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	2.4888	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B113	Story1	RC BEAM 600X500 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	4.1991	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B113	Story1	RC BEAM 600X500 C32	End-J	-95.6471	Ult 02 (1.2G+1.5Q)	515	12.3165	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B161	Story1	RC BEAM 600X500 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	2.1884	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B161	Story1	RC BEAM 600X500 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	6.3592	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463
B161	Story1	RC BEAM 600X500 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	463

PR12

B11	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0.034	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B11	Story1	LINK	Middle	0			0		
B11	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	6.6705	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B51	Story1	LINK	End-I	-4.6949	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B51	Story1	LINK	Middle	-1.3044	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B51	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	1.047	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B66	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	1.8817	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B66	Story1	LINK	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	1.8622	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B66	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0.4002	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B69	Story1	RC BEAM 350X600 C32	End-I	0	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	317	9.2228	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B69	Story1	RC BEAM 350X600 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	12.1748	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B69	Story1	RC BEAM 350X600 C32	End-J	-0.2349	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B72	Story1	RC BEAM 350X600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	124.9107	Ult 02 (1.2G+1.5Q)	585
B72	Story1	RC BEAM 350X600 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	246.6778	Ult 02 (1.2G+1.5Q)	1204
B72	Story1	RC BEAM 350X600 C32	End-J	-253.6759	Ult 02 (1.2G+1.5Q)	1234	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B73	Story1	RC BEAM 350X600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	137.4485	Ult 02 (1.2G+1.5Q)	651
B73	Story1	RC BEAM 350X600 C32	Middle	-1.0008	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	197.3978	Ult 02 (1.2G+1.5Q)	950
B73	Story1	RC BEAM 350X600 C32	End-J	-319.8428	Ult 02 (1.2G+1.5Q)	1577	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B102	Story1	RC BEAM 350X600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	1.1076	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B102	Story1	RC BEAM 350X600 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	2.2155	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B102	Story1	RC BEAM 350X600 C32	End-J	-4.5089	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B30	Story1	RC BEAM 400x500 C32	End-I	-73.8607	Ult 02 (1.2G+1.5Q)	419	0	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	309
B30	Story1	RC BEAM 400x500 C32	Middle	-96.5138	Ult 02 (1.2G+1.5Q)	554	79.7303	Ult 02 (1.2G+1.5Q)	453
B30	Story1	RC BEAM 400x500 C32	End-J	-0.1996	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	309
B31	Story1	RC BEAM 400x500 C32	End-I	-59.241	Ult 02 (1.2G+1.5Q)	338	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	309
B31	Story1	RC BEAM 400x500 C32	Middle	-5.1369	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B31	Story1	RC BEAM 400x500 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0.0102	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B34	Story1	RC BEAM 400x500 C32	End-I	-11.0996	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B34	Story1	RC BEAM 400x500 C32	Middle	-8.1909	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B34	Story1	RC BEAM 400x500 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0.0026	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B35	Story1	LINK	End-I	-12.6142	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B35	Story1	LINK	Middle	0			0		
B35	Story1	LINK	End-J	-1.3556	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B52	Story1	LINK	End-I	-10.0743	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B52	Story1	LINK	Middle	0			0		
B52	Story1	LINK	End-J	-1.5378	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B53	Story1	RC BEAM 400x760 C32	End-I	-36.0665	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	448
B53	Story1	RC BEAM 400x760 C32	Middle	-26.1891	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	131.5778	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	476
B53	Story1	RC BEAM 400x760 C32	End-J	-244.0726	Ult 02 (1.2G+1.5Q)	899	0	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	448
B71	Story1	RC BEAM 400x760 C32	End-I	-281.3028	Ult 02 (1.2G+1.5Q)	1026	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	448
B71	Story1	RC BEAM 400x760 C32	Middle	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	448	287.3892	Ult 02 (1.2G+1.5Q)	1050
B71	Story1	RC BEAM 400x760 C32	End-J	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	448	426.3197	Ult 02 (1.2G+1.5Q)	1595
B93	Story1	RC BEAM 400x760 C32	End-I	-16.6791	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	443.6166	Ult 02 (1.2G+1.5Q)	1664
B93	Story1	RC BEAM 400x760 C32	Middle	-525.3156	Ult 02 (1.2G+1.5Q)	1992	108.7393	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	464
B93	Story1	RC BEAM 400x760 C32	End-J	-2.5527	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448

B98	Story1	RC BEAM 400x500 C32	End-I	-240.941	Ult 02 (1.2G+1.5Q)	1488	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B98	Story1	RC BEAM 400x500 C32	Middle	-130.2238	Ult 02 (1.2G+1.5Q)	775	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B98	Story1	RC BEAM 400x500 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0.0583	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B100	Story1	RC BEAM 400x500 C32	End-I	-161.3992	Ult 02 (1.2G+1.5Q)	968	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B100	Story1	RC BEAM 400x500 C32	Middle	-88.3677	Ult 02 (1.2G+1.5Q)	518	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B100	Story1	RC BEAM 400x500 C32	End-J	-0.0229	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	309
B101	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	0.8038	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B101	Story1	LINK	Middle	0			0		
B101	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	7.7701	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B103	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	9.767	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B103	Story1	LINK	Middle	0			0		
B103	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	1.8165	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B3	Story1	LINK	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	5.9137	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B3	Story1	LINK	Middle	0			0		
B3	Story1	LINK	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543	2.6212	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	543
B4	Story1	RC BEAM 350X600 C32	End-I	0	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	317	43.2031	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B4	Story1	RC BEAM 350X600 C32	Middle	-30.5257	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	80.048	Ult 02 (1.2G+1.5Q)	370
B4	Story1	RC BEAM 350X600 C32	End-J	0	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	317	0	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	317
B108	Story1	RC BEAM 350X700 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	264.4553	Ult 02 (1.2G+1.5Q)	1071
B108	Story1	RC BEAM 350X700 C32	Middle	-49.8521	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	101.315	Ult 02 (1.2G+1.5Q)	396
B108	Story1	RC BEAM 350X700 C32	End-J	-312.0274	Ult 02 (1.2G+1.5Q)	1282	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B75	Story1	RC BEAM 400X850 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	42.912	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B75	Story1	RC BEAM 400X850 C32	Middle	-57.482	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B75	Story1	RC BEAM 400X850 C32	End-J	-175.5353	Ult 02 (1.2G+1.5Q)	604	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B109	Story1	RC BEAM 400X850 C32	End-I	-33.2169	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B109	Story1	RC BEAM 400X850 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0.251	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B109	Story1	RC BEAM 400X850 C32	End-J	-88.6811	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B70	Story1	RC BEAM 400x760 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	485.4425	Ult 02 (1.2G+1.5Q)	1850
B70	Story1	RC BEAM 400x760 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	307.1583	Ult 02 (1.2G+1.5Q)	1145
B70	Story1	RC BEAM 400x760 C32	End-J	-198.3411	Ult 02 (1.2G+1.5Q)	729	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448
B81	Story1	RC BEAM 400x760 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	633.1388	Ult 02 (1.2G+1.5Q)	2459
B81	Story1	RC BEAM 400x760 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448	362.4952	Ult 02 (1.2G+1.5Q)	1354
B81	Story1	RC BEAM 400x760 C32	End-J	-292.3957	Ult 02 (1.2G+1.5Q)	1077	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	448
B83	Story1	RC BEAM 350X550 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293
B83	Story1	RC BEAM 350X550 C32	Middle	0			0		
B83	Story1	RC BEAM 350X550 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293	11.1325	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293
B92	Story1	RC BEAM 350X550 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293	20.105	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293
B92	Story1	RC BEAM 350X550 C32	Middle	-23.9669	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293
B92	Story1	RC BEAM 350X550 C32	End-J	-69.1374	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	491	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	293
B95	Story1	RC BEAM 350X600 C32	End-I	-70.3202	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	439	16.7226	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B95	Story1	RC BEAM 350X600 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	124.8039	Ult 02 (1.2G+1.5Q)	592
B95	Story1	RC BEAM 350X600 C32	End-J	-115.673	Ult 02 (1.2G+1.5Q)	551	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B99	Story1	RC BEAM 900x600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	17.9792	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B99	Story1	RC BEAM 900x600 C32	Middle	-4.695	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	8.5583	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	815
B99	Story1	RC BEAM 900x600 C32	End-J	-33.0957	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	815

B111	Story1	RC BEAM 900x600 C32	End-I	-43.62	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	815
B111	Story1	RC BEAM 900x600 C32	Middle	-74.8982	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	815
B111	Story1	RC BEAM 900x600 C32	End-J	-46.7477	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	815
B112	Story1	RC BEAM 900x600 C32	End-I	0	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	815	72.5541	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B112	Story1	RC BEAM 900x600 C32	Middle	-12.2103	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B112	Story1	RC BEAM 900x600 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	35.9672	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B115	Story1	RC BEAM 900x600 C32	End-I	-10.2924	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B115	Story1	RC BEAM 900x600 C32	Middle	-34.1545	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B115	Story1	RC BEAM 900x600 C32	End-J	-6.6099	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B116	Story1	RC BEAM 350X700 C32	End-I	-361.229	Ult 02 (1.2G+1.5Q)	1462	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B116	Story1	RC BEAM 350X700 C32	Middle	-4.9793	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	232.1391	Ult 02 (1.2G+1.5Q)	926
B116	Story1	RC BEAM 350X700 C32	End-J	-332.982	Ult 02 (1.2G+1.5Q)	1447	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B117	Story1	RC BEAM 350X600 C32	End-I	-230.0049	Ult 02 (1.2G+1.5Q)	1172	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B117	Story1	RC BEAM 350X600 C32	Middle	-109.6603	Ult 02 (1.2G+1.5Q)	569	13.9755	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B117	Story1	RC BEAM 350X600 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	71.5931	Ult 02 (1.2G+1.5Q)	361
B118	Story1	RC BEAM 350X700 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	7.0707	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B118	Story1	RC BEAM 350X700 C32	Middle	-2.1141	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B118	Story1	RC BEAM 350X700 C32	End-J	-13.2684	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B122	Story1	RC BEAM 350X600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	65.5322	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	374
B122	Story1	RC BEAM 350X600 C32	Middle	-73.832	Ult 02 (1.2G+1.5Q)	354	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B122	Story1	RC BEAM 350X600 C32	End-J	-159.3421	Ult 02 (1.2G+1.5Q)	773	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B123	Story1	RC BEAM 400X850 C32	End-I	-2.9933	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B123	Story1	RC BEAM 400X850 C32	Middle	0			0		
B123	Story1	RC BEAM 400X850 C32	End-J	-11.5511	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B125	Story1	RC BEAM 400X850 C32	End-I	-72.5045	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	497
B125	Story1	RC BEAM 400X850 C32	Middle	-174.9543	Ult 02 (1.2G+1.5Q)	567	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B125	Story1	RC BEAM 400X850 C32	End-J	-269.3768	Ult 02 (1.2G+1.5Q)	868	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B126	Story1	RC BEAM 400X850 C32	End-I	-350.213	Ult 02 (1.2G+1.5Q)	1120	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B126	Story1	RC BEAM 400X850 C32	Middle	-24.2711	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	74.3483	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B126	Story1	RC BEAM 400X850 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	231.0013	Ult 02 (1.2G+1.5Q)	726
B128	Story1	RC BEAM 400X850 C32	End-I	0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	497	215.6907	Ult 02 (1.2G+1.5Q)	679
B128	Story1	RC BEAM 400X850 C32	Middle	0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	497	286.1766	Ult 02 (1.2G+1.5Q)	914
B128	Story1	RC BEAM 400X850 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	392.3203	Ult 02 (1.2G+1.5Q)	1277
B129	Story1	RC BEAM 350X700 C32	End-I	-183.4925	Ult 02 (1.2G+1.5Q)	716	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B129	Story1	RC BEAM 350X700 C32	Middle	-182.9675	Ult 02 (1.2G+1.5Q)	710	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B129	Story1	RC BEAM 350X700 C32	End-J	-295.5562	Ult 02 (1.2G+1.5Q)	1186	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364
B131	Story1	RC BEAM 400X850 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	324.6382	Ult 02 (1.2G+1.5Q)	1049
B131	Story1	RC BEAM 400X850 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	189.8388	Ult 02 (1.2G+1.5Q)	600
B131	Story1	RC BEAM 400X850 C32	End-J	-45.4903	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B135	Story1	RC BEAM 400X850 C32	End-I	-67.3236	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B135	Story1	RC BEAM 400X850 C32	Middle	-33.253	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B135	Story1	RC BEAM 400X850 C32	End-J	-1.1852	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B136	Story1	RC BEAM 400X850 C32	End-I	-0.426	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497
B136	Story1	RC BEAM 400X850 C32	Middle	0			0		
B136	Story1	RC BEAM 400X850 C32	End-J	-5.8506	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	497

B138	Story1	RC BEAM 350X600 C32	End-I	-219.7416	Ult 02 (1.2G+1.5Q)	1077	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B138	Story1	RC BEAM 350X600 C32	Middle	-90.9312	Ult 02 (1.2G+1.5Q)	436	99.5995	Ult 02 (1.2G+1.5Q)	479
B138	Story1	RC BEAM 350X600 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	233.2229	Ult 02 (1.2G+1.5Q)	1150
B139	Story1	RC BEAM 900x600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	39.0517	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B139	Story1	RC BEAM 900x600 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	86.9834	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B139	Story1	RC BEAM 900x600 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	257.0684	Ult 02 (1.2G+1.5Q)	1274
B140	Story1	RC BEAM 900x600 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	274.9028	Ult 02 (1.2G+1.5Q)	1351
B140	Story1	RC BEAM 900x600 C32	Middle	-18.1439	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815	229.891	Ult 02 (1.2G+1.5Q)	1133
B140	Story1	RC BEAM 900x600 C32	End-J	-202.5045	Ult 02 (1.2G+1.5Q)	966	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	815
B141	Story1	RC BEAM 350X600 C32	End-I	-394.5151	Ult 02 (1.2G+1.5Q)	1993	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317
B141	Story1	RC BEAM 350X600 C32	Middle	-95.9095	Ult 02 (1.2G+1.5Q)	426	178.4765	Ult 02 (1.2G+1.5Q)	829
B141	Story1	RC BEAM 350X600 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	317	426.9255	Ult 02 (1.2G+1.5Q)	2187
B142	Story1	RC BEAM 350X700 C32	End-I	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	417.7663	Ult 02 (1.2G+1.5Q)	1734
B142	Story1	RC BEAM 350X700 C32	Middle	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	386.0702	Ult 02 (1.2G+1.5Q)	1597
B142	Story1	RC BEAM 350X700 C32	End-J	0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	364	278.2315	Ult 02 (1.2G+1.5Q)	1124

TR16

ETABS TABLE: Level 1 Concrete Beam Shear Envelope

Label	Story	Section	Location	V	V Combo	At	T for At	T Combo At	At Torsion	T for As	T Combo As	As Torsion
				kN		mm²/m	kN-m		mm²/m	kN-m		mm²
B19	Story1	RC BEAM 400X850 C32	End-I	7.8852	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	43.4255	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	43.4255	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B19	Story1	RC BEAM 400X850 C32	Middle	560.1192	Ult 02 (1.2G+1.5Q)	1157.85	8.4156	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	280	8.4156	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	949
B19	Story1	RC BEAM 400X850 C32	End-J	41.2448	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.4156	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	280	8.4156	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	949
B23	Story1	RC BEAM 400X850 C32	End-I	296.7585	Ult 02 (1.2G+1.5Q)	448.52	29.1664	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	29.1664	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B23	Story1	RC BEAM 400X850 C32	Middle	805.4757	Ult 02 (1.2G+1.5Q)	1973.79	9.7523	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	280	9.7523	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	949
B23	Story1	RC BEAM 400X850 C32	End-J	40.7994	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	22.4223	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	22.4223	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B37	Story1	LINK	End-I	40.7676	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	11.4791	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	11.4791	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B37	Story1	LINK	Middle	37.7987	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	11.4791	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	11.4791	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B37	Story1	LINK	End-J	34.8297	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	11.4791	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	11.4791	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B48	Story1	RC BEAM 500X850 C32	End-I	404.7951	Ult 02 (1.2G+1.5Q)	642.58	45.4702	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	350	45.4702	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1292
B48	Story1	RC BEAM 500X850 C32	Middle	749.0732	Ult 02 (1.2G+1.5Q)	1596.88	98.7093	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	350	98.7093	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1292
B48	Story1	RC BEAM 500X850 C32	End-J	782.6637	Ult 02 (1.2G+1.5Q)	1485.68	26.676	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	350	26.676	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1292
B54	Story1	RC BEAM 400x760 C32	End-I	31.4306	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	2.7101	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.7101	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B54	Story1	RC BEAM 400x760 C32	Middle	32.9229	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	0.3618	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.3618	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B54	Story1	RC BEAM 400x760 C32	End-J	47.6228	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	0.1797	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1797	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B55	Story1	RC BEAM 400x760 C32	End-I	25.8132	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	0.8826	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8826	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B55	Story1	RC BEAM 400x760 C32	Middle	38.0744	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	2.7565	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.7565	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B55	Story1	RC BEAM 400x760 C32	End-J	35.9225	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	2.6371	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.6371	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B58	Story1	RC BEAM 350X600 C32	End-I	41.5401	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	3.0694	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.0694	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B58	Story1	RC BEAM 350X600 C32	Middle	37.8868	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	6.1647	Ult 02 (1.2G+1.5Q)	245	6.1647	Ult 02 (1.2G+1.5Q)	610
B58	Story1	RC BEAM 350X600 C32	End-J	41.45	Ult 02 (1.2G+1.5Q)	245	7.288	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	245	7.288	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	610
B59	Story1	RC BEAM 350X600 C32	End-I	52.8132	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	0.1808	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1808	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B59	Story1	RC BEAM 350X600 C32	Middle	48.8545	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	0.2205	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2205	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B59	Story1	RC BEAM 350X600 C32	End-J	45.3524	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	0.2205	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2205	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B60	Story1	RC BEAM 350X600 C32	End-I	71.7357	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	6.8189	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	245	6.8189	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	610
B60	Story1	RC BEAM 350X600 C32	Middle	75.6613	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	7.5625	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	7.5625	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B60	Story1	RC BEAM 350X600 C32	End-J	9.2133	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	7.5625	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	7.5625	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B62	Story1	RC BEAM 350X600 C32	End-I	62.5946	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	0.7624	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.7624	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B62	Story1	RC BEAM 350X600 C32	Middle	31.4433	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	1.6349	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.6349	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B62	Story1	RC BEAM 350X600 C32	End-J	29.807	Ult 02 (1.2G+1.5Q)	245	3.0727	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.0727	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B78	Story1	RC BEAM 600X500 C32	End-I	91.2678	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	24.0193	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	24.0193	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B78	Story1	RC BEAM 600X500 C32	Middle	90.5184	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	420	24.1272	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	420	24.1272	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	1235
B78	Story1	RC BEAM 600X500 C32	End-J	93.705	Ult 02 (1.2G+1.5Q)	420	16.1537	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	16.1537	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B79	Story1	RC BEAM 600X500 C32	End-I	3.8659	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	11.7088	Ult 02 (1.2G+1.5Q)	420	11.7088	Ult 02 (1.2G+1.5Q)	1235
B79	Story1	RC BEAM 600X500 C32	Middle	10.3068	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	16.5133	Ult 02 (1.2G+1.5Q)	420	16.5133	Ult 02 (1.2G+1.5Q)	1235
B79	Story1	RC BEAM 600X500 C32	End-J	13.6587	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	17.6605	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	17.6605	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B46	Story1	LINK	End-I	38.36	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2815	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2815	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B46	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B46	Story1	LINK	End-J	39.8445	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2815	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2815	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B49	Story1	LINK	End-I	50.7277	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0634	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0634	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B49	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B49	Story1	LINK	End-J	52.8271	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0634	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0634	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B56	Story1	LINK	End-I	101.4307	Ult 02 (1.2G+1.5Q)	420	4.4387	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.4387	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B56	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B56	Story1	LINK	End-J	103.212	Ult 02 (1.2G+1.5Q)	420	4.4387	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.4387	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B63	Story1	LINK	End-I	22.7869	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.9706	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.9706	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B63	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B63	Story1	LINK	End-J	21.3025	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.9706	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.9706	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B64	Story1	LINK	End-I	101.6564	Ult 46 (G+0.5EQX-0.5EQY+0.3Q)	420	2.5222	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.5222	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B64	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B64	Story1	LINK	End-J	116.9456	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	420	2.5222	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.5222	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B65	Story1	LINK	End-I	118.4406	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	0.8787	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8787	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B65	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B65	Story1	LINK	End-J	119.9251	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	0.8787	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8787	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B67	Story1	LINK	End-I	32.6912	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.4332	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.4332	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B67	Story1	LINK	Middle	29.7222	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.4332	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.4332	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B67	Story1	LINK	End-J	26.7533	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.4332	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.4332	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B87	Story1	LINK	End-I	40.5759	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.247	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.247	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0

TR17

B87	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B87	Story1	LINK	End-J	43.1207	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.247	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.247	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B90	Story1	RC BEAM 400X850 C32	End-I	261.4771	Ult 02 (1.2G+1.5Q)	324.34	23.4898	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	23.4898	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B90	Story1	RC BEAM 400X850 C32	Middle	251.3888	Ult 02 (1.2G+1.5Q)	342.33	25.7116	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	25.7116	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B90	Story1	RC BEAM 400X850 C32	End-J	73.8334	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	38.7463	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	38.7463	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B94	Story1	RC BEAM 400X850 C32	End-I	162.5519	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	35.2604	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	35.2604	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B94	Story1	RC BEAM 400X850 C32	Middle	235.2276	Ult 02 (1.2G+1.5Q)	305.59	27.5301	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	27.5301	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B94	Story1	RC BEAM 400X850 C32	End-J	58.4894	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	41.5452	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	41.5452	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B97	Story1	RC BEAM 350X700 C32	End-I	508.074	Ult 02 (1.2G+1.5Q)	1216.56	33.9801	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	33.9801	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B97	Story1	RC BEAM 350X700 C32	Middle	486.2705	Ult 02 (1.2G+1.5Q)	1359.36	19.2047	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	19.2047	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B97	Story1	RC BEAM 350X700 C32	End-J	105.3283	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	33.7862	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	33.7862	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B50	Story1	RC BEAM 350X700 C32	End-I	324.9099	Ult 02 (1.2G+1.5Q)	635.9	17.9383	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	17.9383	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B50	Story1	RC BEAM 350X700 C32	Middle	320.7534	Ult 02 (1.2G+1.5Q)	706.36	12.7435	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.7435	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B50	Story1	RC BEAM 350X700 C32	End-J	76.629	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	18.1262	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	18.1262	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B80	Story1	RC BEAM 600X500 C32	End-I	3.4239	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2543	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2543	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B80	Story1	RC BEAM 600X500 C32	Middle	0		-1000	0		-1000	0		-1
B80	Story1	RC BEAM 600X500 C32	End-J	1.3032	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2543	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2543	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B88	Story1	RC BEAM 600X500 C32	End-I	3.5559	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.138	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.138	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B88	Story1	RC BEAM 600X500 C32	Middle	4.1108	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.144	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.144	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B88	Story1	RC BEAM 600X500 C32	End-J	7.1193	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.255	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.255	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B91	Story1	RC BEAM 600X500 C32	End-I	21.0391	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	7.9807	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	7.9807	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B91	Story1	RC BEAM 600X500 C32	Middle	5.9929	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	19.0672	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	19.0672	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B91	Story1	RC BEAM 600X500 C32	End-J	16.1744	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	14.9384	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	14.9384	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B113	Story1	RC BEAM 600X500 C32	End-I	17.7524	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.4982	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	420	12.4982	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	1235
B113	Story1	RC BEAM 600X500 C32	Middle	0.668	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	58.4568	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	58.4568	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B113	Story1	RC BEAM 600X500 C32	End-J	35.6559	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	15.6452	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	15.6452	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B161	Story1	RC BEAM 600X500 C32	End-I	10.922	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	7.5445	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	7.5445	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B161	Story1	RC BEAM 600X500 C32	Middle	9.8875	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	35.9166	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	35.9166	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B161	Story1	RC BEAM 600X500 C32	End-J	17.5963	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	19.4308	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	420	19.4308	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1235
B11	Story1	LINK	End-I	38.6649	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0257	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0257	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B11	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B11	Story1	LINK	End-J	37.1804	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0257	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0257	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B51	Story1	LINK	End-I	11.1717	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8211	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8211	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B51	Story1	LINK	Middle	8.2028	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8211	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8211	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B51	Story1	LINK	End-J	5.2338	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8211	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.8211	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B66	Story1	LINK	End-I	0.8519	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.2518	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.2518	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B66	Story1	LINK	Middle	2.8046	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.2518	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.2518	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B66	Story1	LINK	End-J	5.7736	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.2518	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.2518	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B69	Story1	RC BEAM 350X600 C32	End-I	30.0092	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	10.5461	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	10.5461	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	610
B69	Story1	RC BEAM 350X600 C32	Middle	33.7579	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	245	10.5461	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	10.5461	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	610
B69	Story1	RC BEAM 350X600 C32	End-J	12.2524	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.2407	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.2407	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B72	Story1	RC BEAM 350X600 C32	End-I	56.178	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	6.2355	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	245	6.2355	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	610
B72	Story1	RC BEAM 350X600 C32	Middle	170.821	Ult 02 (1.2G+1.5Q)	322.75	5.2034	Ult 02 (1.2G+1.5Q)	245	5.2034	Ult 02 (1.2G+1.5Q)	610
B72	Story1	RC BEAM 350X600 C32	End-J	204.3211	Ult 02 (1.2G+1.5Q)	468.99	3.0001	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.0001	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B73	Story1	RC BEAM 350X600 C32	End-I	38.401	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	13.2493	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	13.2493	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B73	Story1	RC BEAM 350X600 C32	Middle	160.0299	Ult 02 (1.2G+1.5Q)	317.13	12.0297	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.0297	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B73	Story1	RC BEAM 350X600 C32	End-J	200.8715	Ult 02 (1.2G+1.5Q)	403.44	12.5972	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.5972	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B102	Story1	RC BEAM 350X600 C32	End-I	3.371	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.2555	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.2555	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B102	Story1	RC BEAM 350X600 C32	Middle	1.876	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.5505	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.5505	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B102	Story1	RC BEAM 350X600 C32	End-J	11.8787	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2128	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2128	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B30	Story1	RC BEAM 400x500 C32	End-I	37.9878	Ult 02 (1.2G+1.5Q)	280	9.5973	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	280	9.5973	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	655
B30	Story1	RC BEAM 400x500 C32	Middle	39.0162	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	12.9898	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	12.9898	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B30	Story1	RC BEAM 400x500 C32	End-J	6.0111	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0327	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0327	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B31	Story1	RC BEAM 400x500 C32	End-I	37.764	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	25.8986	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	25.8986	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B31	Story1	RC BEAM 400x500 C32	Middle	30.7289	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	280	24.4681	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	24.4681	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B31	Story1	RC BEAM 400x500 C32	End-J	34.1183	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	280	24.4681	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	24.4681	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B34	Story1	RC BEAM 400x500 C32	End-I	7.1992	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.6641	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.6641	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B34	Story1	RC BEAM 400x500 C32	Middle	2.4773	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.1041	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.1041	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B34	Story1	RC BEAM 400x500 C32	End-J	3.0953	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1173	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1173	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B35	Story1	LINK	End-I	57.1406	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1868	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1868	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B35	Story1	LINK	Middle	0		-1000	0		-1000	0		-1

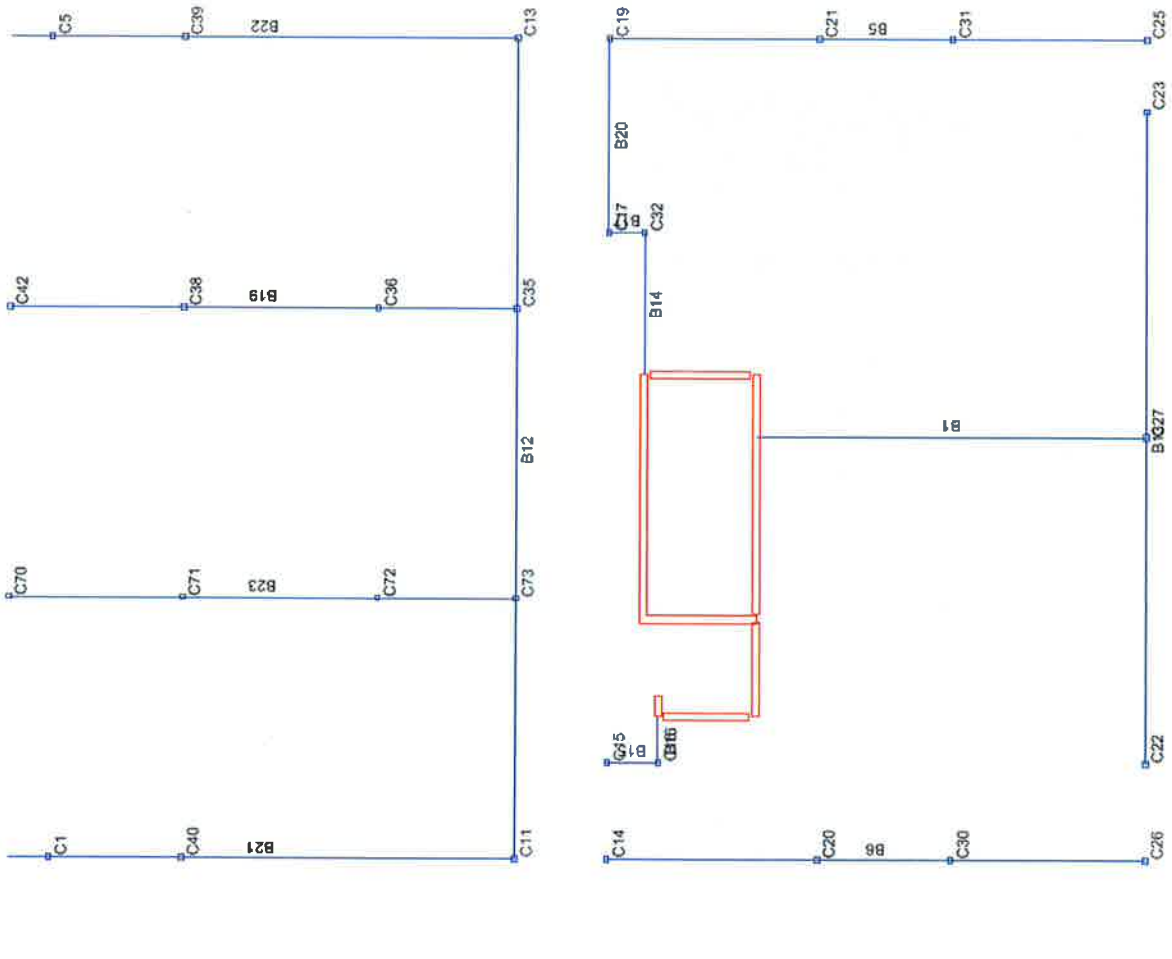
B35	Story1	LINK	End-J	55.4441	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1868	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1868	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B52	Story1	LINK	End-I	43.5301	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.0917	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.0917	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B52	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B52	Story1	LINK	End-J	41.8335	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.0917	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.0917	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B53	Story1	RC BEAM 400x760 C32	End-I	230.6457	Ult 02 (1.2G+1.5Q)	361.58	36.1016	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	36.1016	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B53	Story1	RC BEAM 400x760 C32	Middle	216.4294	Ult 02 (1.2G+1.5Q)	324.81	13.9802	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	13.9802	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B53	Story1	RC BEAM 400x760 C32	End-J	78.1256	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	13.72	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	13.72	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B71	Story1	RC BEAM 400x760 C32	End-I	113.2842	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	0.0218	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0218	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B71	Story1	RC BEAM 400x760 C32	Middle	62.0314	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	0.0387	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0387	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B71	Story1	RC BEAM 400x760 C32	End-J	45.2802	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	0.0417	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.0417	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B93	Story1	RC BEAM 400x760 C32	End-I	322.3108	Ult 02 (1.2G+1.5Q)	612.33	30.6402	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	30.6402	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B93	Story1	RC BEAM 400x760 C32	Middle	360.2081	Ult 02 (1.2G+1.5Q)	654.37	49.0119	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	49.0119	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B93	Story1	RC BEAM 400x760 C32	End-J	75.8731	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	30.2599	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	30.2599	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B98	Story1	RC BEAM 400x500 C32	End-I	247.3081	Ult 02 (1.2G+1.5Q)	585.31	7.8464	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	7.8464	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B98	Story1	RC BEAM 400x500 C32	Middle	244.7633	Ult 02 (1.2G+1.5Q)	663.99	7.9722	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	7.9722	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B98	Story1	RC BEAM 400x500 C32	End-J	208.245	Ult 02 (1.2G+1.5Q)	593.8	7.9722	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	7.9722	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B100	Story1	RC BEAM 400x500 C32	End-I	76.1789	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.1493	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.1493	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B100	Story1	RC BEAM 400x500 C32	Middle	62.9635	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.1101	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.1101	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B100	Story1	RC BEAM 400x500 C32	End-J	61.5497	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.1101	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.1101	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	655
B101	Story1	LINK	End-I	40.5502	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.7549	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.7549	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B101	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B101	Story1	LINK	End-J	39.0658	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.7549	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.7549	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B103	Story1	LINK	End-I	44.6898	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.2301	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.2301	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B103	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B103	Story1	LINK	End-J	46.1743	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.2301	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.2301	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B3	Story1	LINK	End-I	10.0243	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.3802	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.3802	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B3	Story1	LINK	Middle	0		-1000	0		-1000	0		-1
B3	Story1	LINK	End-J	12.5691	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.3802	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.3802	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B4	Story1	RC BEAM 350X600 C32	End-I	31.4225	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	1.1527	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.1527	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B4	Story1	RC BEAM 350X600 C32	Middle	37.3578	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	5.8531	Ult 02 (1.2G+1.5Q)	245	5.8531	Ult 02 (1.2G+1.5Q)	610
B4	Story1	RC BEAM 350X600 C32	End-J	62.2867	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	5.8483	Ult 02 (1.2G+1.5Q)	245	5.8483	Ult 02 (1.2G+1.5Q)	610
B108	Story1	RC BEAM 350X700 C32	End-I	228.5934	Ult 02 (1.2G+1.5Q)	394.97	10.3023	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	10.3023	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B108	Story1	RC BEAM 350X700 C32	Middle	276.526	Ult 02 (1.2G+1.5Q)	594.04	8.638	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	245	8.638	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	684
B108	Story1	RC BEAM 350X700 C32	End-J	279.4702	Ult 02 (1.2G+1.5Q)	545.89	4.5642	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.5642	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B75	Story1	RC BEAM 400X850 C32	End-I	10.0812	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	41.9833	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	41.9833	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B75	Story1	RC BEAM 400X850 C32	Middle	108.313	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	10.4771	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	280	10.4771	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	949
B75	Story1	RC BEAM 400X850 C32	End-J	4.2635	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	32.2622	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	32.2622	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B109	Story1	RC BEAM 400X850 C32	End-I	55.148	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	8.7078	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	8.7078	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B109	Story1	RC BEAM 400X850 C32	Middle	27.031	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	19.2662	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	19.2662	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B109	Story1	RC BEAM 400X850 C32	End-J	53.3612	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	4.4943	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	4.4943	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B70	Story1	RC BEAM 400x760 C32	End-I	134.2893	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	3.4365	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	3.4365	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B70	Story1	RC BEAM 400x760 C32	Middle	289.87	Ult 02 (1.2G+1.5Q)	520.85	5.4772	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	5.4772	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B70	Story1	RC BEAM 400x760 C32	End-J	293.8813	Ult 02 (1.2G+1.5Q)	532	5.4772	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	5.4772	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B81	Story1	RC BEAM 400x760 C32	End-I	289.9747	Ult 02 (1.2G+1.5Q)	387.8	12.0478	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	12.0478	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B81	Story1	RC BEAM 400x760 C32	Middle	411.7655	Ult 02 (1.2G+1.5Q)	880.54	12.0478	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	12.0478	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	874
B81	Story1	RC BEAM 400x760 C32	End-J	415.1322	Ult 02 (1.2G+1.5Q)	888.6	0.1526	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.1526	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B83	Story1	RC BEAM 350X550 C32	End-I	38.688	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	0.373	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.373	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B83	Story1	RC BEAM 350X550 C32	Middle	0		-1000	0		-1000	0		-1
B83	Story1	RC BEAM 350X550 C32	End-J	35.5272	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	0.373	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.373	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B92	Story1	RC BEAM 350X550 C32	End-I	1.3638	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.8408	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.8408	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B92	Story1	RC BEAM 350X550 C32	Middle	53.129	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	1.6907	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.6907	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B92	Story1	RC BEAM 350X550 C32	End-J	59.4505	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	1.6907	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.6907	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B95	Story1	RC BEAM 350X600 C32	End-I	51.2215	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	3.7143	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	245	3.7143	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	610
B95	Story1	RC BEAM 350X600 C32	Middle	48.5321	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	3.4961	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	3.4961	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	610
B95	Story1	RC BEAM 350X600 C32	End-J	66.3763	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	3.1754	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	3.1754	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	610
B99	Story1	RC BEAM 900x600 C32	End-I	6.0943	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.6671	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.6671	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B99	Story1	RC BEAM 900x600 C32	Middle	6.9996	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	6.4394	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	6.4394	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B99	Story1	RC BEAM 900x600 C32	End-J	24.8326	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	8.2819	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	8.2819	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B111	Story1	RC BEAM 900x600 C32	End-I	15.5826	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	15.8024	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	15.8024	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B111	Story1	RC BEAM 900x600 C32	Middle	26.411	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	15.3616	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	15.3616	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B111	Story1	RC BEAM 900x600 C32	End-J	25.3577	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	25.575	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	25.575	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0

T219

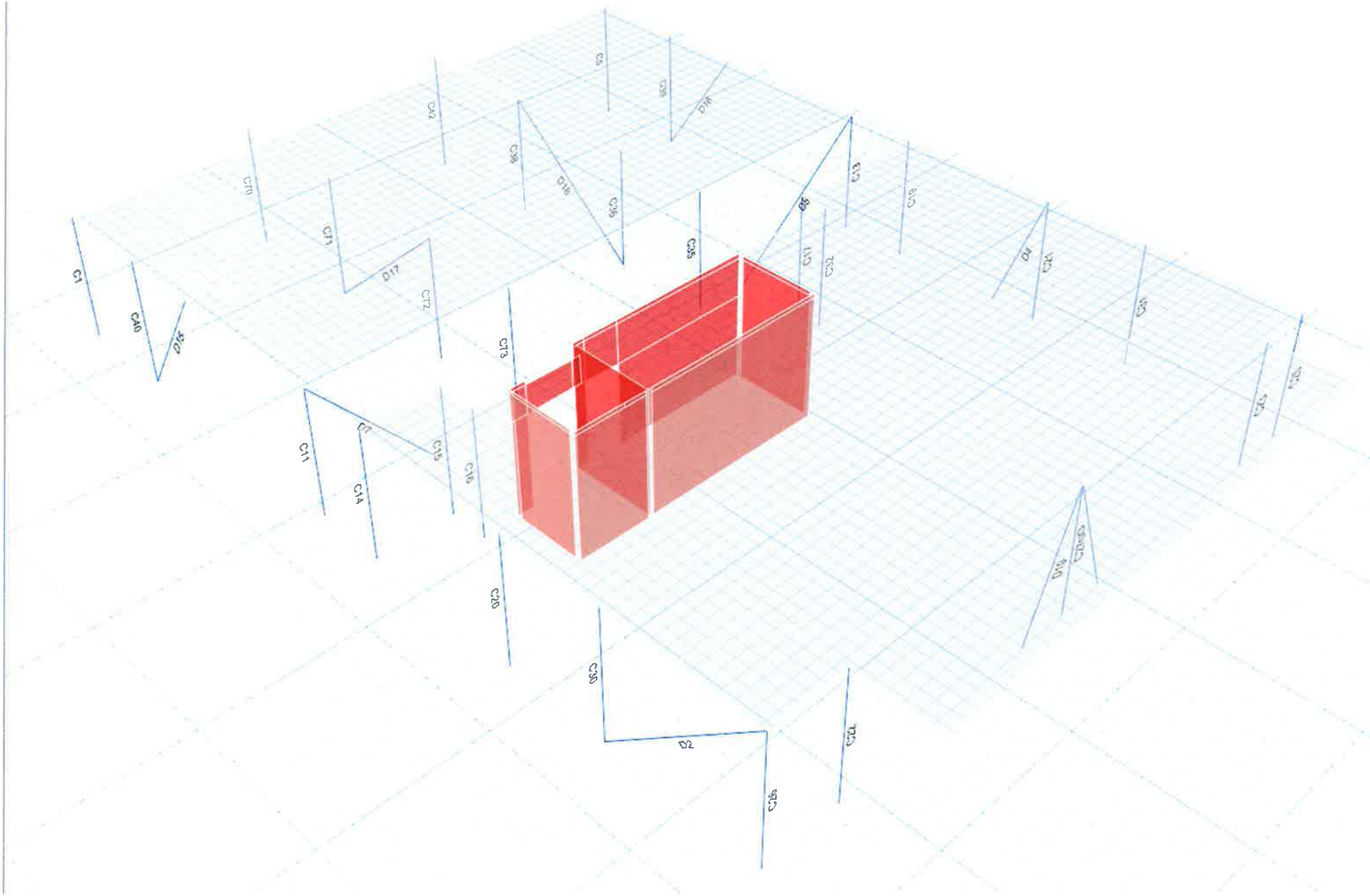
B112	Story1	RC BEAM 900x600 C32	End-I	151.0182	Ult 02 (1.2G+1.5Q)	630	54.0688	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	54.0688	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B112	Story1	RC BEAM 900x600 C32	Middle	18.3954	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	54.8601	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	54.8601	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B112	Story1	RC BEAM 900x600 C32	End-J	44.9061	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	55.0284	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	55.0284	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B115	Story1	RC BEAM 900x600 C32	End-I	156.7903	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	80.9879	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	80.9879	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B115	Story1	RC BEAM 900x600 C32	Middle	55.5191	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	100.1903	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	100.1903	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B115	Story1	RC BEAM 900x600 C32	End-J	149.9456	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	95.596	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	95.596	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B116	Story1	RC BEAM 350X700 C32	End-I	431.8956	Ult 02 (1.2G+1.5Q)	1142.64	1.0461	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.0461	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B116	Story1	RC BEAM 350X700 C32	Middle	413.614	Ult 02 (1.2G+1.5Q)	1072.74	8.5889	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	245	8.5889	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	684
B116	Story1	RC BEAM 350X700 C32	End-J	305.6661	Ult 02 (1.2G+1.5Q)	653.11	9.3075	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	245	9.3075	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	684
B117	Story1	RC BEAM 350X600 C32	End-I	171.9591	Ult 02 (1.2G+1.5Q)	279.74	12.1245	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.1245	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B117	Story1	RC BEAM 350X600 C32	Middle	169.8809	Ult 02 (1.2G+1.5Q)	308.09	12.0337	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.0337	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B117	Story1	RC BEAM 350X600 C32	End-J	33.9405	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.0337	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.0337	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B118	Story1	RC BEAM 350X700 C32	End-I	1.1972	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.0275	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	12.0275	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	684
B118	Story1	RC BEAM 350X700 C32	Middle	32.4141	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	4.7611	Ult 02 (1.2G+1.5Q)	245	4.7611	Ult 02 (1.2G+1.5Q)	684
B118	Story1	RC BEAM 350X700 C32	End-J	37.0325	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	0.2016	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	0.2016	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B122	Story1	RC BEAM 350X600 C32	End-I	49.4855	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	3.0917	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	245	3.0917	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	610
B122	Story1	RC BEAM 350X600 C32	Middle	140.7345	Ult 02 (1.2G+1.5Q)	245.65	2.7424	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	245	2.7424	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	610
B122	Story1	RC BEAM 350X600 C32	End-J	99.5167	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	1.5671	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.5671	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B123	Story1	RC BEAM 400X850 C32	End-I	85.1771	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	1.4672	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.4672	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B123	Story1	RC BEAM 400X850 C32	Middle	0		-1000	0		-1000	0		-1
B123	Story1	RC BEAM 400X850 C32	End-J	85.9783	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	1.4672	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.4672	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B125	Story1	RC BEAM 400X850 C32	End-I	48.1915	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	4.7303	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	280	4.7303	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	949
B125	Story1	RC BEAM 400X850 C32	Middle	58.4717	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	4.7694	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	280	4.7694	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	949
B125	Story1	RC BEAM 400X850 C32	End-J	59.2174	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	4.8051	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	280	4.8051	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	949
B126	Story1	RC BEAM 400X850 C32	End-I	107.6388	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	23.7619	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	23.7619	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B126	Story1	RC BEAM 400X850 C32	Middle	63.2823	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	23.5095	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	23.5095	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B126	Story1	RC BEAM 400X850 C32	End-J	49.5964	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	23.2775	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	23.2775	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B128	Story1	RC BEAM 400X850 C32	End-I	80.4405	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	16.5697	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	16.5697	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B128	Story1	RC BEAM 400X850 C32	Middle	76.4348	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	16.5697	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	16.5697	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B128	Story1	RC BEAM 400X850 C32	End-J	55.5458	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	16.7378	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	16.7378	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	949
B129	Story1	RC BEAM 350X700 C32	End-I	38.6472	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	245	7.1865	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	245	7.1865	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	684
B129	Story1	RC BEAM 350X700 C32	Middle	52.8462	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	8.526	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	245	8.526	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	684
B129	Story1	RC BEAM 350X700 C32	End-J	78.2399	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	5.3711	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	5.3711	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B131	Story1	RC BEAM 400X850 C32	End-I	59.0741	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	6.2532	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	6.2532	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B131	Story1	RC BEAM 400X850 C32	Middle	102.5604	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	6.1849	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	6.1849	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B131	Story1	RC BEAM 400X850 C32	End-J	113.7413	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	6.0306	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	6.0306	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B135	Story1	RC BEAM 400X850 C32	End-I	70.144	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	1.4474	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.4474	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B135	Story1	RC BEAM 400X850 C32	Middle	66.1383	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	1.4474	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.4474	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B135	Story1	RC BEAM 400X850 C32	End-J	62.1326	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	1.4474	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	1.4474	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B136	Story1	RC BEAM 400X850 C32	End-I	16.8885	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	2.0241	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.0241	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B136	Story1	RC BEAM 400X850 C32	Middle	0		-1000	0		-1000	0		-1
B136	Story1	RC BEAM 400X850 C32	End-J	19.2919	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	280	2.0241	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	2.0241	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B138	Story1	RC BEAM 350X600 C32	End-I	183.4253	Ult 02 (1.2G+1.5Q)	331.14	12.2046	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	12.2046	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B138	Story1	RC BEAM 350X600 C32	Middle	183.2505	Ult 02 (1.2G+1.5Q)	397.11	7.4195	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	245	7.4195	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	610
B138	Story1	RC BEAM 350X600 C32	End-J	178.0765	Ult 02 (1.2G+1.5Q)	306	7.4195	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	245	7.4195	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	610
B139	Story1	RC BEAM 900x600 C32	End-I	163.9417	Ult 02 (1.2G+1.5Q)	630	105.5296	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	105.5296	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B139	Story1	RC BEAM 900x600 C32	Middle	156.3073	Ult 02 (1.2G+1.5Q)	630	105.5296	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	105.5296	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B139	Story1	RC BEAM 900x600 C32	End-J	79.2718	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	105.3925	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	105.3925	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	2608
B140	Story1	RC BEAM 900x600 C32	End-I	40.9227	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	10.9457	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	10.9457	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B140	Story1	RC BEAM 900x600 C32	Middle	154.4364	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	630	9.7632	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	9.7632	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B140	Story1	RC BEAM 900x600 C32	End-J	159.1079	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	630	9.9975	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	9.9975	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0
B141	Story1	RC BEAM 350X600 C32	End-I	378.742	Ult 02 (1.2G+1.5Q)	1076.3	8.1385	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	245	8.1385	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	610
B141	Story1	RC BEAM 350X600 C32	Middle	374.8006	Ult 02 (1.2G+1.5Q)	1147.81	8.2395	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	8.2395	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B141	Story1	RC BEAM 350X600 C32	End-J	331.2212	Ult 02 (1.2G+1.5Q)	817.54	8.2395	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	8.2395	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	610
B142	Story1	RC BEAM 350X700 C32	End-I	13.808	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0	12.0645	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	245	12.0645	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	684
B142	Story1	RC BEAM 350X700 C32	Middle	49.907	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	14.0154	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	14.0154	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684
B142	Story1	RC BEAM 350X700 C32	End-J	63.2216	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	14.1226	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	245	14.1226	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	684

Upper floors - steel framing

SF 1



FEMS MODEL - L3 FLOOR SUPPORT STRUCTURE



ETABS MODEL - C2 COLUMNS & WALL BRACES

SF2

ETABS TABLE: L3 Steel Floor Beam Envelope

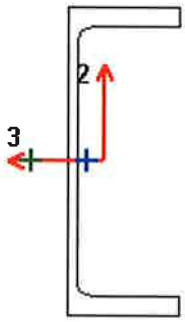
Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
B5	Story3	250PFC	0.773 = 0.002 + 0.773 + 0	Ult 02 (1.2G+1.5Q)	0.182	0.0002041	Compact
B6	Story3	250PFC	0.666 = 0.004 + 0.666 + 0	Ult 02 (1.2G+1.5Q)	0.21	0.001	Compact
B12	Story3	300PFC	0.441 = 0.002 + 0.441 + 0	Ult 06 (1.2G-Wy+0.4Q)	0.099	0.008	Compact
B13	Story3	300PFC	0.564 = 0.003 + 0.564 + 0	Ult 02 (1.2G+1.5Q)	0.087	0.001	Compact
B14	Story3	200PFC	0.1 = 0.057 + 0.027 + 0.015	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.045	0.001	Compact
B15	Story3	150PFC	0.034 = 0.001 + 0.013 + 0.02	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.019	0.004	Compact
B16	Story3	150PFC	0.041 = 2.227E-04 + 0.04 + 0	Ult 02 (1.2G+1.5Q)	0.045	0	Compact
B17	Story3	150PFC	0.001 = 2.85E-04 + 2.238E-04 + 0	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	0.0004813	0	Compact
B19	Story3	250PFC	0.575 = 0.007 + 0.575 + 0	Ult 06 (1.2G-Wy+0.4Q)	0.209	0.0002119	Compact
B20	Story3	200PFC	0.075 = 1.265E-04 + 0.075 + 0	Ult 06 (1.2G-Wy+0.4Q)	0.014	0.0001926	Compact
B21	Story3	250PFC	0.175 = 0.002 + 0.17 + 0.003	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	0.073	0.002	Compact
B22	Story3	250PFC	0.244 = 0.002 + 0.24 + 0.002	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	0.091	0.002	Compact
B23	Story3	250PFC	0.559 = 4.531E-04 + 0.559 + 0	Ult 04 (1.2G-Wx+0.4Q)	0.221	0.0002552	Compact

L3 Floor Beams
Critical Member

SF4

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Summary)



Element Details

Level	Element	Unique Name	Location (mm)	Combo	Element Type	Section	Classification
Story3	B5	76	2000	Ult 02 (1.2G+1.5Q)	Sway Frame	250PFC	Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
45.2	4510	99.9	360.8	27	421

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	I_w (cm⁶)
23.8	364	28.4	59.3	20	107	35009.4

Material Properties

E (MPa)	f_y (MPa)	α
200000	300	NA

Demand/Capacity (D/C) Ratio (8.4.4.1)

D/C Ratio = $M^*_x/\phi M_{ox}$
0.773 = 0.773

Stress Check Forces and Moments (8.4.4.1) (Combo Ult 02 (1.2G+1.5Q))

Location (mm)	N* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
2000	-1.8877	47.7277	-0.0067	27.2927	-0.0106

Basic Factors (8.4.4.1)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	0.1	1050	10.512
Minor Bending	1	0.1	1050	37.001
Major Braced	1	0.1	1050	10.512
Minor Braced	1	0.1	1050	37.001
LTB	1.4	0.35	3675	181.303

Axial Force & Biaxial Moment Design Factors (8.4.4.1)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	0.1	1	1	1	1	1	-1
Minor Bending	0.1	1	1	1	1	1	-1

	L_{ltb}	k_t	k_l	k_r	α_m	α_s
LTB	0.35	1	1.4	1	1.22	0.446

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	18.475	0.5	0.862

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	5.988	9	16	90	0.374	Compact
Major Web	30.125	82	115	180	0.262	Compact
Minor Flange	6.573	9	25	90	0.263	Compact
Minor Web	30.125	30	45	180	0.669	Non-Compact
Axial Flange	5.988		16		0.374	Compact
Axial Web	30.125		45		0.669	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	$b - b_e$ (mm)	$d - d_e$ (mm)	A_{eff} (cm²)
421	88.7	0	0	45.2

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_i (kN-m)	N_c (kN)
Major Moment	47.7277	126.3	126.1046	126.1046	1356
Minor Moment	0.0067	26.6036	26.5624	26.5558	1168.4211

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_l (kN-m)
Major Moment	76.6594	68.6994	68.5761	68.5761	68.5761

Axial Capacities

	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	1.8877	1356	1168.4211	1356	2240.2303

Shear Design

	V* Force (kN)	V_v Capacity (kN)	Stress Ratio
Major Shear	27.2927	324	0.084
Minor Shear	0.0106	437.4	2.415E-05

ETABS TABLE: L2 Steel Column Envelope

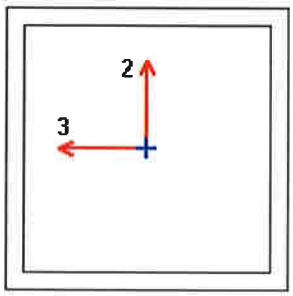
Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
C1	Story3	100X100X6SHS	0.107 = 0.107 + 0.008 + 0.012	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	0.005	0.004	Compact
C5	Story3	100X100X6SHS	0.153 = 0.153 + 0.071 + 0.019	Ult 02 (1.2G+1.5Q)	0.007	0.004	Compact
C11	Story3	100X100X6SHS	0.06 = 0.06 + 0.016 + 0.019	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.002	0.003	Compact
C13	Story3	100X100X6SHS	0.144 = 0.144 + 0.025 + 0.046	Ult 02 (1.2G+1.5Q)	0.003	0.004	Compact
C14	Story3	100X100X6SHS	0.017 = 0.005 + 0.017 + 0.01	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.001	0.001	Compact
C17	Story3	100X100X6SHS	0.051 = 0.01 + 3.508E-04 + 0.051	Ult 02 (1.2G+1.5Q)	0.0002447	0.002	Compact
C19	Story3	100X100X6SHS	0.056 = 0.049 + 0.056 + 0	Ult 02 (1.2G+1.5Q)	0.003	0.001	Compact
C20	Story3	100X100X6SHS	0.11 = 0.11 + 0.04 + 0.03	Ult 04 (1.2G-Wx+0.4Q)	0.004	0.004	Compact
C21	Story3	100X100X6SHS	0.22 = 0.22 + 0.08 + 0.006	Ult 06 (1.2G-Wy+0.4Q)	0.008	0.002	Compact
C22	Story3	100X100X6SHS	0.4 = 0.4 + 0.03 + 0.106	Ult 02 (1.2G+1.5Q)	0.002	0.007	Compact
C23	Story3	100X100X6SHS	0.383 = 0.383 + 0.05 + 0.102	Ult 02 (1.2G+1.5Q)	0.003	0.007	Compact
C25	Story3	100X100X6SHS	0.103 = 0.103 + 0.04 + 0.021	Ult 02 (1.2G+1.5Q)	0.002	0.001	Compact
C26	Story3	100X100X6SHS	0.047 = 0.047 + 4.87E-04 + 0.001	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.001	0.001	Compact
C27	Story3	150X100X9RHS	0.244 = 0.244 + 0.002 + 0.123	Ult 02 (1.2G+1.5Q)	0.001	0.011	Compact
C30	Story3	100X100X6SHS	0.332 = 0.332 + 0.122 + 0.034	Ult 02 (1.2G+1.5Q)	0.009	0.002	Compact
C31	Story3	100X100X6SHS	0.354 = 0.354 + 0.169 + 0.029	Ult 02 (1.2G+1.5Q)	0.011	0.003	Compact
C32	Story3	100X100X6SHS	0.2 = 0.2 + 1.793E-04 + 0.016	Ult 02 (1.2G+1.5Q)	0.001	0.002	Compact
C35	Story3	100X100X6SHS	0.28 = 0.28 + 0.007 + 0.07	Ult 02 (1.2G+1.5Q)	0.002	0.005	Compact
C36	Story3	100X100X6SHS	0.391 = 0.391 + 0.015 + 0.076	Ult 02 (1.2G+1.5Q)	0.002	0.004	Compact
C38	Story3	100X100X6SHS	0.266 = 0.266 + 0.04 + 0.004	Ult 02 (1.2G+1.5Q)	0.004	0.002	Compact
C39	Story3	100X100X6SHS	0.129 = 0.064 + 0.129 + 0	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.007	0.002	Compact
C40	Story3	100X100X6SHS	0.113 = 0.113 + 0.004 + 0.032	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.005	0.002	Compact
C42	Story3	100X100X6SHS	0.109 = 0.037 + 0.109 + 0	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.007	0.002	Compact
C70	Story3	100X100X6SHS	0.083 = 0.083 + 0.015 + 0.025	Ult 02 (1.2G+1.5Q)	0.004	0.003	Compact
C71	Story3	100X100X6SHS	0.456 = 0.456 + 0.02 + 0.003	Ult 02 (1.2G+1.5Q)	0.003	0.001	Compact
C72	Story3	100X100X6SHS	0.476 = 0.476 + 0.046 + 0.08	Ult 02 (1.2G+1.5Q)	0.003	0.004	Compact
C73	Story3	100X100X6SHS	0.317 = 0.317 + 0.05 + 0.078	Ult 02 (1.2G+1.5Q)	0.003	0.005	Compact

L2 Steel Columns
Critical member

SF7

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Summary)



Element Details

Level	Element	Unique Name	Location (mm)	Combo	Element Type	Section	Classification
Story3	C72	50	0	Ult 02 (1.2G+1.5Q)	Sway Frame	100X100X6SHS	Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
21.3	304	37.8	60.8	12	73.5

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	I_w (cm⁶)
515	304	37.8	60.8	12	73.5	

Material Properties

E (MPa)	f_y (MPa)	α
199948	450	NA

Demand/Capacity (D/C) Ratio (6.1b)

D/C Ratio = $N^* / \phi N_s$ or $N^* / \phi N_c$
0.476 = 0.476

Stress Check Forces and Moments (6.1b) (Combo Ult 02 (1.2G+1.5Q))

Location (mm)	N* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
0	-228.499	-1.0584	-1.9929	-0.6386	-1.1767

Basic Factors (6.1b)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	1	3200	84.704
Minor Bending	1	1	3200	84.704
Major Braced	1	1	3200	84.704
Minor Braced	1	1	3200	84.704
LTB	1.4	1	3200	118.585

Axial Force & Biaxial Moment Design Factors (6.1b)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	1	1	1	1	1	0.272	0.82
Minor Bending	1	1	1	1	1	0.217	0.956

	L_{ltb}	k_t	k_l	k_r	α_m	α_s
LTB	1	1	1.4	1	2.5	0.983

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	15.901	-1	0.556

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	19.677	30	45	180	0.437	Compact
Major Web	19.677	82	115	180	0.171	Compact
Minor Flange	19.677	82	115	180	0.171	Compact
Minor Web	19.677	30	45	180	0.437	Compact
Axial Flange	19.677		45		0.437	Compact
Axial Web	19.677		45		0.437	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	b - b_e (mm)	d - d_e (mm)	A_{eff} (cm²)
73.5	73.5	0	0	21.3

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_i (kN-m)	N_c (kN)
Major Moment	1.0584	33.075	28.6906	25.5537	533.0502
Minor Moment	1.9929	33.075	28.6906	27.5467	533.0502

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_t (kN-m)
Major Moment	344.0667	33.075	17.3216	17.3216	17.3216

Axial Capacities

	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	228.499	958.5	533.0502	905.25	138748.076

Shear Design

	V* Force (kN)	V_v Capacity (kN)	Stress Ratio
Major Shear	0.6386	291.6	0.002
Minor Shear	1.1767	291.6	0.004

ETABS TABLE: L2 Steel Wall Brace Envelope

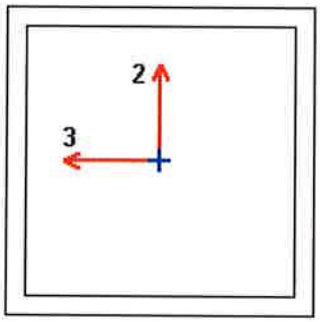
Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
D2	Story3	100X100X6SHS	0.059 = 0.059 + 0 + 0	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	0.001	0	Compact
D4	Story3	100X100X6SHS	0.061 = 0.061 + 0 + 0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0.0004559	0	Compact
D5	Story3	100X100X6SHS	0.378 = 0.378 + 0 + 0	Ult 02 (1.2G+1.5Q)	0.0004832	0.0001461	Compact
D7	Story3	100X100X6SHS	0.228 = 0.228 + 0 + 0	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.001	0.000118	Compact
D8	Story3	100X100X6SHS	0.261 = 0.261 + 0 + 0	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.001	0	Compact
D15	Story3	100X100X6SHS	0.29 = 0.29 + 0 + 0	Ult 02 (1.2G+1.5Q)	0.001	0.0002568	Compact
D16	Story3	100X100X6SHS	0.322 = 0.322 + 0 + 0	Ult 02 (1.2G+1.5Q)	0.001	0.0002855	Compact
D17	Story3	100X100X6SHS	0.221 = 0.221 + 0 + 0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.001	0	Compact
D18	Story3	100X100X6SHS	0.714 = 0.714 + 0 + 0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	0.002	0.0003385	Compact
D19	Story3	100X100X6SHS	0.287 = 0.287 + 0 + 0	Ult 02 (1.2G+1.5Q)	0.001	0.0001099	Compact

L2 wall braces critical member

SF10

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Summary)



Element Details (Part 1 of 2)

Level	Element	Unique Name	Location (mm)	Combo	Element Type	Section
Story3	D18	322	0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	Sway Frame	100X100X6SHS

Element Details (Part 2 of 2)

Classification
Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
21.3	304	37.8	60.8	12	73.5

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	I_w (cm⁶)
515	304	37.8	60.8	12	73.5	

Material Properties

E (MPa)	f_y (MPa)	α
199948	450	NA

Demand/Capacity (D/C) Ratio (6.1b)

D/C Ratio = $N^* / \phi N_s$ or $N^* / \phi N_c$
0.714 = 0.714

Stress Check Forces and Moments (6.1b) (Combo Ult 47 (G+0.3EQX-1.0EQY+0.3Q))

Location (mm)	N^* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
0	-152.9623	0	0	-0.3794	-0.0665

SF11

Basic Factors (6.1b)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	1	4967.9	131.5
Minor Bending	1	1	4967.9	131.5
Major Braced	1	1	4967.9	131.5
Minor Braced	1	1	4967.9	131.5
LTB	1.4	1	4967.9	184.1

Axial Force & Biaxial Moment Design Factors (6.1b)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	1	1	1	2.697	1	1	-1
Minor Bending	1	1	1	2.697	1	1	-1

	L_{ltb}	k_t	k_l	k_r	α_m	α_s
LTB	1	1	1.4	1	1.388	0.954

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	11.226	-1	0.248

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	19.677	30	45	180	0.437	Compact
Major Web	19.677	82	115	180	0.171	Compact
Minor Flange	19.677	82	115	180	0.171	Compact
Minor Web	19.677	30	45	180	0.437	Compact
Axial Flange	19.677		45		0.437	Compact
Axial Web	19.677		45		0.437	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	$b - b_e$ (mm)	$d - d_e$ (mm)	A_{eff} (cm²)
73.5	73.5	0	0	21.3

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_i (kN-m)	N_c (kN)
Major Moment	0	33.075	32.1081	9.4568	238.0099
Minor Moment	0	33.075	32.1081	9.4568	238.0099

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_t (kN-m)
Major Moment	221.6257	33.075	9.4568	9.4568	9.4568

Axial Capacities

	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	152.9623	958.5	238.0099	905.25	138748.076

Shear Design

	V* Force (kN)	V_v Capacity (kN)	Stress Ratio
Major Shear	0.3794	291.6	0.001
Minor Shear	0.0665	291.6	2.281E-04

Ref.:	**1702160**
Date:	**03-Jun-10**
Design:	**FK**
Page:	SF12

COMPOSITE BEAM DESIGN - SIMPLY SUPPORTED BEAMS - EDGE & INTERNAL BEAMS

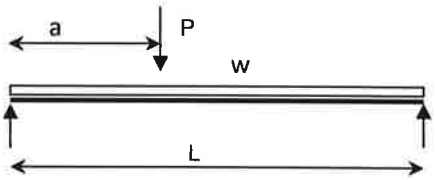
These calculations comply with AS 2327.1 - 2003 Composite Structures - Simply Supported Beams.

Beam Designation	3.FB5	**Edge/Internal Beam (E/I)**	I	
Beam Span	**7500** mm	**Distance, a, from LH Support to Point Load =**	**0**	mm

		Load	Load Width		
Uniform DL		**6.5** kPa	**7.9** m	51.35	kN/m
	Steel beam self-weight =	59.7 kg/m @	0.00981 kN/kg	0.59	kN/m
	Party Wall Over	**3.0** kN/m		3.00	kN/m
				54.94	kN/m
Point DL					**kN**
Uniform LL	**General Living Area =**	**2.0** kPa	**7.9** m	15.80	
		kN/m		0.00	kN/m
				15.80	kN/m
Point LL					**kN**

Bending Moments and Stiffness

For strength, w* = 1.2G + 1.5Q =	89.62 kN/m
P* = 1.2G + 1.5Q =	0.00 kN
Max Bending Moment, **M*** =	630.16 kNm
Max Shear Force, **V*** =	336.09 kN
For serviceability, w_s = 1.0G + 0.4Q =	61.26 kN/m
P_s = 1.0G + 0.4Q =	0.00 kN
Limit Δ_{max} = Span/ **500**	15.0 mm



=> $I_{required} = 5 \times w_s \times L^4 / (384 \times E \times \Delta_{max}) + P_s \times L^3 / (48 \times E \times \Delta_{max}) \times [3(a/L) - 4(a/L)^3]$ = 841.2E+6 mm^4

For Beam Type: **UB** => **610 UB 113 (G300+)**

=> Therefore Use Composite Beam & Try **410 UB 59.7** **(G300+)** **Compact Section**

Steel Beam Member Properties

Self-weight =	59.7 kg/m	r_x =	168 mm	$f_{y\ flange}$ =	300 MPa
A_s =	7640 mm^2	r_y =	39.7 mm	b_{f_top} =	178 mm ***
I_x =	216.0E+6 mm^4	d_1 =	381 mm	t_{f_top} =	12.8 mm
Z_{ex} =	1.2E+6 mm^3	t_w =	7.8 mm	b_{f_bot} =	178 mm
E =	200E+3 MPa	$f_{y\ web}$ =	320 MPa	t_{f_bot} =	12.8 mm

Slab Properties

f_c' =	**32** MPa	D_c' =	250 mm
Slab Depth D_c =	**250** mm	b_1 =	**7900** mm
Bondek h_r =	**0** i.e. no Bondek	b_2 =	**7900** mm

(NOTE: (1) 'h_r' = 0 - for solid slabs. (2) In this design, the ribs MUST be perpendicular to the steel beam)

Calculations

Effective Width b_e

$b_{e1} = [L_{ef}/8; b_1/2; b_{sf1}+8D_c']_{MIN}$ =	937.5 mm	Clause 5.2.2.1
$b_{e2} = [L_{ef}/8; b_2/2; b_{sf1}+kD_c']_{MIN}$ =	937.5 mm (Note: k = 8)	
$b_{cf} = b_{e1} + b_{e2}$ =	1875 mm	

Shear Capacity of Steel Beam Web

Check web plate slenderness **			Check flange plate slenderness ***			
λ_{e_web} =	55.26	**< 82 :. OK**	λ_{e_flange} =	7.28	**< 16 :. OK**	
λ_{ep_web} =	82		λ_{ep_flange} =	9		AS 2327.1 Table 5.1
λ_{ey_web} =	115		λ_{ey_flange} =	16		

** **Note:** The design approach used in this calculation requires that $\lambda_{e\_web} \le \lambda_{ep\_web}$. For this case, $V_u = V_w$.
*** **Note:** If $\lambda_{ep\_flange} < \lambda_{e\_flange} \le \lambda_{ey\_flange}$, calculate the effective compression flange width to Clause 5.2.3.

Check shear yield capacity

$V_w = 0.6 * f_y * A_w$ =	570.6 kN	AS 4100 Clause 5.11.4
$V_w = V_u = V_v$ =	570.6 kN	
For shear, $\phi = 0.9$:. ϕV_v =	513.5 kNm	AS 2327.1 Table 3.1

Since ϕ. Vv > V* = 336.1 kN => OK

Moment Capacity of Composite Beam - Full Shear Transfer

Check nominal moment capacity

Maximum Shear Ratio $\gamma = V^*/\phi Vu$ =	0.65 *	
* **Note**: If max. γ **> 0.5**, check γ at cross-sections for which bending is critical.		Appendix D
→ For full shear transfer, β =	**1.00**	
$F_{st} = (A_{f1}+A_{f2}).f_{uy} + A_w.f_{yw}$ =	2318 kN	Equation D2.3.2(1)(i)
d_{sr} =	453 mm	Equation D2.3.2(1)(ii)
$F_{c1} = 0.85f_c'.b_{cf}.(D_c - h_r)$ =	12750 kN	Equation D2.3.2(2)
$F_{c2} = 0.85f_c'.\lambda b_{cf}.h_r$ =	0.0 kN (Ribs are assumed ≥ 60° to the beam)	
$F_{scf} = f_{yf}.b_{sf}.t_{f1}$ =	684 kN	Equation D2.3.2(4)

→	If **Case 1** applies, i.e. $F_{st} \le F_{c1}$		Clause D2.3.2(c)
then	$d_c = d_h = (D_c-h_r).F_{cc} / F_{c1}$ =	45.5 mm	Equation D2.3.2(5)
where	$F_{cc} = F_{st}$ =	2318 kN	
	=> Depth of compression zone lies within the slab thickness :. OK		
	$M_{bc} = F_{cc} (d_{sr} - d_c / 2)$ =	998 kNm	Equation D2.3.2(6)
	$\phi M_{bv} = \phi M_{bc}$ =	699 kNm	
	=> ϕ. Mbv > M* = 630 kNm => OK		**← Governs**

→	If **Case 2** applies, i.e. $F_{c1} < F_{st} \le (F_{c1} + F_{c2})$		Clause D2.3.2(c)
then	$d_c = d_h = (D_c-h_r) + [h_r.(F_{st} - F_{c1})/F_{c2}]$ =	250 mm	Equation D2.3.2(7)
where	$F_{cc} = F_{st}$ =	2318 kN	
	=> Not Appropriate Design Case		
	$M_{bc} = F_{c1} [d_{sr} - (D_c - h_r)/2] + (F_{cc} - F_{c1}).[d_{sr} - d_h/2 - (D_c - h_r)/2]$		
	=	n/a	kNm
	$\phi M_{bv} = \phi M_{bc}$ =	n/a	kNm
	=> ϕ. Mbv not checked against M*		

→	If **Case 3** applies, i.e. $(F_{c1} + F_{c2}) < F_{st} \le (F_{c1} + F_{c2} + 2F_{scf})$			Clause D2.3.2(c)
then	$d_c = D_c =$	250	mm	
where	$F_{cc} = F_{c1} + F_{c2} =$	12750	kN	Equation D2.3.2(9)
and	$F_{sc} = F_{st} - F_{cc} =$	0	kN	Equation D2.3.2(9)
	$d_h = D_c + t_{f1}.F_{sc}/(2F_{scf})$	250.0	mm	Equation D2.3.2(10)
	=> Not Appropriate Design Case			
	$M_{bc} = F_{c1}.[d_{sr} - (D_c - h_r)/2] + F_{c2}.[d_{sr} - D_c + h_r/2] + F_{sc}.[d_{sr} - (D_c + d_h)/2]$			Equation D2.3.2(11)
	=	n/a	kNm	
	$\phi M_{bv} = \phi M_{bc} =$	n/a	kNm	
	=> ϕ. Mbv not checked against M*			

→	If **Case 4** applies, i.e. $(F_{c1} + F_{c2} + 2F_{scf}) < F_{st}$			Clause D2.3.2(c)
then	$d_c = D_c =$	250	mm	
where	$F_{cc} = F_{c1} + F_{c2} =$	12750	kN	
and	$F_b = F_{st} - F_{cc} - 2F_{scf} =$	0	kN	Equation D2.3.2(12)
	$d_h = D_c + t_{f1} + F_b/(2f_{yw}.t_w)$	262.8	mm	Equation D2.3.2(13)
	=> Not Appropriate Design Case			
	$M_{bc} = F_{c1}.[d_{sr} - (D_c - h_r)/2] + F_{c2}.[d_{sr} - D_c + h_r/2] + 2F_{scf}.(d_{sr} - D_c - t_{f1}/2) + F_b.[d_{sr} - (D_c + t_{f1} + d_h)/2]$			
	=	n/a	kNm	Equation D2.3.2(14)
	$\phi M_{bv} = \phi M_{bc} =$	n/a	kNm	
	=> ϕ. Mbv not checked against M*			

Moment Capacity of Composite Beam - Partial Shear Transfer

Check nominal moment capacity

	Shear Ratio $\gamma = V^*/\phi Vu$ =	0.65		Appendix D
	For this design, use β =	**0.830**		
	$F_{st} = (A_{f1}+A_{f2}).f_{uy} + A_w.f_{yw} =$	2318	kN	Equation D2.3.2(1)(i)
	$d_{sr} =$	453	mm	Equation D2.3.2(1)(ii)
	$F_{c1} = 0.85f_c'.b_{cf}.(D_c - h_r) =$	12750	kN	Equation D2.3.2(2)
	$F_{c2} = 0.85f_c'.\lambda b_{cf}.h_r =$	0.0	kN (Ribs are assumed ≥ 60° to the beam)	
	$F_{scf} = f_{yf}.b_{sf}.t_{f1} =$	684	kN	Equation D2.3.2(4)
	$F_{scw} = f_{yw}.d_1.t_w =$	951	kN	
Now:	$F_{cc} =$	2318	kN	Clause D2.3.2(c)
	$F_{cp} = \beta.F_{cc} =$	1924	kN	Equation D2.3.3(2)
	$F_{sc} = F_{st} - F_{cp}$	394	kN	Equation D2.3.3(3)

→ **Try:**	$F_{cp} \le F_{c1}$, so that			
	$d_c = (D_c - h_r).F_{cp} / F_{c1} =$	37.7	mm	Equation D2.3.3(4)
	=> Depth of compression zone lies within the slab thickness :. OK			
	Case 1: If $F_{sc} \le 2F_{scf}$			
then	$d_h = D_c + t_{f1}.F_{sc} / (2F_{scf}) =$	253.7	mm	Equation D2.3.3(6)
	=> Depth of compression zone lies within the top flange of the beam :. OK			
	$M_b = F_{cp}.(d_{sr} - d_c / 2) + F_{sc}.[d_{sr} - (D_c + d_h)/2]$			Equation D2.3.2(9)
	=	915	kNm	
	$\phi M_{bv} = \phi M_b =$	641	kNm	
	=> ϕ. Mbv > M* = 630 kNm => OK			← **Governs**

Case 2: If $2F_{scf} < F_{sc} \le 2F_{scf} + 2F_{scw}$

then $d_h = D_c + t_{f1} + (F_{sc} - 2F_{scf}) / (2f_{yw}.t_w) =$ 67.9 mm — Equation D2.3.3(7)

=> Not Appropriate Design Case

$M_b = F_{cp}.(d_{sr} - d_c/2) + 2F_{scf}.(d_{sr} - D_c - t_{f1}/2) + (F_{sc} - 2F_{scf}).[d_{sr} - (D_c + t_{f1} + d_h)/2]$

= n/a kNm — Equation D2.3.2(10)

$\phi M_{bv} = \phi M_b =$ n/a kNm

=> ϕ. Mbv not checked against M*

Case 3: If $F_{sc} > 2F_{scf} + 2F_{scw}$

then $d_h = D_c + Ds - t_{f2} + (F_{sc} - 2F_{scf} - 2F_{scw})/(2f_{yf}.b_{sf2}) =$ 616.9 mm — Equation D2.3.3(8)

=> Not Appropriate Design Case

$M_b = F_{cp}.(d_{sr} - d_c/2) + 2F_{scf}.(d_{sr} - D_c - t_{f1}/2) + 2F_{scw}.[d_{sr} - D_c - (Ds + t_{f1} + t_{f2})/2] + (F_{sc} - 2F_{scf} - 2F_{scw}).[d_{sr} - (D_c + D_s - t_{f2} + d_h)/2]$ — Equation D2.3.2(11)

= n/a kNm

$\phi M_{bv} = \phi M_b =$ n/a kNm

=> ϕ. Mbv not checked against M*

→ **Try:** $F_{cp} > F_{c1}$, so that

$d_c = D_c - h_r + hr * (F_{cp} - F_{c1}) / F_{c2} =$ 250.0 mm — Equation D2.3.3(5)

=> Not Appropriate Design Case

Case 4: If $F_{sc} \le 2F_{scf}$

then $d_h = D_c + t_{f1}.F_{sc} / (2F_{scf}) =$ 253.7 mm — Equation D2.3.3(6)

=> Not Appropriate Design Case

$M_b = F_{c1}.[d_{sr} - (D_c - h_r)/2] + (F_{cp} - F_{c1}).[d_{sr} - (D_c - h_r + d_c)/2] + F_{sc}.[d_{sr} - (D_c + d_h)/2]$

= n/a kNm — Equation D2.3.2(12)

$\phi M_{bv} = \phi M_b =$ n/a kNm

=> ϕ. Mbv not checked against M*

Case 5: If $2F_{scf} < F_{sc} \le 2F_{scf} + 2F_{scw}$

then $d_h = D_c + t_{f1} + (F_{sc} - 2F_{scf}) / (2f_{yw}.t_w) =$ -710.0 mm — Equation D2.3.3(7)

=> Not Appropriate Design Case

$M_b = F_{cp}.(d_{sr} - d_c/2) + 2F_{scf}.(d_{sr} - D_c - t_{f1}/2) + (F_{sc} - 2F_{scf}).[d_{sr} - (D_c + t_{f1} + d_h)/2] =$

= n/a kNm — Equation D2.3.2(13)

$\phi M_{bv} = \phi M_b =$ n/a kNm

=> ϕ. Mbv not checked against M*

Case 6: If $F_{sc} > 2F_{scf} + 2F_{scw}$

then $d_h = D_c + Ds - t_{f2} + (F_{sc} - 2F_{scf} - 2F_{scw})/(2f_{yf}.b_{sf2}) =$ 616.9 mm — Equation D2.3.3(8)

=> Not Appropriate Design Case

$M_b = F_{c1}.[d_{sr} - (D_c - h_r)/2) + (F_{cp} - F_{c1}).[d_{sr} - (D_c - h_r + d_c)/2] + 2F_{scf}.(d_{sr} - D_c - t_{f1}/2) + 2F_{scw}.[d_{sr} - D_c - (D_s + t_{f1} - t_{f2})/2] + (F_{sc} - 2F_{scf} - 2F_{scw}).[d_{sr} - (D_c + D_s - t_{f2} + d_h)/2]$

= n/a kNm — Equation D2.3.2(14)

$\phi M_{bv} = \phi M_b =$ n/a kNm

=> ϕ. Mbv not checked against M*

=> USE PARTIAL SHEAR TRANSFER FOR THIS DESIGN

Shear Connectors

Check nominal shear capacity of a single shear connector - Headed Studs

d_{bs} = **19** mm
E_c = 28600 MPa
$f_{vs} = [0.6d_{bs}^2 f_{uc}; 0.31 d_{bs}^2 (f_{cj}E_c)^{0.5}]_{MIN}$ = 93 kN — Clause 8.3.2.1, Table 8.1

Design Shear Capacity (Partial Shear Transfer)

$n_i = F_{cp.i} / f_{ds}$
$k_n = 1.18 - 0.18 / n_i^{0.5}$ — Equation 8.3.4(2)
$f_{ds} = \phi\, k_n f_{vs}$, where ϕ = 0.85 for longitudinal shear connectors (Table 3.1) — Equation 8.3.4(1)
Re-arrange these equations to get:
$F_{cp.i} = \phi\, n_i (1.18 - 0.18 / n_i^{0.5})\, f_{vs}$
For **partial shear transfer**, $F_{cp.i} \geq F_{cp}$ = **1,924** kN (Page)
Try n_i = **22.0** headed studs each side of midspan
=> $\phi\, n_i (1.18 - 0.18 / n_i^{0.5})\, f_{vs}$ = **1,988** kN **> 1,924kN :. OK**
:. for the entire beam, need 44 no. headed studs @ 170.0 mm c/c

=> Provide Single 19 mm Studs @ 170.0 mm c/c 150 mm high

Longitudinal Shear Reinforcement: (Note - Maximum spacing of bars is 2x shear stud spacing)

=> Try N12 @ 200 mm c/c

Check minimum shear force requirement

Requirement : ϕV_L => V_L* (per unit length) — Clause 9.3.1
V_L* = 548 kN/metre length

Shear Perimeter U

Head diameter = 23 mm — b_{y1} = 175 mm
h_c = 150 mm — b_{y2} = 175 mm

Type 1 $U = [D_c, D_c$ @ Bar Curt., D_c @ Ribs$]_{MIN}$ = 250 mm
Type 2 $U = b_x + 2h_c$ = 323 mm — Clause 9.4.1
Type 3 $U = [b_x+b_{y2}+h_c; bx+b_{y1}+h_c; bx+b_{y2}+b_{y1}]_{MIN}$ = 348 mm

Check nominal longitudinal shear reinforcement

NOTE: The design must satisfy: $\phi V_L = \phi[U\,0.36f_c'^{0.5} + 0.9A_{sv}fyr\ ;\ 0.32f_c'U]_{MIN} > V_L$*

Type 1 For U = 250 mm
V_L* = ***274*** kN per m
$\phi V_L = \phi\, 0.32f_c'U$ = 1792 kN per m **> 274 kN per m :. OK**
A_{sv} = 550 mm²/m
$\phi V_L = \phi(U\,0.36f_c'^{0.5} + 0.9A_{sv}fyr)$ = 530 kN per m **> 274 kN per m :. OK**

Type 2 For U = 323 mm
V_L* = ***548*** kN per m
$\phi V_L = \phi\, 0.32f_c'U$ = 2315 kN per m **> 548 kN per m :. OK**
A_{sv} = 1100 mm²/m ($A_{sv\,min} = 800U / f_{yr}$ = 516.8 mm²/m)
Therefore A_{sv} = 1100 mm²/m **:. OK**
$\phi V_L = \phi(U\,0.36f_c'^{0.5} + 0.9A_{sv}fyr)$ = 807 kN per m **> 548 kN per m :. OK**

Check nominal longitudinal shear reinforcement (cont.)

Type 3 For U =	348 mm			
V_L* =	***548*** kN per m			
$\phi V_L = \phi\ 0.32 f_c' U$ =	2496 kN per m	**> 548 kN per m :. OK**		
A_{sv} =	1100 mm^2/m	($A_{sv\ min} = 800U\ /\ f_{yr}$ =	557 mm^2/m)	
Therefore A_{sv} =	1100 mm^2/m			**:. OK**
$\phi V_L = \phi(U 0.36 f_c'^{0.5} + 0.9 A_{sv} fyr)$ =	843 kN per m	**> 548 kN per m :. OK**		
=> $A_{sp.b}$ =	**550 mm^2/m**	**=> Provide**	**N12 @ 200 mm c/c**	

Deflections

Notes on the deflection calculations

1. The design assumes that the beam is **fully-propped** until the concrete slab has reached its **28-day compressive strength**.
2. Once the props are removed, the beam is assumed to deflect in response to the dead loads present at the time of their removal. The calculation checks the response of the beam to the application of the total dead load used in the design.
3. A calculation is made of the deflection of the composite beam in the short term due to the application of all the live loads used in the design, separate from the dead loads.
4. The beam deflection is then calculated in response to the application of the total dead load, using the long-term properties of the composite section.
5. Finally, the deflection is calculated for the total dead load plus 40% of the total design live load, using the long-term properties of the composite section.
6. The design deflection limits are specified in the table below using a minimum span:deflection ratio and a maximum deflection value for each of the short-term and long-term conditions.

	Short-term deflection limits				Long-term deflection limits		
Load condition	DL	LL	DL + 0.4LL		DL	LL	DL + 0.4LL
Span:deflection ratio	**500**	**500**			**500**		**400**
Max. deflection (mm)	**16**	**16**			**16**		**20**

1. Short-term Deflections

Short-term modular ratio = $\alpha_{ti} = E_s/E_c$ =	7.0	
d_{sg} =	453 mm	Use full steel section
$c_1 = 2A_s/b_{cf}d_{sg}$ =	0.018	
$\alpha_{ti} c_1$ =	0.126	
For Partial Shear Transfer, ζ = 0.40 and β =	0.830	*Composite Steel & Concrete Structural Members*, Oehlers & Bradford, p.48
$I_{no} = b_{cf}/\alpha_{ti}.(D_c - h_r)^3 / 12 + I_s$ =	565.12E+6 mm^4	
Note: Deflection Multiplier = $[1 + (I_{full} / I_{no} - 1).\zeta + (1 - I_{full} / I_{no}).\zeta.\beta]$		

Depth To The Neutral Axis (NOTE: In this calculation, λ = 0 in all cases) Appendix B3

Short-term Deflections (cont.)

If the slab is **solid** or it is **composite** with the **N.A. within the cover slab**, then:

$D_{NA} = kD_b = [(\alpha_{ti}.c_1*(\alpha_{ti}.c_1 + 4))^{0.5} - \alpha_{ti}.c_1]*d_{sa} / 2 =$ 134.74 mm Equation B3.2(3)

< 250 mm :. OK

For this case, $I_{ti} = I_s + A_s (d_{sa} - kD_b)^2 + b_{cf} (kD_b)^3 / 3\alpha_{ti}$ Equation B3.2(4)

=> For short-term deflections, deflection mulitplier, $\Delta_{multiplier}$ = 1.08

$\Delta_{DL\,ti} = 5.w_s.L^4 / (384.E_s.I_{ti}) + P_s.L^3 / (48.E_s.I_{ti}).[3(a/L) - 4(a/L)^3].\Delta_{multiplier}$ = 10.08 mm

= Span / 744 :. OK

$\Delta_{LL\,ti} = 5.w_s.L^4 / (384.E_s.I_{ti}) + P_s.L^3 / (48.E_s.I_{ti}) \times [3(a/L) - 4(a/L)^3].\Delta_{multiplier}$ = 2.90 mm

= Span / 2587 :. OK

2. Long-term Deflections

Long-term modular ratio = $\alpha_{tl} = 3 * E_s/E_c$ = 21.0 Clause B3.1

$\alpha_{tl}\ c_1$ = 0.377

If the slab is **solid** or it is **composite** with the **N.A. within the cover slab**, then:

$D_{NA} = kD_b = [(\alpha_{tl}.c_1*(\alpha_{tl}.c_1 + 4))^{0.5} - \alpha_{tl}.c_1]*d_{sa} /2 =$ 205.73 mm Equation B3.2(3)

< 250 mm :. OK

For this case, $I_{tl} = I_s + A_s (d_{sa} - kD_b)^2 + b_{cf} (kD_b)^3 / 3\alpha_{tl}$ Equation B3.2(4)

=> For long-term deflections, deflection multiplier, $\Delta_{multiplier}$ = 1.05

$\Delta_{DL\,tl} = 5.w_s.L^4 / (384.E_s.I_{tl}) + P_s.L^3 / (48.E_s.I_{tl}).[3(a/L) - 4(a/L)^3].\Delta_{multiplier}$ = 12.54 mm

= Span / 598 :. OK

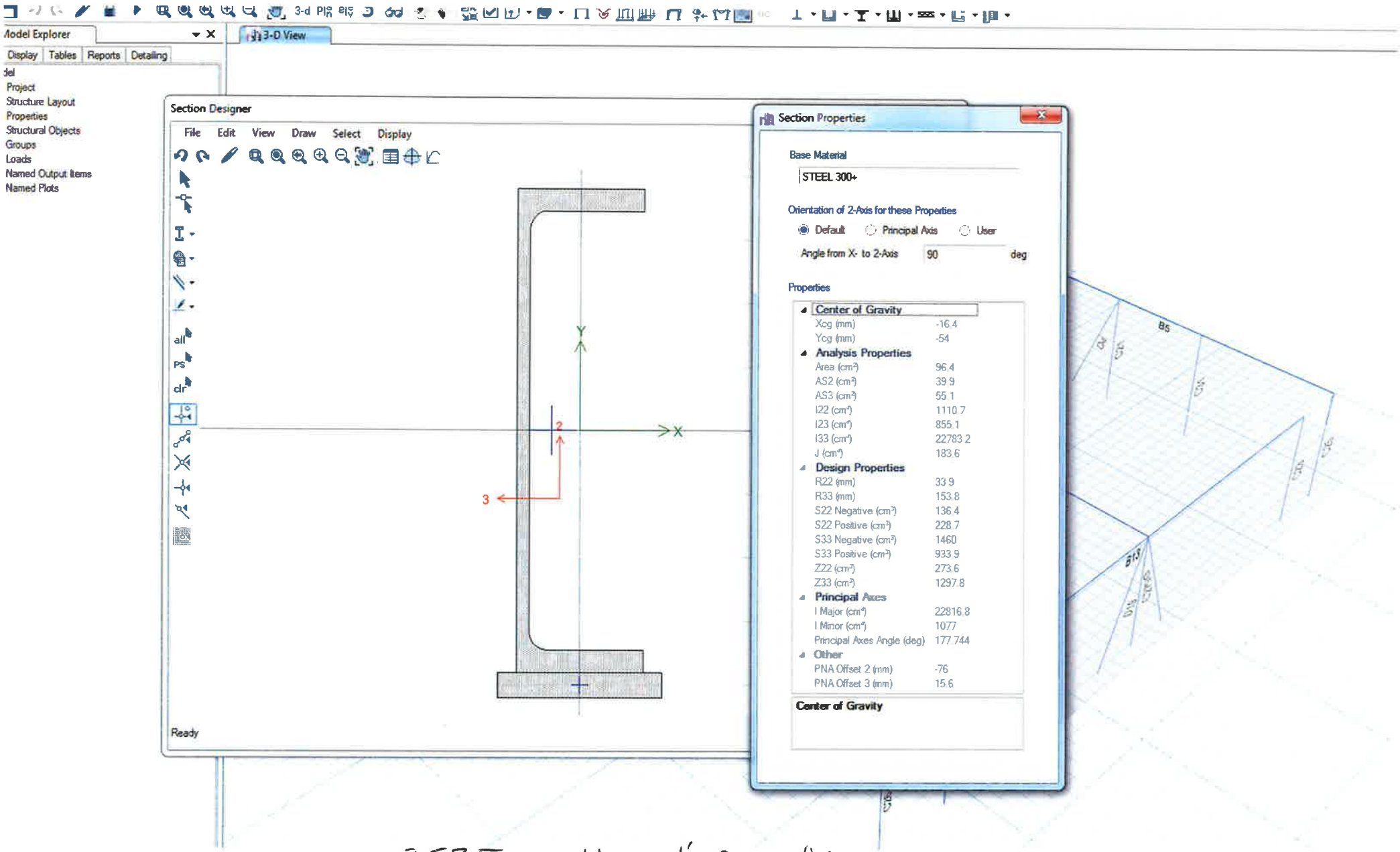
$\Delta_{DL+0.4LL\,tl} = 5.w_s.L^4/(384.E_s.I_{tl}) + P_s.L^3/(48.E_s.I_{tl}).[3(a/L)-4(a/L)^3].\Delta_{multiplier}$ = 13.98 mm

= Span/ 536 :. OK

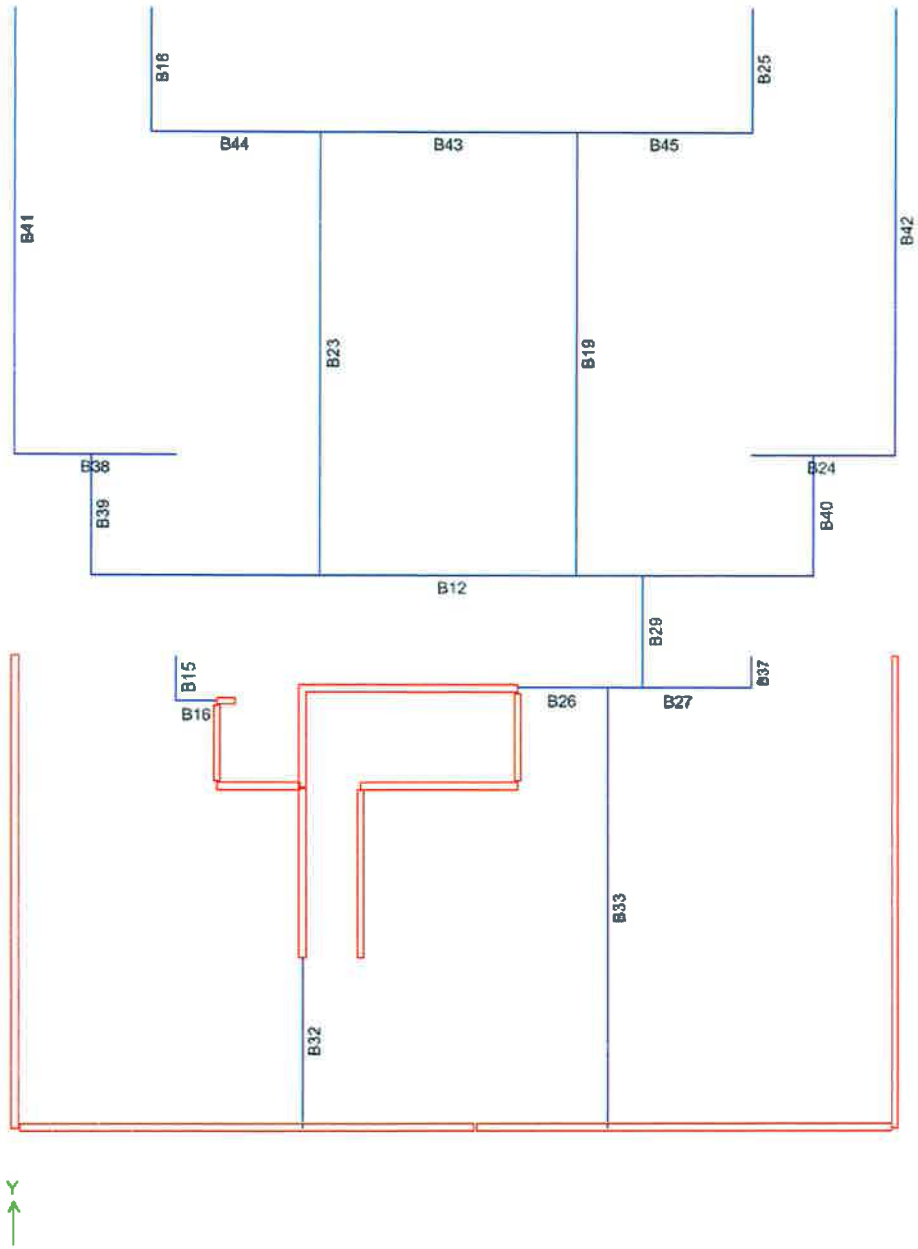
ADOPT: **410 UB 59.7 (G300+) for steel beam**
19 mm diameter Single Studs @ 170 mm c/c 150 mm high
Concrete slab thickness 250 mm
Concrete strength 32 MPa at 28 days
Longitudinal reinforcement N12 @ 200 mm c/c

End of Calculation

Note - can use alternative section
380PFC + 130x20PL - section stronger than
410UB60 (see properties
attached)

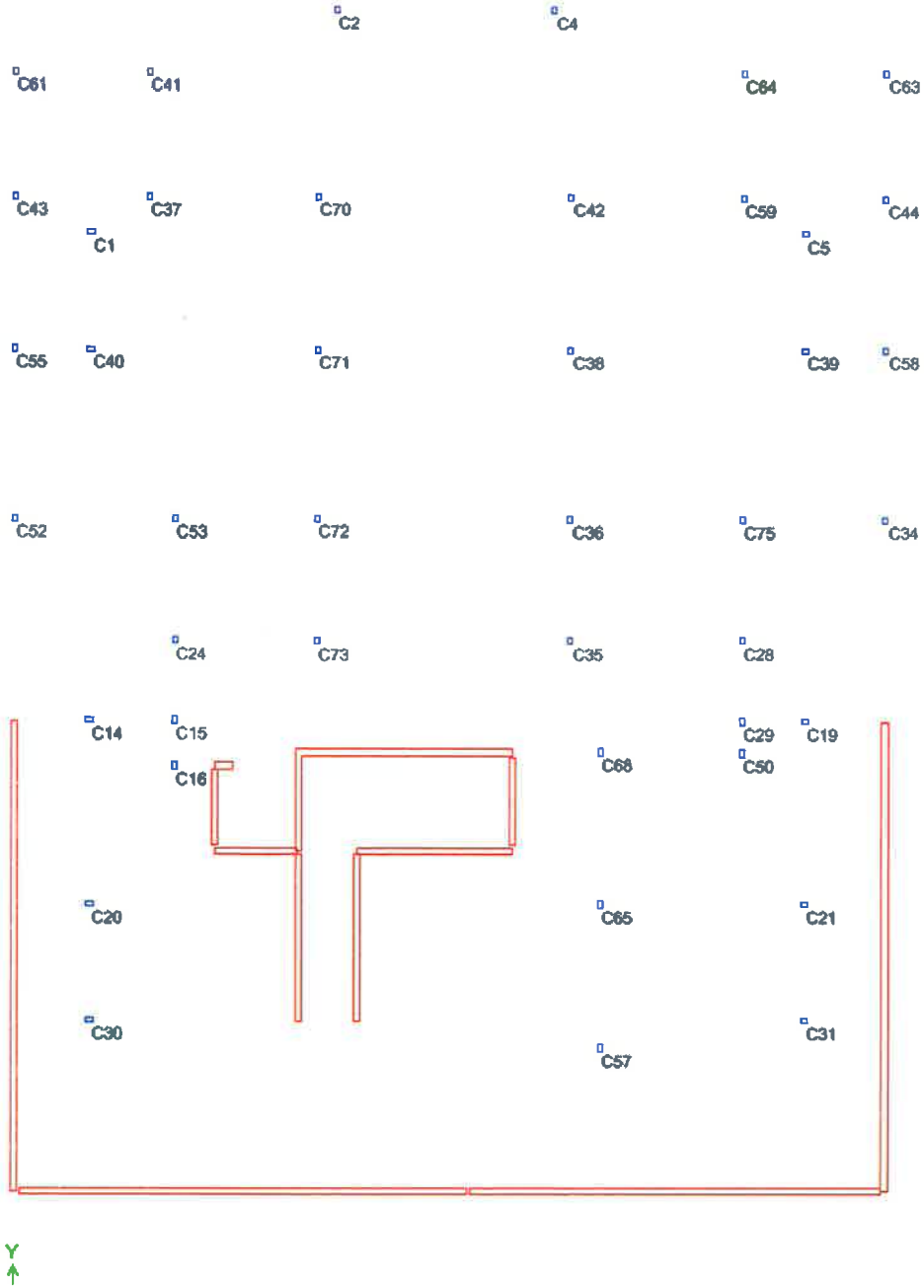


3FB5 - alternative section



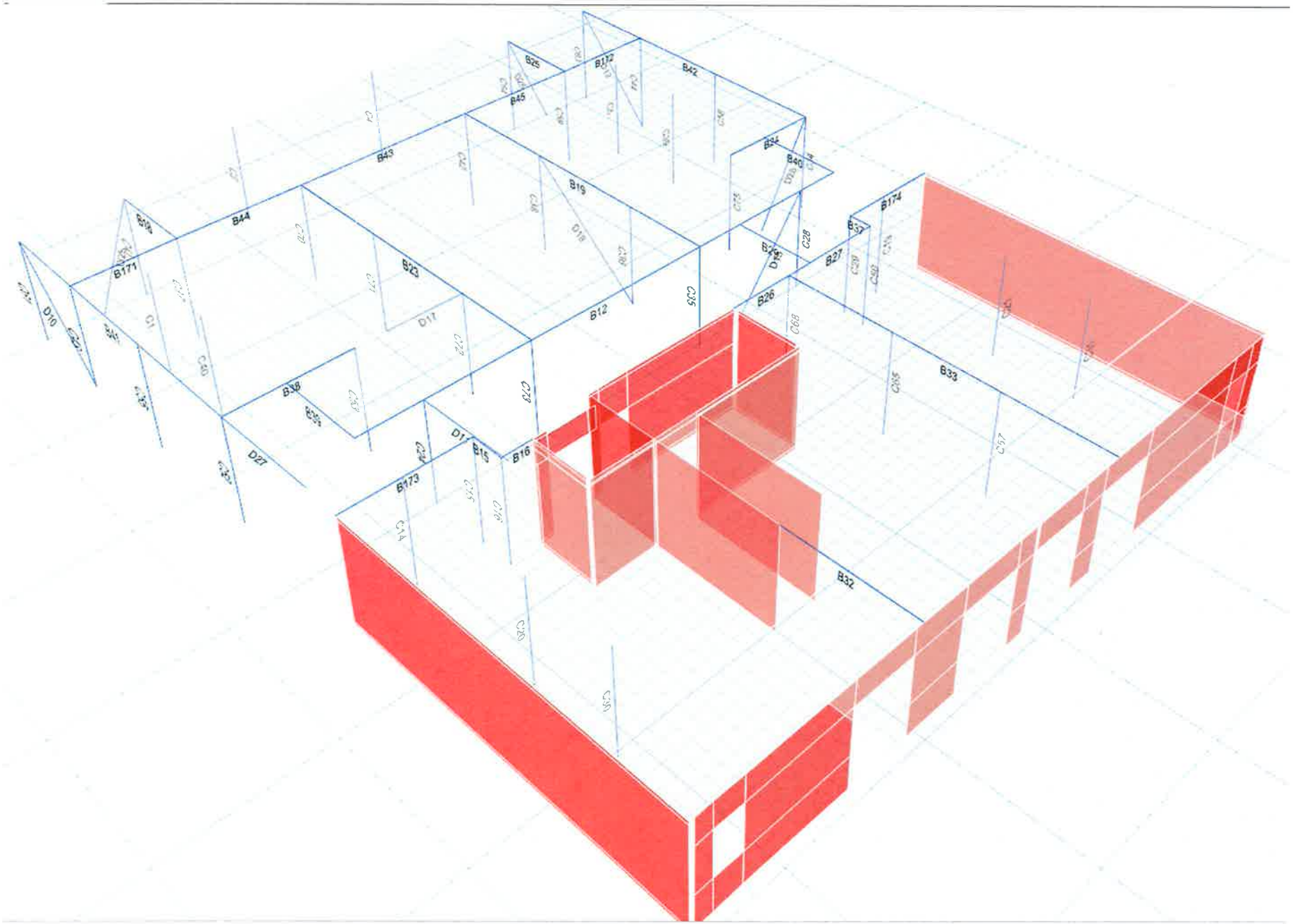
ETABS MODEL – LEVEL 2 FLOOR SUPPORT BEAM LAYOUT

SF20



ETABS MODEL – LEVEL 2 FLOOR SUPPORT COLUMN LAYOUT

SF21



ETABS MODEL – LEVEL 2 FLOOR SUPPORT LAYOUT 3D VIEW

SF22

ETABS TABLE: Level 2 Steel Floor Beam Envelope

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
B12	Story2	380PFC	0.293 = 0.01 + 0.293 + 0	Ult 02 (1.2G+1.5Q)	0.047	0.004	Compact
B15	Story2	150PFC	0.03 = 0.001 + 0.012 + 0.017	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.017	0.003	Compact
B16	Story2	150PFC	0.058 = 0.019 + 0.026 + 0.013	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.044	0.003	Compact
B19	Story2	250PFC	0.571 = 0.004 + 0.571 + 0	Ult 02 (1.2G+1.5Q)	0.207	0.0001555	Compact
B23	Story2	250PFC	0.639 = 0.001 + 0.639 + 0	Ult 02 (1.2G+1.5Q)	0.233	0.0001414	Compact
B18	Story2	200PFC	0.142 = 0.001 + 0.142 + 0	Ult 02 (1.2G+1.5Q)	0.028	0.0001242	Compact
B25	Story2	200PFC	0.169 = 0.001 + 0.169 + 0	Ult 02 (1.2G+1.5Q)	0.035	0.0001268	Compact
B26	Story2	200PFC	0.335 = 0.335 + 0.006 + 0.038	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.045	0.011	Compact
B27	Story2	200PFC	0.123 = 0.027 + 0.123 + 0	Ult 02 (1.2G+1.5Q)	0.061	0.0002413	Compact
B24	Story2	200PFC	0.049 = 0.015 + 0.049 + 0	Ult 02 (1.2G+1.5Q)	0.009	0.0003906	Compact
B29	Story2	250PFC	0.065 = 0 + 0.065 + 0	Ult 02 (1.2G+1.5Q)	0.016	0.000168	Compact
B32	Story2	300PFC	0.568 = 0.003 + 0.568 + 0	Ult 02 (1.2G+1.5Q)	0.103	0.001	Compact
B33	Story2	250PFC	0.63 = 0.001 + 0.63 + 0	Ult 02 (1.2G+1.5Q)	0.169	0.001	Compact
B37	Story2	150PFC	0.002 = 0.002 + 1.88E-04 + 0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	0.0004413	0	Compact
B38	Story2	200PFC	0.054 = 0.005 + 0.054 + 0	Ult 02 (1.2G+1.5Q)	0.009	0.0004854	Compact
B39	Story2	200PFC	0.229 = 2.007E-04 + 0.229 + 0	Ult 02 (1.2G+1.5Q)	0.042	0.001	Compact
B40	Story2	200PFC	0.247 = 0 + 0.247 + 0	Ult 02 (1.2G+1.5Q)	0.045	0.001	Compact
B41	Story2	250PFC	0.633 = 0.001 + 0.633 + 0	Ult 02 (1.2G+1.5Q)	0.161	0.0002942	Compact
B42	Story2	250PFC	0.724 = 1.999E-04 + 0.724 + 0	Ult 02 (1.2G+1.5Q)	0.177	0.0002924	Compact
B43	Story2	250PFC	0.164 = 0.004 + 0.164 + 0	Ult 02 (1.2G+1.5Q)	0.047	0	Compact
B44	Story2	200PFC	0.091 = 0.003 + 0.091 + 0	Ult 02 (1.2G+1.5Q)	0.042	0	Compact
B45	Story2	200PFC	0.068 = 0.002 + 0.068 + 0	Ult 02 (1.2G+1.5Q)	0.006	0	Compact

SF23

ETABS TABLE: Level 1 Steel Column Envelope

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
C1	Story2	150X100X9RHS	0.112 = 0.112 + 0.056 + 0.005	Ult 02 (1.2G+1.5Q)	0.005	0.002	Compact
C5	Story2	150X100X9RHS	0.163 = 0.163 + 0.079 + 0.001	Ult 02 (1.2G+1.5Q)	0.006	0.002	Compact
C14	Story2	150X100X9RHS	0.032 = 0.032 + 0.003 + 0.001	Ult 02 (1.2G+1.5Q)	0.001	0.0002306	Compact
C15	Story2	150X100X9RHS	0.024 = 0.024 + 1.167E-04 + 0.006	Ult 02 (1.2G+1.5Q)	0.0001046	0.001	Compact
C16	Story2	150X100X9RHS	0.063 = 0.063 + 0.002 + 0.005	Ult 02 (1.2G+1.5Q)	0.001	0.001	Compact
C19	Story2	150X100X9RHS	0.033 = 0.033 + 0.026 + 0.025	Ult 02 (1.2G+1.5Q)	0.002	0.002	Compact
C20	Story2	150X100X9RHS	0.092 = 0.092 + 0.005 + 0.003	Ult 02 (1.2G+1.5Q)	0.001	0.0001722	Compact
C21	Story2	150X100X9RHS	0.259 = 0.259 + 0.019 + 0.011	Ult 02 (1.2G+1.5Q)	0.002	0.001	Compact
C24	Story2	150X100X9RHS	0.184 = 0.184 + 0.027 + 0.015	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.005	0.001	Compact
C28	Story2	150X100X9RHS	0.181 = 0.181 + 0.058 + 0.008	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.005	0.001	Compact
C29	Story2	150X100X9RHS	0.042 = 0.003 + 0.042 + 0.017	Ult 02 (1.2G+1.5Q)	0.002	0.001	Compact
C30	Story2	150X100X9RHS	0.201 = 0.201 + 0.011 + 0.003	Ult 02 (1.2G+1.5Q)	0.001	0.0003337	Compact
C31	Story2	150X100X9RHS	0.196 = 0.196 + 0.071 + 0.009	Ult 02 (1.2G+1.5Q)	0.005	0.001	Compact
C35	Story2	150X100X9RHS	0.279 = 0.279 + 0.089 + 0.013	Ult 02 (1.2G+1.5Q)	0.005	0.002	Compact
C36	Story2	150X100X9RHS	0.379 = 0.379 + 0.03 + 0.027	Ult 02 (1.2G+1.5Q)	0.003	0.002	Compact
C38	Story2	150X100X9RHS	0.317 = 0.317 + 0.036 + 0.03	Ult 02 (1.2G+1.5Q)	0.002	0.003	Compact
C39	Story2	150X100X9RHS	0.375 = 0.375 + 0.06 + 0.038	Ult 02 (1.2G+1.5Q)	0.005	0.002	Compact
C40	Story2	150X100X9RHS	0.234 = 0.234 + 0.043 + 0.043	Ult 02 (1.2G+1.5Q)	0.004	0.003	Compact
C42	Story2	150X100X9RHS	0.193 = 0.193 + 0.014 + 0.022	Ult 02 (1.2G+1.5Q)	0.003	0.003	Compact
C50	Story2	150X100X9RHS	0.165 = 0.165 + 0.03 + 0.02	Ult 02 (1.2G+1.5Q)	0.001	0.002	Compact
C52	Story2	150X100X9RHS	0.11 = 0.11 + 0.022 + 0.026	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	0.004	0.002	Compact
C53	Story2	150X100X9RHS	0.141 = 0.141 + 0.04 + 0.012	Ult 02 (1.2G+1.5Q)	0.004	0.002	Compact
C55	Story2	150X100X9RHS	0.097 = 0.097 + 0.036 + 0.027	Ult 02 (1.2G+1.5Q)	0.004	0.003	Compact
C58	Story2	150X100X9RHS	0.059 = 0.041 + 0.059 + 0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0.003	0.004	Compact
C59	Story2	150X100X9RHS	0.06 = 0.06 + 0.026 + 0.048	Ult 02 (1.2G+1.5Q)	0.004	0.005	Compact
C61	Story2	150X100X9RHS	0.132 = 0.132 + 0.037 + 0.007	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.003	0.003	Compact
C63	Story2	150X100X9RHS	0.122 = 0.122 + 0.039 + 0.014	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0.003	0.003	Compact
C64	Story2	150X100X9RHS	0.187 = 0.187 + 0.069 + 0.025	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.007	0.003	Compact
C57	Story2	150X100X9RHS	0.151 = 0.151 + 0.031 + 0.007	Ult 02 (1.2G+1.5Q)	0.003	0.001	Compact
C65	Story2	150X100X9RHS	0.247 = 0.247 + 0.019 + 0.003	Ult 02 (1.2G+1.5Q)	0.001	0.001	Compact
C70	Story2	150X100X9RHS	0.273 = 0.273 + 0.006 + 0.023	Ult 02 (1.2G+1.5Q)	0.002	0.003	Compact
C71	Story2	150X100X9RHS	0.584 = 0.584 + 0.09 + 0.04	Ult 02 (1.2G+1.5Q)	0.003	0.003	Compact
C72	Story2	150X100X9RHS	0.556 = 0.556 + 0.062 + 0.045	Ult 02 (1.2G+1.5Q)	0.004	0.003	Compact
C73	Story2	150X100X9RHS	0.346 = 0.346 + 0.075 + 0.04	Ult 02 (1.2G+1.5Q)	0.005	0.003	Compact
C34	Story2	150X100X9RHS	0.146 = 0.146 + 0.005 + 0.04	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.003	0.003	Compact
C37	Story2	150X100X9RHS	0.045 = 0.023 + 0.023 + 0.045	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.003	0.004	Compact
C41	Story2	150X100X9RHS	0.114 = 0.114 + 0.059 + 0.009	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	0.006	0.003	Compact
C68	Story2	150X100X9RHS	0.131 = 0.131 + 0.048 + 0.014	Ult 02 (1.2G+1.5Q)	0.002	0.001	Compact
C75	Story2	150X100X9RHS	0.219 = 0.219 + 0.039 + 0.044	Ult 02 (1.2G+1.5Q)	0.002	0.004	Compact
C2	Story2	100X100X5SHS	0.258 = 0.258 + 0.057 + 0.046	Ult 02 (1.2G+1.5Q)	0.005	0.004	Compact
C4	Story2	100X100X5SHS	0.202 = 0.202 + 0.053 + 0.019	Ult 02 (1.2G+1.5Q)	0.004	0.003	Compact
C43	Story2	150X100X9RHS	0.076 = 0.076 + 0.005 + 0.038	Ult 02 (1.2G+1.5Q)	0.002	0.004	Compact
C44	Story2	150X100X9RHS	0.079 = 0.079 + 0.008 + 0.039	Ult 02 (1.2G+1.5Q)	0.003	0.004	Compact

SF24

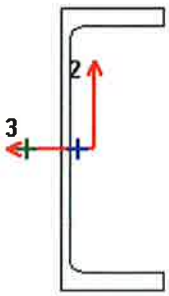
ETABS TABLE: Level 1 Steel Wall Brace Envelope

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
D11	Story2	150X100X9RHS	0.217 = 0.217 + 0 + 0	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	0.001	0	Compact
D13	Story2	150X100X9RHS	0.193 = 0.193 + 0 + 0	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.001	0	Compact
D17	Story2	150X100X9RHS	0.23 = 0.23 + 0 + 0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.001	0	Compact
D18	Story2	150X100X9RHS	0.427 = 0.427 + 0 + 0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	0.001	0	Compact
D25	Story2	150X100X9RHS	0.224 = 0.224 + 0 + 0	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.0004041	0.0001281	Compact
D26	Story2	150X100X9RHS	0.22 = 0.22 + 0 + 0	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.000439	0	Compact
D27	Story2	150X100X9RHS	0.066 = 0.066 + 0 + 0	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	0.001	0	Compact
D28	Story2	150X100X9RHS	0.096 = 0.096 + 0 + 0	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	0.001	0.0001707	Compact
D10	Story2	150X100X9RHS	0.126 = 0.126 + 0 + 0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.001	0.0001262	Compact
D12	Story2	150X100X9RHS	0.135 = 0.135 + 0 + 0	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	0.001	0.0001088	Compact

SF26

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Envelope)



Element Details

Level	Element	Unique Name	Section	Combo	Location	Frame Type	Classification
Story2	B42	162	250PFC	Ult 02 (1.2G+1.5Q)	3800	Sway Frame	Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
45.2	4510	99.9	360.8	27	421

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	C_w (cm⁶)
23.8	364	28.4	59.3	20	107	35009.4

Material Properties

E (MPa)	f_y (MPa)	α
200000	300	NA

LLRF and Demand/Capacity Ratio

L (mm)	LLRF	Stress Ratio Limit
10000.0	1	0.95

Demand/Capacity (D/C) Ratio (8.4.4.1)

D/C Ratio = $M^*_x/\phi M_{ox}$
0.703 = 0.703

Stress Check Forces and Moments

Location (mm)	N* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
3800	-0.6465	-46.4247	0.0088	-48.0361	0.0034

Basic Factors (8.4.4.1)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	0.1	1000	10.011
Minor Bending	1	0.1	1000	35.239
Major Braced	1	0.1	1000	10.011
Minor Braced	1	0.1	1000	35.239

SF27

Basic Factors (8.4.4.1) (continued)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
LTB	1.4	0.5	5000	246.67

Axial Force & Biaxial Moment Design Factors (8.4.4.1)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	0.1	1	1	1	1	1	-1
Minor Bending	0.1	1	1	1	1	1	-1

	L_{ltb}	k_t	k_l	k_r	α_m	α_s
LTB	0.5	1	1.4	1	1.676	0.347

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	17.872	0.5	0.872

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	5.988	9	16	90	0.374	Compact
Major Web	30.125	82	115	180	0.262	Compact
Minor Flange	6.573	9	25	90	0.263	Compact
Minor Web	30.125	30	45	180	0.669	Non-Compact
Axial Flange	5.988		16.000		0.374	Compact
Axial Web	30.125		45.000		0.669	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	$b - b_e$ (mm)	$d - d_e$ (mm)	A_{eff} (cm²)
421	88.7	0	0	45.2

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_i (kN-m)	N_c (kN)
Major Moment	46.4247	126.3	126.2331	126.2331	1356
Minor Moment	0.0088	26.6036	26.5895	26.5874	1182.5806

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_t (kN-m)
Major Moment	54.7605	73.3984	73.3538	73.3538	73.3538

Axial Capacities

	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	0.6465	1356	1182.5806	1356	2022.0586

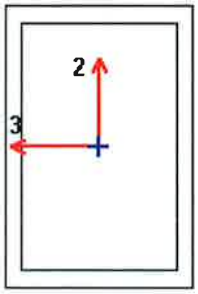
Shear Design

	V* Force (kN)	V_v Resistance (kN)	Stress Ratio
Major Shear	48.0361	324	0.148
Minor Shear	0.0034	437.4	7.686E-06

SF28

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Envelope)



Element Details

Level	Element	Unique Name	Section	Combo	Location	Frame Type	Classification
Story2	C71	138	150X100X9RHS	Ult 02 (1.2G+1.5Q)	0	Sway Frame	Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
39	1090	52.9	145.3	18	185

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	C_w (cm⁶)
1320	577	38.5	115.4	27	140	

Material Properties

E (MPa)	f_y (MPa)	α
199948	450	NA

LLRF and Demand/Capacity Ratio

L (mm)	LLRF	Stress Ratio Limit
3200.0	0.544	0.95

Demand/Capacity (D/C) Ratio (6.1b)

D/C Ratio = $N^* / \phi N_s$ or $N^* / \phi N_c$
0.584 = 0.584

Stress Check Forces and Moments

Location (mm)	N* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
0	-526.8862	-4.7902	1.7097	-2.0985	1.0578

Basic Factors (6.1b)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	1	3200	60.53
Minor Bending	1	1	3200	83.194
Major Braced	1	1	3200	60.53
Minor Braced	1	1	3200	83.194

SF29

Basic Factors (6.1b) (continued)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
LTB	1.4	1	3200	116.472

Axial Force & Biaxial Moment Design Factors (6.1b)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	1	1	1	1	1	0.403	0.491
Minor Bending	1	1	1	1	1	0.205	0.986

	L_{ltb}	k_t	k_l	k_r	α_m	α_s
LTB	1	1	1.4	1	2.31	0.975

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	16.097	-1	0.571

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	12.224	30	45	180	0.272	Compact
Major Web	19.677	82	115	180	0.171	Compact
Minor Flange	12.224	82	115	180	0.106	Compact
Minor Web	19.677	30	45	180	0.437	Compact
Axial Flange	12.224		45.000		0.272	Compact
Axial Web	19.677		45.000		0.437	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	$b - b_e$ (mm)	$d - d_e$ (mm)	A_{eff} (cm²)
185	140	0	0	39

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_i (kN-m)	N_c (kN)
Major Moment	4.7902	83.25	65.466	59.4028	1399.1391
Minor Moment	1.7097	63	49.5418	47.5167	1002.7235

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_t (kN-m)
Major Moment	758.887	83.25	34.6454	34.6454	34.6454

Axial Capacities

	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	526.8862	1755	1002.7235	1657.5	237490.7259

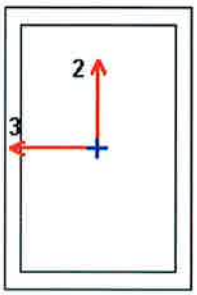
Shear Design

	V* Force (kN)	V_v Resistance (kN)	Stress Ratio
Major Shear	2.0985	656.1	0.003
Minor Shear	1.0578	437.4	0.002

SF30

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Envelope)



Element Details

Level	Element	Unique Name	Section	Combo	Location	Frame Type	Classification
Story2	D18	314	150X100X9RHS	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	0	Sway Frame	Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
39	1090	52.9	145.3	18	185

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	C_w (cm⁶)
1320	577	38.5	115.4	27	140	

Material Properties

E (MPa)	f_y (MPa)	α
199948	450	NA

LLRF and Demand/Capacity Ratio

L (mm)	LLRF	Stress Ratio Limit
4967.9	1	0.95

Demand/Capacity (D/C) Ratio (6.1b)

D/C Ratio = $N^* / \phi N_s$ or $N^* / \phi N_c$
0.426 = 0.426

Stress Check Forces and Moments

Location (mm)	N* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
0	-173.3016	0	0	-0.6142	-0.0144

Basic Factors (6.1b)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	1	4967.9	93.971
Minor Bending	1	1	4967.9	129.157
Major Braced	1	1	4967.9	93.971

Basic Factors (6.1b) (continued)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Minor Braced	1	1	4967.9	129.157
LTB	1.4	1	4967.9	180.819

Axial Force & Biaxial Moment Design Factors (6.1b)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	1	1	1	1.248	1	1	-1
Minor Bending	1	1	1	1.602	1	1	-1

	L_{ltb}	k_t	k_l	k_r	α_m	α_s
LTB	1	1	1.4	1	1.388	0.942

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	11.403	-1	0.257

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	12.224	30	45	180	0.272	Compact
Major Web	19.677	82	115	180	0.171	Compact
Minor Flange	12.224	82	115	180	0.106	Compact
Minor Web	19.677	30	45	180	0.437	Compact
Axial Flange	12.224		45.000		0.272	Compact
Axial Web	19.677		45.000		0.437	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	$b - b_e$ (mm)	$d - d_e$ (mm)	A_{eff} (cm²)
185	140	0	0	39

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_i (kN-m)	N_c (kN)
Major Moment	0	83.25	83.25	63.7885	823.6996
Minor Moment	0	63	63	36.1356	451.569

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_l (kN-m)
Major Moment	488.8263	83.25	47.7507	47.7507	47.7507

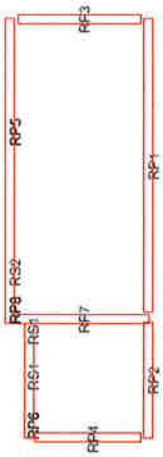
Axial Capacities

	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	173.3016	1755	451.569	1657.5	237490.7259

Shear Design

	V* Force (kN)	V_v Resistance (kN)	Stress Ratio
Major Shear	0.6142	656.1	0.001
Minor Shear	0.0144	437.4	3.285E-05

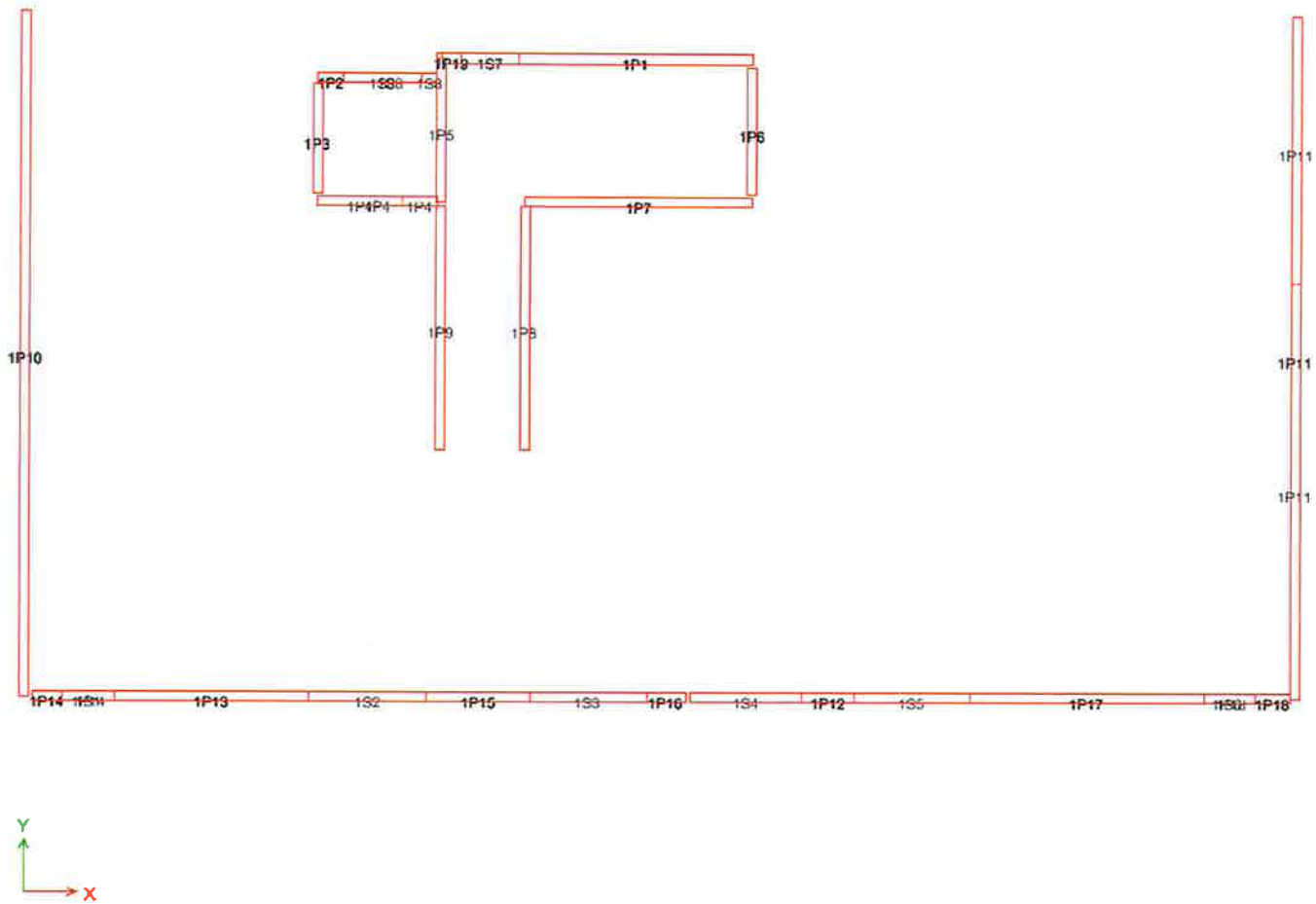
ETABS – WALL PANEL DESIGN



ETABS MODEL –LEVEL 3 PRECAST WALL LAYOUT

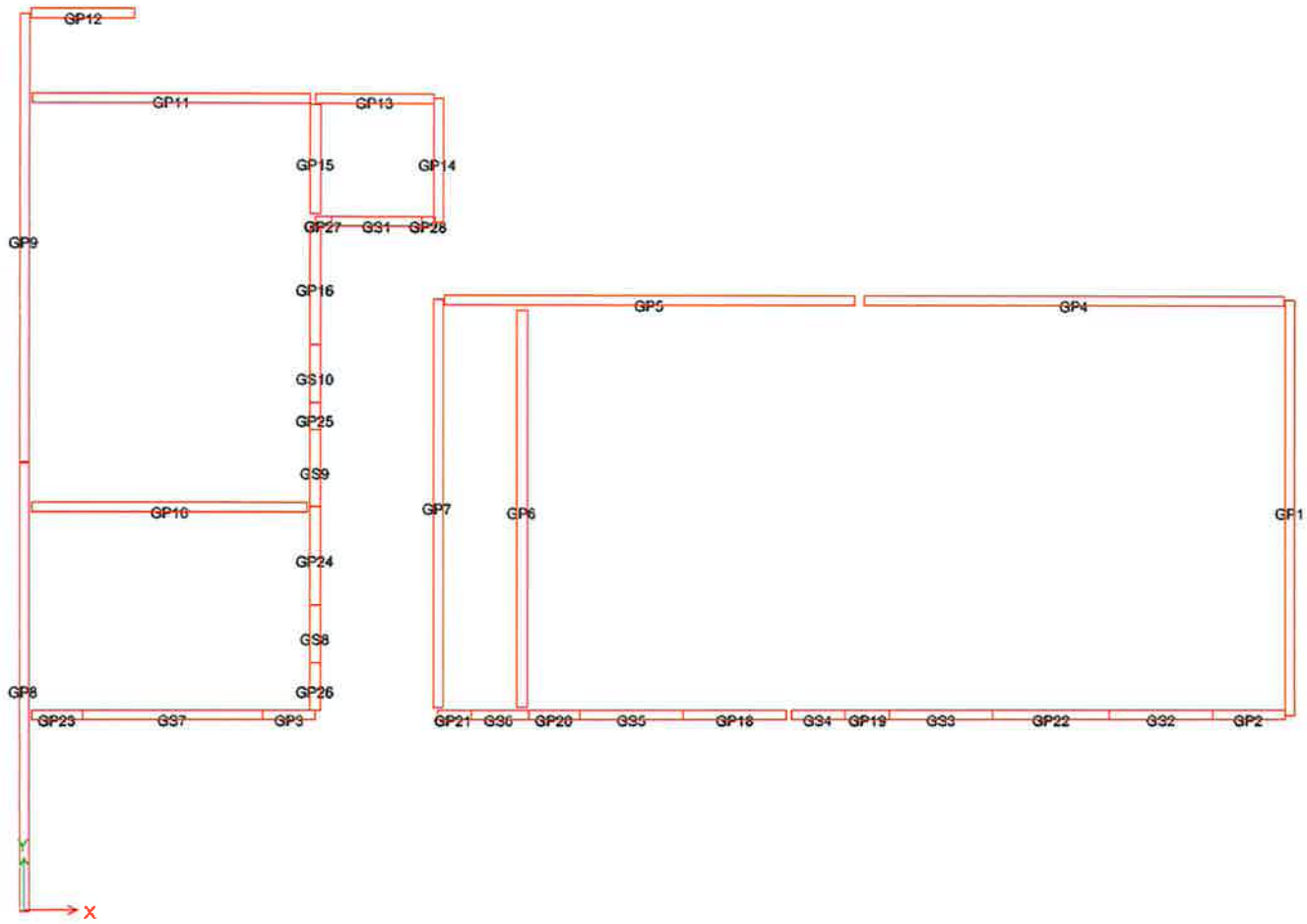
ETABS MODEL – LEVEL 2 PRECAST WALL LAYOUT

WP2



ETABS MODEL – LEVEL 1 PRECAST WALL LAYOUT

WP3



ETABS MODEL – GROUND LEVEL PRECAST WALL LAYOUT

WP4

ETABS SHEAR WALL DESIGN OUTPUT

ETABS TABLE: Shear Wall Pier Summary - AS 3600-09

Story	Pier Label	Station	Design Type	Required Reinf	Pier Leg	Leg X1 (mm)	Leg Y1 (mm)	Leg X2 (mm)	Leg Y2 (mm)	Shear Rebar (mm2/m)	Compressive Stress Left (MPa)	Compressive Stress Right (Mpa)	Compressive Stress Limit Left (Mpa)	Compressive Stress Limit Right (Mpa)
Story1	GP1	Top	Uniform	0.25	Top Leg 1	19600	3000	19600	9400	375	0.65	0.99	8	8
Story1	GP1	Bottom	Uniform	0.25	Bottom Leg 1	19600	3000	19600	9400	375	2.7	0.79	8	8
Story1	GP2	Top	Uniform	0.25	Top Leg 1	18400	3000	19525	3000	375	1.1	1.58	8	8
Story1	GP2	Bottom	Uniform	0.25	Bottom Leg 1	18400	3000	19525	3000	375	1.7	3.98	8	8
Story1	GP3	Top	Uniform	0.25	Top Leg 1	3700	3000	4500	3000	375	0	1.24	0	8
Story1	GP3	Bottom	Uniform	0.25	Bottom Leg 1	3700	3000	4500	3000	375	1.52	3.09	8	8
Story1	GP4	Top	Uniform	0.25	Top Leg 1	13000	9400	19500	9400	375	0.79	1.06	8	8
Story1	GP4	Bottom	Uniform	0.25	Bottom Leg 1	13000	9400	19500	9400	375	0.96	1.15	8	8
Story1	GP5	Top	Uniform	0.25	Top Leg 1	6500	9400	12850	9400	375	1.04	0.94	8	8
Story1	GP5	Bottom	Uniform	0.25	Bottom Leg 1	6500	9400	12850	9400	375	1.1	3.25	8	8
Story1	GP6	Top	Uniform	0.25	Top Leg 1	7700	3125	7700	9250	375	0	1.71	0	8
Story1	GP6	Bottom	Uniform	0.25	Bottom Leg 1	7700	3125	7700	9250	375	2.83	0.74	8	8
Story1	GP7	Top	Uniform	0.25	Top Leg 1	6400	3125	6400	9400	375	0.21	1.02	8	8
Story1	GP7	Bottom	Uniform	0.25	Bottom Leg 1	6400	3125	6400	9400	375	2.08	0.73	8	8
Story1	GP8	Top	Uniform	0.25	Top Leg 1	0	-20	0	6880	375	0	0.72	0	8
Story1	GP8	Bottom	Uniform	0.25	Bottom Leg 1	0	-20	0	6880	375	0.77	0.51	8	8
Story1	GP9	Top	Uniform	0.25	Top Leg 1	0	6900	0	13800	375	0.59	0.56	8	8
Story1	GP9	Bottom	Uniform	0.25	Bottom Leg 1	0	6900	0	13800	375	0.74	2.01	8	8
Story1	GP10	Top	Uniform	0.25	Top Leg 1	125	6200	4375	6200	375	0.85	0.3	8	8
Story1	GP10	Bottom	Uniform	0.25	Bottom Leg 1	125	6200	4375	6200	375	0.53	2.62	8	8
Story1	GP11	Top	Uniform	0.25	Top Leg 1	125	12500	4425	12500	375	0.53	0.96	8	8
Story1	GP11	Bottom	Uniform	0.25	Bottom Leg 1	125	12500	4425	12500	375	0.84	0.86	8	8
Story1	GP12	Top	Uniform	0.25	Top Leg 1	100	13800	1700	13800	375	0.76	0.26	8	8
Story1	GP12	Bottom	Uniform	0.25	Bottom Leg 1	100	13800	1700	13800	375	0.42	2.35	8	8
Story1	GP13	Top	Uniform	0.25	Top Leg 1	4500	12500	6325	12500	375	0	4.09	0	8
Story1	GP13	Bottom	Uniform	0.25	Bottom Leg 1	4500	12500	6325	12500	375	3.29	1.3	8	8
Story1	GP14	Top	Uniform	0.25	Top Leg 1	6400	10600	6400	12500	375	0	3.04	0	8
Story1	GP14	Bottom	Uniform	0.25	Bottom Leg 1	6400	10600	6400	12500	375	2.03	3.19	8	8
Story1	GP15	Top	Uniform	0.25	Top Leg 1	4500	10725	4500	12400	375	0.73	0.82	8	8
Story1	GP15	Bottom	Uniform	0.25	Bottom Leg 1	4500	10725	4500	12400	375	1.21	0.93	8	8
Story1	GP16	Top	Uniform	0.25	Top Leg 1	4500	8700	4500	10535	375	0.48	1.49	8	8
Story1	GP16	Bottom	Uniform	0.25	Bottom Leg 1	4500	8700	4500	10535	375	1.76	0.84	8	8
Story1	GP18	Top	Uniform	0.25	Top Leg 1	10200	3000	11800	3000	375	1.07	1.82	8	8
Story1	GP18	Bottom	Uniform	0.25	Bottom Leg 1	10200	3000	11800	3000	375	2.48	1.85	8	8
Story1	GP19	Top	Uniform	0.25	Top Leg 1	12700	3000	13400	3000	375	2.29	0	8	0
Story1	GP19	Bottom	Uniform	0.25	Bottom Leg 1	12700	3000	13400	3000	375	2.41	1.7	8	8
Story1	GP20	Top	Uniform	0.25	Top Leg 1	7800	3000	8600	3000	375	1.04	0	8	0
Story1	GP20	Bottom	Uniform	0.25	Bottom Leg 1	7800	3000	8600	3000	375	2.06	2.81	8	8
Story1	GP21	Top	Uniform	0.25	Top Leg 1	6400	3000	6900	3000	375	0	1.03	0	8
Story1	GP21	Bottom	Uniform	0.25	Bottom Leg 1	6400	3000	6900	3000	375	1.84	1.01	8	8

WPS

Story1	GP22	Top	Uniform	0.25	Top Leg 1	15000	3000	16800	3000	375	0.92	0.87	8	8
Story1	GP22	Bottom	Uniform	0.25	Bottom Leg 1	15000	3000	16800	3000	375	2.37	1.31	8	8
Story1	GP23	Top	Uniform	0.25	Top Leg 1	125	3000	900	3000	375	0.17	0.89	8	8
Story1	GP23	Bottom	Uniform	0.25	Bottom Leg 1	125	3000	900	3000	375	2.72	0.25	8	8
Story1	GP24	Top	Uniform	0.25	Top Leg 1	4500	4700	4500	6200	375	0.33	0	8	0
Story1	GP24	Bottom	Uniform	0.25	Bottom Leg 1	4500	4700	4500	6200	375	0.71	0.98	8	8
Story1	GP25	Top	Uniform	0.25	Top Leg 1	4500	7400	4500	7800	375	0	0	0	0
Story1	GP25	Bottom	Uniform	0.25	Bottom Leg 1	4500	7400	4500	7800	375	1.4	1.3	8	8
Story1	GP26	Top	Uniform	0.25	Top Leg 1	4500	3075	4500	3800	375	2.93	0	8	0
Story1	GP26	Bottom	Uniform	0.25	Bottom Leg 1	4500	3075	4500	3800	375	1.44	2.08	8	8
Story1	GP27	Top	Uniform	0.25	Top Leg 1	4500	10600	4750	10600	375	2.08	0	8	0
Story1	GP27	Bottom	Uniform	0.25	Bottom Leg 1	4500	10600	4750	10600	375	2.29	0	8	0
Story1	GP28	Top	Uniform	0.25	Top Leg 1	6150	10600	6350	10600	375	0	2.64	0	8
Story1	GP28	Bottom	Uniform	0.25	Bottom Leg 1	6150	10600	6350	10600	375	1.56	1.34	8	8
Story2	1P1	Top	Uniform	0.25	Top Leg 1	7600	12800	11200	12800	375	0.51	0.02	8	8
Story2	1P1	Bottom	Uniform	0.39	Bottom Leg 1	7600	12800	11200	12800	375	1.35	0	8	0
Story2	1P2	Top	Uniform	0.25	Top Leg 1	4500	12500	4900	12500	375	0.87	0.89	8	8
Story2	1P2	Bottom	Uniform	0.25	Bottom Leg 1	4500	12500	4900	12500	375	4.09	0.99	8	8
Story2	1P3	Top	Uniform	0.29	Top Leg 1	4500	10725	4500	12400	375	0.89	1.21	8	8
Story2	1P3	Bottom	Uniform	0.25	Bottom Leg 1	4500	10725	4500	12400	375	0	3.07	0	8
Story2	1P4	Top	Uniform	0.25	Top Leg 1	4500	10600	6350	10600	375	0.31	1.77	8	8
Story2	1P4	Bottom	Uniform	0.25	Bottom Leg 1	4500	10600	6350	10600	375	4.04	1.93	8	8
Story2	1P5	Top	Uniform	0.25	Top Leg 1	6400	10600	6400	12800	375	0.89	3.23	8	8
Story2	1P5	Bottom	Uniform	0.25	Bottom Leg 1	6400	10600	6400	12800	375	0	3.24	0	8
Story2	1P6	Top	Uniform	0.33	Top Leg 1	11200	10725	11200	12675	375	0.83	2.25	8	8
Story2	1P6	Bottom	Uniform	0.73	Bottom Leg 1	11200	10725	11200	12675	375	5.85	0	8	0
Story2	1P7	Top	Uniform	0.25	Top Leg 1	7700	10600	11200	10600	375	0	2.95	0	8
Story2	1P7	Bottom	Uniform	0.25	Bottom Leg 1	7700	10600	11200	10600	375	0.81	1.22	8	8
Story2	1P8	Top	Uniform	0.25	Top Leg 1	7700	6800	7700	10525	375	0.42	1.63	8	8
Story2	1P8	Bottom	Uniform	0.25	Bottom Leg 1	7700	6800	7700	10525	375	1.95	0	8	0
Story2	1P9	Top	Uniform	0.25	Top Leg 1	6400	6800	6400	10545	375	0.43	1.05	8	8
Story2	1P9	Bottom	Uniform	0.25	Bottom Leg 1	6400	6800	6400	10545	375	0.92	0.53	8	8
Story2	1P10	Top	Uniform	0.25	Top Leg 1	0	3000	0	13500	375	0.15	0.09	8	8
Story2	1P10	Bottom	Uniform	0.25	Bottom Leg 1	0	3000	0	13500	375	0.22	0.38	8	8
Story2	1P11	Top	Uniform	0.25	Top Leg 1	19600	3000	19600	13500	375	0.22	0	8	0
Story2	1P11	Bottom	Uniform	0.25	Bottom Leg 1	19600	3000	19600	13500	375	0.22	0.47	8	8
Story2	1P12	Top	Uniform	0.25	Top Leg 1	12000	3000	12800	3000	375	0.77	0	8	0
Story2	1P12	Bottom	Uniform	0.25	Bottom Leg 1	12000	3000	12800	3000	375	2.99	2.13	8	8
Story2	1P13	Top	Uniform	0.25	Top Leg 1	1400	3000	4400	3000	375	0	0.85	0	8
Story2	1P13	Bottom	Uniform	0.25	Bottom Leg 1	1400	3000	4400	3000	375	0	2.69	0	8
Story2	1P14	Top	Uniform	0.26	Top Leg 1	125	3000	600	3000	375	0	0	0	0
Story2	1P14	Bottom	Uniform	0.25	Bottom Leg 1	125	3000	1400	3000	375	2.52	0	8	0
Story2	1P15	Top	Uniform	0.25	Top Leg 1	6200	3000	7800	3000	375	0.78	0.42	8	8
Story2	1P15	Bottom	Uniform	0.25	Bottom Leg 1	6200	3000	7800	3000	375	1.17	4.04	8	8
Story2	1P16	Top	Uniform	0.25	Top Leg 1	9600	3000	10200	3000	375	0	3.94	0	8

WP6

Story2	1P16	Bottom	Uniform	0.25	Bottom Leg 1	9600	3000	10200	3000	375	2.51	7.5	8	8
Story2	1P17	Top	Uniform	0.25	Top Leg 1	14600	3000	18200	3000	375	0.57	0	8	0
Story2	1P17	Bottom	Uniform	0.25	Bottom Leg 1	14600	3000	18200	3000	375	0.88	0.78	8	8
Story2	1P18	Top	Uniform	0.51	Top Leg 1	19000	3000	19525	3000	375	0	0	0	0
Story2	1P18	Bottom	Uniform	0.25	Bottom Leg 1	18200	3000	19525	3000	375	0	3.37	0	8
Story2	1P19	Top	Uniform	0.28	Top Leg 1	6400	12800	6700	12800	375	2.88	0	8	0
Story2	1P19	Bottom	Uniform	0.57	Bottom Leg 1	6400	12800	6700	12800	375	4.37	0	8	0
Story3	2P1	Top	Uniform	0.25	Top Leg 1	7600	12800	11200	12800	375	0.12	0.28	8	8
Story3	2P1	Bottom	Uniform	0.25	Bottom Leg 1	7600	12800	11200	12800	375	1.4	1.75	8	8
Story3	2P2	Top	Uniform	0.25	Top Leg 1	4500	12500	4900	12500	375	2.89	0.24	8	8
Story3	2P2	Bottom	Uniform	0.25	Bottom Leg 1	4500	12500	4900	12500	375	0.62	4.25	8	8
Story3	2P3	Top	Uniform	0.25	Top Leg 1	4500	10725	4500	12400	375	0.4	0.14	8	8
Story3	2P3	Bottom	Uniform	0.29	Bottom Leg 1	4500	10725	4500	12400	375	0.27	2.71	8	8
Story3	2P4	Top	Uniform	0.28	Top Leg 1	4500	10600	6350	10600	375	0.87	0.61	8	8
Story3	2P4	Bottom	Uniform	0.4	Bottom Leg 1	4500	10600	6350	10600	375	1.59	2.52	8	8
Story3	2P5	Top	Uniform	0.25	Top Leg 1	6500	10600	11200	10600	375	0	1.03	0	8
Story3	2P5	Bottom	Uniform	0.25	Bottom Leg 1	6500	10600	11200	10600	375	1.01	0.95	8	8
Story3	2P6	Top	Uniform	0.25	Top Leg 1	6400	10600	6400	12800	375	1.02	0.91	8	8
Story3	2P6	Bottom	Uniform	0.25	Bottom Leg 1	6400	10600	6400	12800	375	1.23	2.4	8	8
Story3	2P7	Top	Uniform	0.25	Top Leg 1	11200	10725	11200	12675	375	0.5	0.18	8	8
Story3	2P7	Bottom	Uniform	0.45	Bottom Leg 1	11200	10725	11200	12675	375	1.83	7.3	8	8
Story3	2P8	Top	Uniform	0.25	Top Leg 1	6400	12800	6700	12800	375	1.15	0.5	8	8
Story3	2P8	Bottom	Uniform	0.78	Bottom Leg 1	6400	12800	6700	12800	375	4.63	0.87	8	8
Story4	RP1	Top	Uniform	0.25	Top Leg 1	6500	10600	11200	10600	375	0.19	0.16	8	8
Story4	RP1	Bottom	Uniform	0.25	Bottom Leg 1	6500	10600	11200	10600	375	0.28	0.2	8	8
Story4	RP2	Top	Uniform	0.25	Top Leg 1	4500	10600	6350	10600	375	0.2	0.05	8	8
Story4	RP2	Bottom	Uniform	0.25	Bottom Leg 1	4500	10600	6350	10600	375	0	0.56	0	8
Story4	RP3	Top	Uniform	0.25	Top Leg 1	11200	10725	11200	12675	375	0.02	0.52	8	8
Story4	RP3	Bottom	Uniform	0.25	Bottom Leg 1	11200	10725	11200	12675	375	1.68	0.18	8	8
Story4	RP4	Top	Uniform	0.25	Top Leg 1	4500	10725	4500	12400	375	0	0	0	0
Story4	RP4	Bottom	Uniform	0.25	Bottom Leg 1	4500	10725	4500	12400	375	0.44	0.11	8	8
Story4	RP5	Top	Uniform	0.25	Top Leg 1	7600	12800	11200	12800	375	0.05	0.22	8	8
Story4	RP5	Bottom	Uniform	0.25	Bottom Leg 1	7600	12800	11200	12800	375	0.42	1.67	8	8
Story4	RP6	Top	Uniform	0.25	Top Leg 1	4500	12500	4900	12500	375	0.1	0.12	8	8
Story4	RP6	Bottom	Uniform	0.27	Bottom Leg 1	4500	12500	4900	12500	375	2.38	0.78	8	8
Story4	RP7	Top	Uniform	0.25	Top Leg 1	6400	10600	6400	12800	375	0.85	0.18	8	8
Story4	RP7	Bottom	Uniform	0.25	Bottom Leg 1	6400	10600	6400	12800	375	0.78	0.78	8	8
Story4	RP8	Top	Uniform	0.35	Top Leg 1	6400	12800	6700	12800	375	0.97	0.66	8	8
Story4	RP8	Bottom	Uniform	0.52	Bottom Leg 1	6400	12800	6700	12800	375	1.59	2.5	8	8

critical - see ETABS calculation.

note: all wall members requiring greater than the minimum reinf. ratio are short nib walls; all other walls need only minimum steel for flexure & shear.

WP8

ETABS 2016 Shear Wall Design

AS 3600-09 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
Story3	2P8	6550	12800	300	150	1

Material Properties

E_c (MPa)	f'_c (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31939	40	1	500	500

Design Code Parameters

Φ_t	Φ_c	Φ_v	IP_{MAX}	IP_{MIN}	P_{MAX}
0.75	0.6	0.7	0.02	0.0025	0.8

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	6400	12800	6700	12800	300	150
Bottom	Leg 1	6400	12800	6700	12800	300	150

Flexural Design for N*, M^*_2 and M^*_3

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	FlexuralCombo	N* kN	M^*_2 kN-m	M^*_3 kN-m	Pier A_g mm²
Top	113	0.0025	0.0045	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	25.5654	0.015	-2.4416	45000
Bottom	352	0.0078	0.0045	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	-55.4891	-0.0131	-8.9248	45000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	N* kN	M* kN-m	V* kN	ΦV_c kN	ΦV_n kN
Top	Leg 1	375	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	20.6225	-1.6495	7.8486	27.0944	58.5944
Bottom	Leg 1	375	Ult 36 (G-EQX+0.3Q)	-3.0348	-10.8911	19.7914	27.0944	58.5944

Boundary Element Check (Part 1 of 2)

Station Location	ID	Edge Length (mm)	Governing Combo	N* kN	M* kN-m	Stress Comp MPa
Top–Left	Leg 1	0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	29.7285	-1.093	1.15
Top–Right	Leg 1	0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	22.0586	0.022	0.5
Bottom–Left	Leg 1	0	Ult 37 (G+EQY+0.3Q)	139.3516	-3.4421	4.63
Botttom–Right	Leg 1	0	Ult 37 (G+EQY+0.3Q)	18.221	1.0548	0.87

Boundary Element Check (Part 2 of 2)

Stress Limit MPa	C Depth mm	C Limit mm
8	Not Required	Not Required
8	Not Required	Not Required
8	Not Required	Not Required
8	Not Required	Not Required

REF:	1702160
DATE:	Jun-17
SHEET:	RC1
DESIGN:	FK

Purlins
P1

span	7.8	m	single span
spacing	1.2	m	
live load	0.31	kPa	
wind pressure	0.96	kPa	(Ultimate)
Cpn	1.2		
roof weight	0.4	kPa	(sheet + ceiling)

LOADS

DL			
roof	0.48	kN/m	
self wt.	0.08	kN/m	
	0.56	kN/m	total
LL			
roof	0.37	kN/m	
	0.37	kN/m	total
WL	1.38	kN/m	(ultimate)

STRENGTH DESIGN

w* = 1.2DL + 1.5LL	=	1.23	kN/m
w* = 0.9DL + WL(ult)	=	-0.88	kN/m

SERVICABILITY DESIGN

w (serv)	=	0.82	kN/m

Win =	2.5	kN/m	from lysaght tables
Wout =	1.6	kN/m	from lysaght tables
w for Δ=L/150	1.23	kN/m	from lysaght tables
Δserv =	35	mm	L/ 224
Δdl =	24	mm	L/ 329

Adopt SZ20024 @ 1200c/c **1 Row Bridging**

REF:	1702160
DATE:	May-17
SHEET:	RC2
DESIGN:	FK

Purlins
P2

span	6.5	m	single span
spacing	1.2	m	
live load	0.35	kPa	
wind pressure	0.96	kPa	(Ultimate)
Cpn	1.2		
roof weight	0.4	kPa	(sheet + ceiling)

LOADS

DL			
roof	0.48	kN/m	
self wt.	0.08	kN/m	
	0.56	kN/m	total
LL			
roof	0.42	kN/m	
	0.42	kN/m	total
WL	1.38	kN/m	(ultimate)

STRENGTH DESIGN

w* = 1.2DL + 1.5LL	=	1.30	kN/m
w* = 0.9DL + WL(ult)	=	-0.88	kN/m

SERVICABILITY DESIGN

w (serv)	=	0.85	kN/m

Win =	1.88	kN/m	from lysaght tables
Wout =	1.59	kN/m	from lysaght tables
w for Δ=L/150	1.88	kN/m	from lysaght tables
Δserv =	20	mm	L/ 330
Δdl =	13	mm	L/ 504

Adopt SZ20015 @ 1200c/c **1 Row Bridging**

Ref.:	1702160
Date:	21-Mar-17
Design:	FK
Page:	RC3

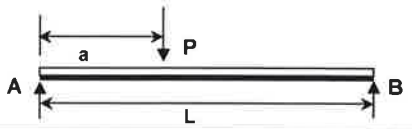
STEEL BEAM DESIGN

These calculations comply with the requirements of AS4100 — 1998 Steel Structures

Member **R.R1** Design span, L = **5600** mm

Effective length of lateral restraint, l_e = **1200** mm

Distance, a, from LH Support to Point Load = **0** mm



Load Type	UDL		Width		
1a. Uniform DL	0.40 kPa	x	4.00 m =	1.60	kN/m
				0.00	kN/m
Self Weight				0.18	kN/m
			Total	1.78	kN/m
1b. Point DL			Total	0.00	kN
2a. Uniform LL	0.25 kPa	x	4.00 m =	1.00	kN/m
				0.00	kN/m
			Total	1.00	kN/m
2b. Point LL			Total	0.00	kN
3a. Uniform WL (see note)	-1.15 kPa	x	4.00 m =	-4.60	kN/m
				0.00	kN/m
			Total	-4.60	kN/m
3b. Point WL			Total	0.00	kN

*Note: For WL, 'positive' loads act downward and 'negative' loads act upward

STRENGTH DESIGN Combination of Load Types **

- (●) DL + LL
- ( ) DL + LL + WL
- ( ) DL + WL

** AS/NZS 1170.0:2002

Deflection Limits	Span:Deflection Ratio	Maximum Deflection (mm)
1. Dead Load	360	12
2. Dead Load + 0.7 * Live Load	250	18
3. Wind Load Only	400	10

Bending Moments and Stiffness (Refer to Combination of Load Types for Member Strength Calculations)

W* =	3.63 kN/m	P* =	0.00 kN	M* =	14.24 kNm	
R_A* =	10.17 kN	R_B* =	10.17 kN	$I_{req,DL}$ =	9.5E+6 mm^4	← Governs
$W_{s,DL+0.7LL}$ =	2.48 kN/m	$P_{s,DL+0.7LL}$ =	0.00 kN	$I_{req,DL+0.7LL}$ =	8.8E+6 mm^4	
$W_{s,WL}$ =	0.78 kN/m	$P_{s,WL}$ =	0.00 kN	$I_{req,WL}$ =	5.0E+6 mm^4	

Trial Section

Trial beam size : 180 UB 18.1

Depth of section, d =	175	mm	
Flange width, b_f =	90	mm	
Flange thickness, t_f =	8	mm	
Web thickness, t_w =	5	mm	
Section area, A_g =	2300	mm^2	
I_x =	12.1E+6	mm^4	:. OK
Z_x =	139E+3	mm^3	
S_x =	157E+3	mm^3	
r_x =	72.6	mm	
I_y =	975.00E+3	mm^4	
Z_y =	21.7E+3	mm^3	
S_y =	33.7E+3	mm^3	
r_y =	20.6	mm	
J =	44.8E+3	mm^4	
I_w =	6.8E+9	mm^6	
Flange, f_y =	320	MPa	
Web, f_y =	320	MPa	
k_f =	1.00		
Z_{ex} =	157E+3	mm^3	
Z_{ey} =	32.5E+3	mm^3	
Compactness =	C		

Material Properties

E =	200E+3	MPa
G =	76.9E+3	MPa

Section Capacity -- $M^* \le \phi M_{sx}$

Check $M^* \le \phi M_{sx}$ ($=\phi f_y Z_{ex}$)

M_{sx} =	50.2	kNm (Clause 5.2.1)
ϕM_{sx} =	**45.2 kNm > 14.24 kNm :. OK**	

Member Capacity -- $M^* \le \phi M_{bx}$

Check $M^* \le \phi M_{bx}$ ($= \phi\, \alpha_m . \alpha_s . M_{sx} \le \phi M_{sx}$)

β_m =	0.00	AS 4100 Table 5.6.1
α_m =	1.13	
k_t =	1.00	Table 5.6.3(1)
k_l =	1.00	Table 5.6.3(2)
k_r =	1.00	Table 5.6.3(3)
l_e =	1200 mm	
M_o =	130.6 kNm	(Eq. 6.5.1.1(3))
α_s =	0.83	Eq. 5.6.1.1(2)
M_{bx} =	47.3 kNm	(Eq. 5.6.1.1(1))
ϕM_{bx} =	**42.6 kNm > 14.24 kNm :. OK**	

ADOPT

180 UB 18.1 (180 PFC also ok)

Restrain top flange laterally at 1200 mm centres (maximum)

Ref.:	1702160
Date:	21-Mar-17
Design:	FK
Page:	RC4

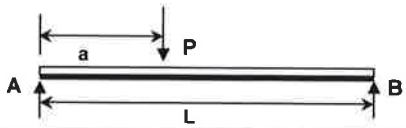
STEEL BEAM DESIGN

These calculations comply with the requirements of AS4100 — 1998 Steel Structures

Member **R.R1** Design span, L = **5600** mm

Effective length of lateral restraint, l_e = **5600** mm

Distance, a, from LH Support to Point Load = **0** mm



Load Type	UDL		Width		
1a. Uniform DL	0.40 kPa	x	4.00 m =	1.60	kN/m
				0.00	kN/m
Self Weight				0.18	kN/m
			Total	1.78	kN/m
1b. Point DL			Total	0.00	kN
2a. Uniform LL	0.25 kPa	x	4.00 m =	1.00	kN/m
				0.00	kN/m
			Total	1.00	kN/m
2b. Point LL			Total	0.00	kN
3a. Uniform WL (see note)	-1.15 kPa	x	4.00 m =	-4.60	kN/m
				0.00	kN/m
			Total	-4.60	kN/m
3b. Point WL			Total	0.00	kN

STRENGTH DESIGN Combination of Load Types **

- ○ DL + LL
- ○ DL + LL + WL
- ◉ DL + WL

*Note: For WL, 'positive' loads act downward and 'negative' loads act upward

** AS/NZS 1170.0:2002

Deflection Limits	Span:Deflection Ratio	Maximum Deflection (mm)
1. Dead Load	360	12
2. Dead Load + 0.7 * Live Load	250	18
3. Wind Load Only	400	10

Bending Moments and Stiffness (Refer to Combination of Load Types for Member Strength Calculations)

W^* =	-3.00 kN/m	P^* =	0.00 kN	M^* =	-11.76 kNm	
R_A^* =	-8.40 kN	R_B^* =	-8.40 kN	$I_{req,DL}$ =	9.5E+6 mm^4	← Governs
$W_{s,DL+0.7LL}$ =	2.48 kN/m	$P_{s,DL+0.7LL}$ =	0.00 kN	$I_{req,DL+0.7LL}$ =	8.8E+6 mm^4	
$W_{s,WL}$ =	0.78 kN/m	$P_{s,WL}$ =	0.00 kN	$I_{req,WL}$ =	5.0E+6 mm^4	

Trial Section

Trial beam size : 180 UB 18.1

Depth of section, d =	175	mm	
Flange width, b_f =	90	mm	
Flange thickness, t_f =	8	mm	
Web thickness, t_w =	5	mm	
Section area, A_g =	2300	mm^2	
I_x =	12.1E+6	mm^4	:. OK
Z_x =	139E+3	mm^3	
S_x =	157E+3	mm^3	
r_x =	72.6	mm	
I_y =	975.00E+3	mm^4	
Z_y =	21.7E+3	mm^3	
S_y =	33.7E+3	mm^3	
r_y =	20.6	mm	
J =	44.8E+3	mm^4	
I_w =	6.8E+9	mm^6	
Flange, f_y =	320	MPa	
Web, f_y =	320	MPa	
k_f =	1.00		
Z_{ex} =	157E+3	mm^3	
Z_{ey} =	32.5E+3	mm^3	
Compactness =	C		

Material Properties

E =	200E+3	MPa
G =	76.9E+3	MPa

Section Capacity -- $M^* \le \phi M_{sx}$

Check $M^* \le \phi M_{sx}$ ($=\phi f_y.Z_{ex}$)

M_{sx} =	50.2 kNm	(Clause 5.2.1)
ϕM_{sx} =	**45.2 kNm > 11.76 kNm :. OK**	

Member Capacity -- $M^* \le \phi M_{bx}$

Check $M^* \le \phi M_{bx}$ ($= \phi\ \alpha_m.\alpha_s.M_{sx} \le \phi M_{sx}$)

β_m =	0.00	AS 4100 Table 5.6.1
α_m =	1.13	
k_t =	1.00	Table 5.6.3(1)
k_l =	1.00	Table 5.6.3(2)
k_r =	1.00	Table 5.6.3(3)
l_e =	5600 mm	
M_o =	15.4 kNm	(Eq. 6.5.1.1(3))
α_s =	0.26	Eq. 5.6.1.1(2)
M_{bx} =	14.7 kNm	(Eq. 5.6.1.1(1))
ϕM_{bx} =	**13.2 kNm > 11.76 kNm :. OK**	

ADOPT

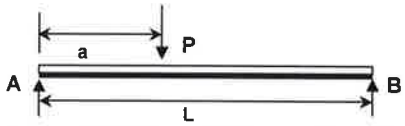
180 UB 18.1 (180 PFC also OK)

Restrain bottom flange laterally at 5600 mm centres (maximum)

STEEL BEAM DESIGN

These calculations comply with the requirements of AS4100 — 1998 Steel Structures

Member **R.R2** Design span, L = **3000** mm
Effective length of lateral restraint, l_e = **1200** mm
Distance, a, from LH Support to Point Load = **0** mm



Load Type	UDL		Width		
1a. Uniform DL	0.40 kPa	x	7.90 m =	3.16	kN/m
				0.00	kN/m
Self Weight				0.14	kN/m
			Total	3.30	kN/m
1b. Point DL			Total	0.00	kN
2a. Uniform LL	0.25 kPa	x	7.90 m =	1.98	kN/m
				0.00	kN/m
			Total	1.98	kN/m
2b. Point LL			Total	0.00	kN
3a. Uniform WL (see note)	-1.15 kPa	x	7.90 m =	-9.09	kN/m
				0.00	kN/m
			Total	-9.09	kN/m
3b. Point WL			Total	0.00	kN

*Note: For WL, 'positive' loads act downward and 'negative' loads act upward

STRENGTH DESIGN Combination of Load Types **

- (●) DL + LL
- ( ) DL + LL + WL
- ( ) DL + WL

** AS/NZS 1170.0:2002

Deflection Limits	Span:Deflection Ratio	Maximum Deflection (mm)
1. Dead Load	360	12
2. Dead Load + 0.7 * Live Load	250	18
3. Wind Load Only	400	20

Bending Moments and Stiffness (Refer to Combination of Load Types for Member Strength Calculations)

W^* =	6.92 kN/m	P^* =	0.00 kN	M^* =	7.78 kNm	
R_A^* =	10.38 kN	R_B^* =	10.38 kN	$I_{req,DL}$ =	2.1E+6 mm^4	← Governs
$W_{s,DL+0.7LL}$ =	4.68 kN/m	$P_{s,DL+0.7LL}$ =	0.00 kN	$I_{req,DL+0.7LL}$ =	2.1E+6 mm^4	
$W_{s,WL}$ =	0.78 kN/m	$P_{s,WL}$ =	0.00 kN	$I_{req,WL}$ =	548.4E+3 mm^4	

Trial Section

Trial beam size : 150 UB 14

Depth of section, d =	150 mm	
Flange width, b_f =	75 mm	
Flange thickness, t_f =	7 mm	
Web thickness, t_w =	5 mm	
Section area, A_g =	1780 mm^2	
I_x =	6.7E+6 mm^4	:. OK
Z_x =	89E+3 mm^3	
S_x =	102E+3 mm^3	
r_x =	61.1 mm	
I_y =	495.00E+3 mm^4	
Z_y =	13.2E+3 mm^3	
S_y =	20.8E+3 mm^3	
r_y =	16.6 mm	
J =	28.1E+3 mm^4	
I_w =	2.5E+9 mm^6	
Flange, f_y =	320 MPa	
Web, f_y =	320 MPa	
k_f =	1.00	
Z_{ex} =	102E+3 mm^3	
Z_{ey} =	19.8E+3 mm^3	
Compactness =	C	

Material Properties

E = 200E+3 MPa
G = 76.9E+3 MPa

Section Capacity -- $M^* \le \phi M_{sx}$

Check $M^* \le \phi M_{sx}$ ($=\phi f_y.Z_{ex}$)

M_{sx} = 32.6 kNm (Clause 5.2.1)
ϕM_{sx} = **29.4 kNm > 7.78 kNm :. OK**

Member Capacity -- $M^* \le \phi M_{bx}$

Check $M^* \le \phi M_{bx}$ ($= \phi\, \alpha_m.\alpha_s.M_{sx} \le \phi M_{sx}$)

β_m =	0.00	AS 4100 Table 5.6.1
α_m =	1.13	
k_t =	1.00	Table 5.6.3(1)
k_l =	1.00	Table 5.6.3(2)
k_r =	1.00	Table 5.6.3(3)
l_e =	1200 mm	
M_o =	61.8 kNm	(Eq. 6.5.1.1(3))
α_s =	0.77	Eq. 5.6.1.1(2)
M_{bx} =	28.4 kNm	(Eq. 5.6.1.1(1))
ϕM_{bx} =	**25.5 kNm > 7.78 kNm :. OK**	

ADOPT

150 UB 14 (150 PFC also OK)

Restrain top flange laterally at 1200 mm centres (maximum)

Ref.:	1702160
Date:	21-Mar-17
Design:	FK
Page:	R6

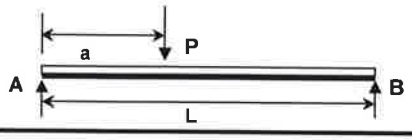
STEEL BEAM DESIGN

These calculations comply with the requirements of AS4100 — 1998 Steel Structures

Member **R.R2** Design span, L = **3000** mm

Effective length of lateral restraint, l_e = **3000** mm

Distance, a, from LH Support to Point Load = **0** mm



Load Type	UDL		Width		
1a. Uniform DL	0.40 kPa	x	7.90 m =	3.16	kN/m
				0.00	kN/m
Self Weight				0.14	kN/m
			Total	3.30	kN/m
1b. Point DL			Total	0.00	kN
2a. Uniform LL	0.25 kPa	x	7.90 m =	1.98	kN/m
				0.00	kN/m
			Total	1.98	kN/m
2b. Point LL			Total	0.00	kN
3a. Uniform WL (see note)	-1.15 kPa	x	7.90 m =	-9.09	kN/m
				0.00	kN/m
			Total	-9.09	kN/m
3b. Point WL			Total	0.00	kN

STRENGTH DESIGN Combination of Load Types **

- ○ DL + LL
- ○ DL + LL + WL
- ◉ DL + WL

*Note: For WL, 'positive' loads act downward and 'negative' loads act upward

** AS/NZS 1170.0:2002

Deflection Limits	Span:Deflection Ratio	Maximum Deflection (mm)
1. Dead Load	360	12
2. Dead Load + 0.7 * Live Load	250	18
3. Wind Load Only	400	20

Bending Moments and Stiffness (Refer to Combination of Load Types for Member Strength Calculations)

W^* =	-6.12 kN/m	P^* =	0.00 kN	M^* =	-6.88 kNm	
R_A^* =	-9.18 kN	R_B^* =	-9.18 kN	$I_{req,DL}$ =	2.1E+6 mm^4	← Governs
$W_{s,DL+0.7LL}$ =	4.68 kN/m	$P_{s,DL+0.7LL}$ =	0.00 kN	$I_{req,DL+0.7LL}$ =	2.1E+6 mm^4	
$W_{s,WL}$ =	0.78 kN/m	$P_{s,WL}$ =	0.00 kN	$I_{req,WL}$ =	548.4E+3 mm^4	

Trial Section

Trial beam size : 150 UB 14

Depth of section, d =	150 mm	
Flange width, b_f =	75 mm	
Flange thickness, t_f =	7 mm	
Web thickness, t_w =	5 mm	
Section area, A_g =	1780 mm^2	
I_x =	6.7E+6 mm^4	:. OK
Z_x =	89E+3 mm^3	
S_x =	102E+3 mm^3	
r_x =	61.1 mm	
I_y =	495.00E+3 mm^4	
Z_y =	13.2E+3 mm^3	
S_y =	20.8E+3 mm^3	
r_y =	16.6 mm	
J =	28.1E+3 mm^4	
I_w =	2.5E+9 mm^6	
Flange, f_y =	320 MPa	
Web, f_y =	320 MPa	
k_f =	1.00	
Z_{ex} =	102E+3 mm^3	
Z_{ey} =	19.8E+3 mm^3	
Compactness =	C	

Material Properties

E =	200E+3 MPa
G =	76.9E+3 MPa

Section Capacity -- $M^* \le \phi M_{sx}$

Check $M^* \le \phi M_{sx}$ ($=\phi f_y Z_{ex}$)

M_{sx} =	32.6 kNm	(Clause 5.2.1)
ϕM_{sx} =	**29.4 kNm > 6.88 kNm :. OK**	

Member Capacity -- $M^* \le \phi M_{bx}$

Check $M^* \le \phi M_{bx}$ ($= \phi\, \alpha_m . \alpha_s . M_{sx} \le \phi M_{sx}$)

β_m =	0.00	AS 4100 Table 5.6.1
α_m =	1.13	
k_t =	1.00	Table 5.6.3(1)
k_l =	1.00	Table 5.6.3(2)
k_r =	1.00	Table 5.6.3(3)
l_e =	3000 mm	
M_o =	17.2 kNm	(Eq. 6.5.1.1(3))
α_s =	0.40	Eq. 5.6.1.1(2)
M_{bx} =	14.8 kNm	(Eq. 5.6.1.1(1))
ϕM_{bx} =	**13.4 kNm > 6.88 kNm :. OK**	

ADOPT

150 UB 14 (150 PFC also OK)

Restrain bottom flange laterally at 3000 mm centres (maximum)

Ref.:	1702160
Date:	21-Mar-17
Design:	FK
Page:	2C7

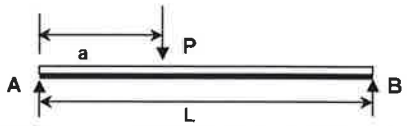
STEEL BEAM DESIGN

These calculations comply with the requirements of AS4100 — 1998 Steel Structures

Member **R.R3** Design span, L = **7500** mm

Effective length of lateral restraint, l_e = **1200** mm

Distance, a, from LH Support to Point Load = **1200** mm



Load Type	UDL		Width		
1a. Uniform DL	0.40 kPa	x	7.90 m =	3.16	kN/m
					kN/m
Self Weight				0.25	kN/m
			Total	3.41	kN/m
1b. Point DL			Total		kN
2a. Uniform LL	0.25 kPa	x	7.90 m =	1.98	kN/m
					kN/m
			Total	1.98	kN/m
2b. Point LL			Total	0.00	kN
3a. Uniform WL (see note)	-1.15 kPa	x	7.90 m =	-9.09	kN/m
					kN/m
			Total	-9.09	kN/m
3b. Point WL			Total		kN

STRENGTH DESIGN Combination of Load Types **

- (●) DL + LL
- ( ) DL + LL + WL
- ( ) DL + WL

*Note: For WL, 'positive' loads act downward and 'negative' loads act upward

** AS/NZS 1170.0:2002

Deflection Limits	Span:Deflection Ratio	Maximum Deflection (mm)
1. Dead Load	360	20
2. Dead Load + 0.7 * Live Load	250	30
3. Wind Load Only	400	10

Bending Moments and Stiffness (Refer to Combination of Load Types for Member Strength Calculations)

W^* =	7.06 kN/m	P^* =	0.00 kN	M^* =	49.62 kNm	
R_A^* =	26.46 kN	R_B^* =	26.46 kN	$I_{req,DL}$ =	35.1E+6 mm^4	← Governs
$W_{s,DL+0.7LL}$ =	4.79 kN/m	$P_{s,DL+0.7LL}$ =	0.00 kN	$I_{req,DL+0.7LL}$ =	32.9E+6 mm^4	
$W_{s,WL}$ =	0.78 kN/m	$P_{s,WL}$ =	0.00 kN	$I_{req,WL}$ =	16.1E+6 mm^4	

Trial Section

Trial beam size : 250 UB 25.7

Depth of section, d =	248 mm	
Flange width, b_f =	124 mm	
Flange thickness, t_f =	8 mm	
Web thickness, t_w =	5 mm	
Section area, A_g =	3270 mm^2	
I_x =	35.4E+6 mm^4	:. OK
Z_x =	285E+3 mm^3	
S_x =	319E+3 mm^3	
r_x =	104 mm	
I_y =	2.55E+6 mm^4	
Z_y =	41.1E+3 mm^3	
S_y =	63.6E+3 mm^3	
r_y =	27.9 mm	
J =	67.4E+3 mm^4	
I_w =	36.7E+9 mm^6	
Flange, f_y =	320 MPa	
Web, f_y =	320 MPa	
k_f =	0.95	
Z_{ex} =	319E+3 mm^3	
Z_{ey} =	61.7E+3 mm^3	
Compactness =	C	

Material Properties

E =	200E+3 MPa
G =	76.9E+3 MPa

Section Capacity -- $M^* \le \phi M_{sx}$

Check $M^* \le \phi M_{sx}$ ($=\phi f_y.Z_{ex}$)

M_{sx} =	102.1 kNm	(Clause 5.2.1)
ϕM_{sx} =	**91.9 kNm > 49.62 kNm :. OK**	

Member Capacity -- $M^* \le \phi M_{bx}$

Check $M^* \le \phi M_{bx}$ ($= \phi\, \alpha_m.\alpha_s.M_{sx} \le \phi M_{sx}$)

β_m =	0.00	AS 4100 Table 5.6.1
α_m =	1.13	
k_t =	1.00	Table 5.6.3(1)
k_l =	1.00	Table 5.6.3(2)
k_r =	1.00	Table 5.6.3(3)
l_e =	1200 mm	
M_o =	440.4 kNm	(Eq. 6.5.1.1(3))
α_s =	0.91	Eq. 5.6.1.1(2)
M_{bx} =	104.9 kNm	(Eq. 5.6.1.1(1))
ϕM_{bx} =	**91.9 kNm > 49.62 kNm :. OK**	

ADOPT

250 UB 25.7 (250PFC also OK)

Restrain top flange laterally at 1200 mm centres (maximum)

Ref.:	1702160
Date:	21-Mar-17
Design:	FK
Page:	RC8

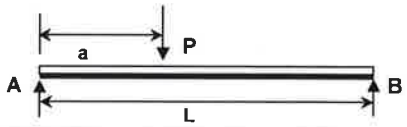
STEEL BEAM DESIGN

These calculations comply with the requirements of AS4100 — 1998 Steel Structures

Member **R.R3** Design span, L = **7500** mm

Effective length of lateral restraint, l_e = **3750** mm

Distance, a, from LH Support to Point Load = **1200** mm



Load Type	UDL		Width		
1a. Uniform DL	0.40 kPa	x	7.90 m =	3.16	kN/m
					kN/m
Self Weight				0.25	kN/m
			Total	3.41	kN/m
1b. Point DL			Total		kN
2a. Uniform LL	0.25 kPa	x	7.90 m =	1.98	kN/m
					kN/m
			Total	1.98	kN/m
2b. Point LL			Total	0.00	kN
3a. Uniform WL (see note)	-1.15 kPa	x	7.90 m =	-9.09	kN/m
					kN/m
			Total	-9.09	kN/m
3b. Point WL			Total		kN

STRENGTH DESIGN Combination of Load Types **

- ○ DL + LL
- ○ DL + LL + WL
- ◉ DL + WL

*Note: For WL, 'positive' loads act downward and 'negative' loads act upward

** AS/NZS 1170.0:2002

Deflection Limits	Span:Deflection Ratio	Maximum Deflection (mm)
1. Dead Load	360	20
2. Dead Load + 0.7 * Live Load	250	30
3. Wind Load Only	400	10

Bending Moments and Stiffness (Refer to Combination of Load Types for Member Strength Calculations)

W^* =	-6.01 kN/m	P^* =	0.00 kN	M^* =	-42.29 kNm	
R_A^* =	-22.55 kN	R_B^* =	-22.55 kN	$I_{req,DL}$ =	35.1E+6 mm^4	← Governs
$W_{s,DL+0.7LL}$ =	4.79 kN/m	$P_{s,DL+0.7LL}$ =	0.00 kN	$I_{req,DL+0.7LL}$ =	32.9E+6 mm^4	
$W_{s,WL}$ =	0.78 kN/m	$P_{s,WL}$ =	0.00 kN	$I_{req,WL}$ =	16.1E+6 mm^4	

Trial Section

Trial beam size : 250 UB 25.7

Depth of section, d =	248	mm	
Flange width, b_f =	124	mm	
Flange thickness, t_f =	8	mm	
Web thickness, t_w =	5	mm	
Section area, A_g =	3270	mm^2	
I_x =	35.4E+6	mm^4	:. OK
Z_x =	285E+3	mm^3	
S_x =	319E+3	mm^3	
r_x =	104	mm	
I_y =	2.55E+6	mm^4	
Z_y =	41.1E+3	mm^3	
S_y =	63.6E+3	mm^3	
r_y =	27.9	mm	
J =	67.4E+3	mm^4	
I_w =	36.7E+9	mm^6	
Flange, f_y =	320	MPa	
Web, f_y =	320	MPa	
k_f =	0.95		
Z_{ex} =	319E+3	mm^3	
Z_{ey} =	61.7E+3	mm^3	
Compactness =	C		

Material Properties

E =	200E+3	MPa
G =	76.9E+3	MPa

Section Capacity -- $M^* \le \phi M_{sx}$

Check $M^* \le \phi M_{sx}$ ($=\phi f_y Z_{ex}$)

M_{sx} =	102.1 kNm	(Clause 5.2.1)
ϕM_{sx} =	**91.9 kNm > 42.29 kNm :. OK**	

Member Capacity -- $M^* \le \phi M_{bx}$

Check $M^* \le \phi M_{bx}$ ($= \phi\, \alpha_m . \alpha_s . M_{sx} \le \phi M_{sx}$)

β_m =	0.00	AS 4100 Table 5.6.1
α_m =	1.13	
k_t =	1.00	Table 5.6.3(1)
k_l =	1.00	Table 5.6.3(2)
k_r =	1.00	Table 5.6.3(3)
l_e =	3750 mm	
M_o =	60.8 kNm	(Eq. 6.5.1.1(3))
α_s =	0.44	Eq. 5.6.1.1(2)
M_{bx} =	50.8 kNm	(Eq. 5.6.1.1(1))
ϕM_{bx} =	**45.7 kNm > 42.29 kNm :. OK**	

ADOPT

250 UB 25.7 (250PFC also ok)

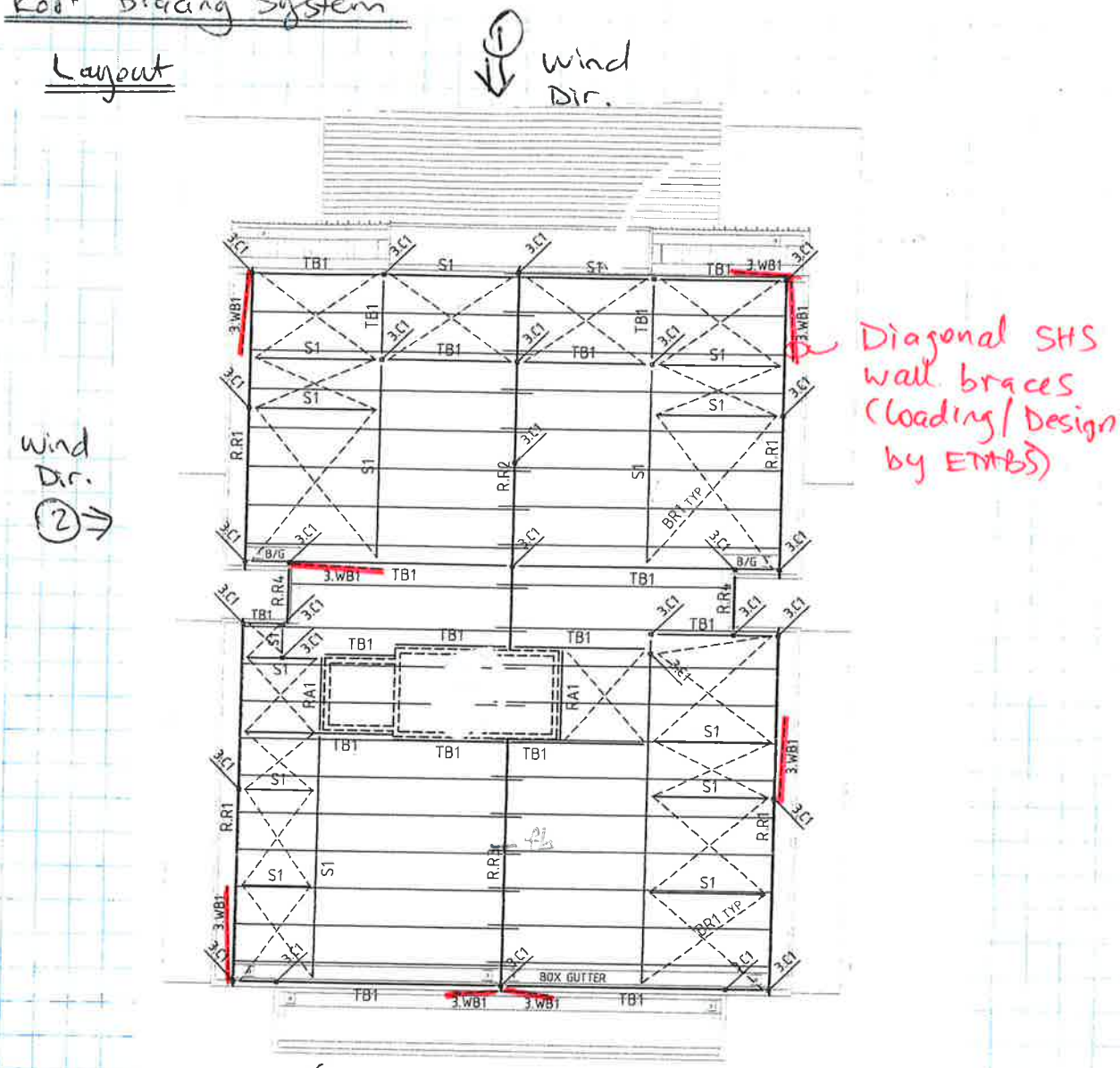
Restrain bottom flange laterally at 3750 mm centres (maximum)

TMK CONSULTING ENGINEERS

Ref.: 1702160
Date: 18/5/17
Design: FK
Page: RC9

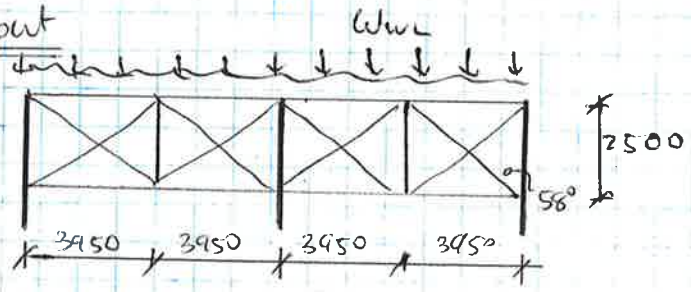
Roof Bracing System

Layout



Wind Dir ① - (largest roof truss span at rear tower)

Layout



$W_{WL} = 2.8m \times 0.96kPa \times 1.2 \times 1/2 = 1.62kN/m \rightarrow$ (ult)

$\Rightarrow M^*_{TRUSS} = 1.62 \times 15.8^2/8 = 50.5kN.m$

$\Rightarrow N^*_c(strut) = 50.5/2.5 = \underline{20.2kN}$

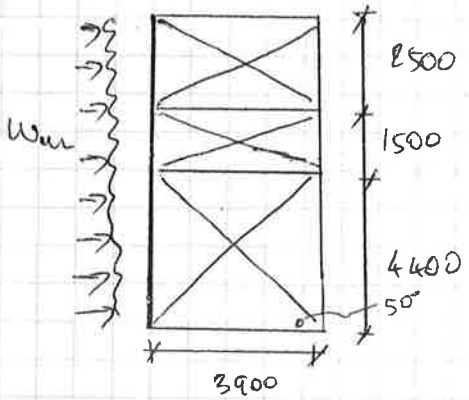
$N^*_t(bracing) = \frac{1.62 \times 15.8}{2} / \cos 58° = \underline{24.2kN}$

Checked : .....

Date : ...../...../.....

Wind Dir ② (largest roof truss span at rear tower)

Layout



$W_{ul} = 1.62$ kN/m → (U lt)

$M^*_{truss} = 1.62 \times 8.4^2/8 = 14.29$ kNm

N^*_c (strut) $= 14.29/3.9 = \underline{3.7 \text{ kN}}$

N^*_t (roof brace) $= 1.62 \times 8.4\text{m}/2 / \cos 50° = \underline{10.6 \text{ kN}}$

⇒ wind dir ① is critical

Rod Bracing - $N^*_t = 24.2$ kN ⇒ by inspection adopt Ø20 Rod.

Strut: $N^*_c = 20.2$ kN, $l = 7200$ mm } ⇒ adopt 89×89×6.0 SHS see spreadsheet.

Checked : .....

Date : ...../...../.....

Roof Tie Beam, TB1

Max span ≈ 7600mm
lateral load width ≈ 2800mm

Loads

$w_l = 0.96kPa \times 1.2 \times 2.8m \times 1/2 = 1.61kN/m \rightarrow (ULS)$ (share width
$= 1.08kN/m (SLS)$ leward end)

Serviceability Design

$D_{lim} = L/250$ (ULS serv)
$= 30.4mm$

$I_{req} = 5/384 \times \frac{1.08 \times 7600^4}{2 \times 10^5 \times 30.4}$
$= 7.7 \times 10^6 mm^4$

Strength Design

$w^* = 1.61kN/m \Rightarrow M^* = 11.6kNm$
$L_e = 7600mm$
$\alpha_m = 1.13$

$\Rightarrow$ 150PFC on flat OK. $I_x = 8.34$
$\phi M_b = 12.1kNm$

Checked : .....
Date : ..../..../.....

(Strut, S1)

COLUMN DESIGN - SHS SECTIONS - PINNED TOP & PINNED BASE

These calculations comply with the requirements of AS 4100 - 1998 Steel Structures.

N^* =	20.2	kN	vertical compression load (strength factored load)
l_h =	7200	mm	column height
k_e =	1.00		effective length factor (Clause 4.6.3)
e =	45	mm	applied load eccentricity at the top of the column
⇒ M^*=	0.91	kNm	

Column material yield stress ◉ 350 MPa ○ 450 MPa

Trial column size : 89x89x6.0 SHS (C350)

$A_n = A_g$ =	1870	mm^2	f_y =	350	MPa	k_f =	1.0
Z_e =	56.6E+3	mm^3	$r_x = r_y$ =	33.2	mm	S_x =	56.6E+3 mm^3
$I_x = I_y$ =	2.1E+6	mm^4	J =	3.5E+6	mm^4	b/t =	11.8

Check member capacity

Capacity factors

ϕ_b =	0.9	Table 3.4 - bending	ϕ_c =	0.9	Table 3.4 - compression
For cold-formed (non-stress relieved) SHS,			α_b =	-0.5	Table 6.3.3(2)

(a) Nominal section capacity in compression **Clause 6.1**

$N_s = k_f.A_n.f_y$ = 654.5 kN

$\phi_c.N_s$ = 589.1 kN

> 20.2 kN Required :.OK

(b) Nominal member capacity in compression **Clause 6.3**

λ_n	=	256.6	α_a	=	7.98	λ	=	252.61
η	=	0.780	ξ	=	0.613	α_c	=	0.114

Clause 6.3.3

$N_c = \alpha_c.N_s \le N_s$ = 74.7 kN

$\phi_c.N_c$ = 67.3 kN

> 20.2 kN Required :.OK

(c) Nominal section capacity for combined bending and compression

$M_{sx} = f_y.Z_e$ = 19.8 kNm — Clause 5.2.1

M_{rx} = 19.8 kNm — Clause 8.3.2(a) and (b)

$\phi_b.M_{rx}$ = 17.8 kNm

> 0.909 kNm Required :.OK

(d) Nominal member capacity for combined bending and compression

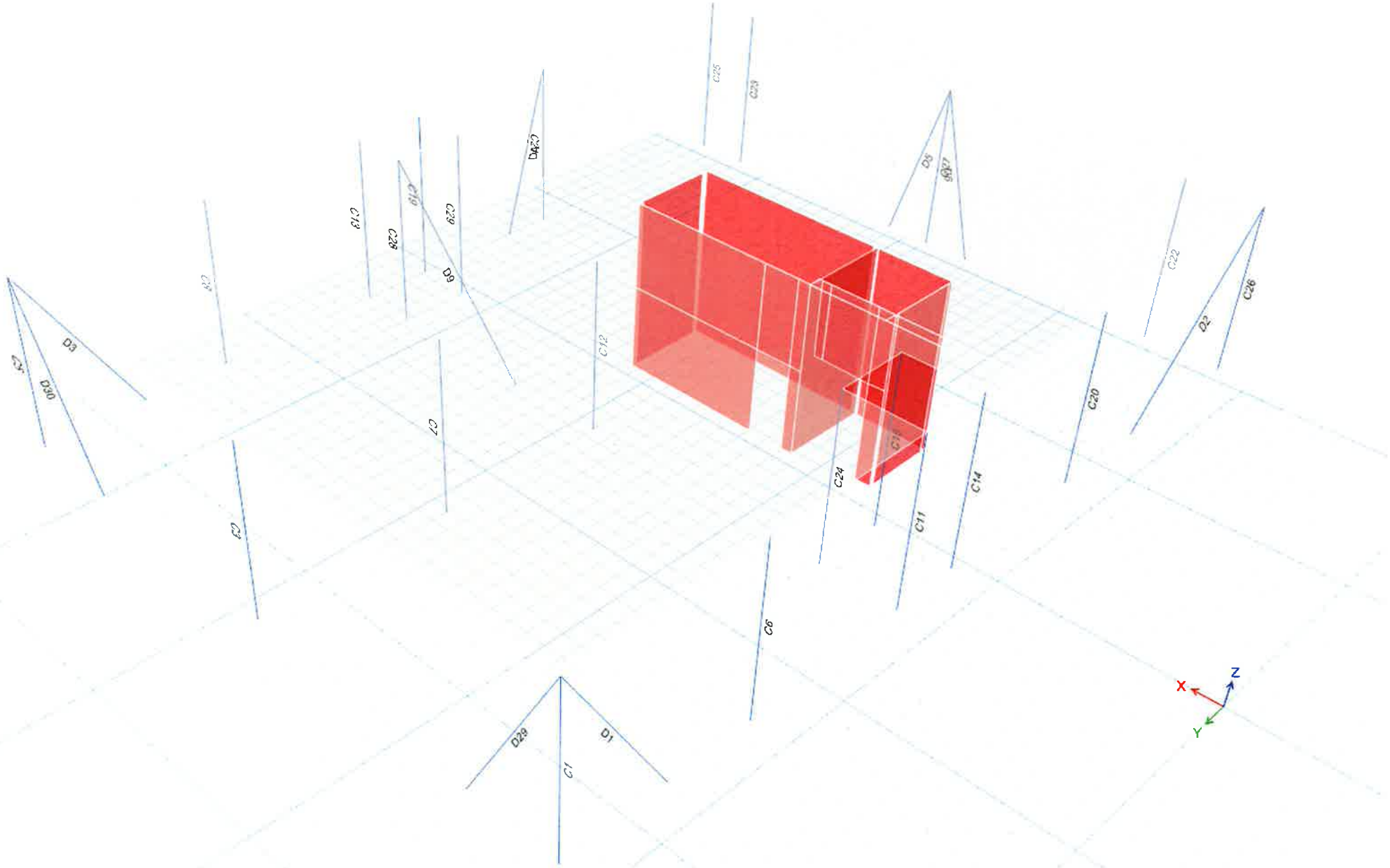
M_i = 13.9 kNm — Clause 8.4.2.2

$\phi_b.M_i$ = 12.5 kNm

> 0.909 kNm Required :.OK

⇒ Column is Satisfactory in Combined Bending and Compression

ADOPT **89x89x6.0 SHS (C350)**



ETABS MODEL - ROOF COLUMN & WALL BRACE LAYOUT

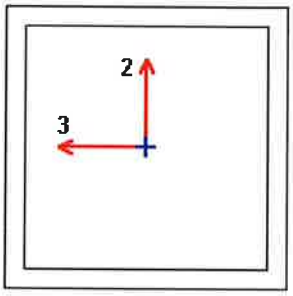
ETABS TABLE: Roof Column Envelope

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
C1	Story4	89X89X6SHS	0.201 = 0.201 + 0.018 + 0.02	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	0.002	0.002	Compact
C3	Story4	89X89X6SHS	0.161 = 0.161 + 0.014 + 0.038	Ult 04 (1.2G-Wx+0.4Q)	0.001	0.002	Compact
C5	Story4	89X89X6SHS	0.411 = 0.411 + 0.048 + 0.036	Ult 02 (1.2G+1.5Q)	0.002	0.002	Compact
C6	Story4	89X89X6SHS	0.654 = 0.654 + 0.056 + 0.038	Ult 06 (1.2G-Wy+0.4Q)	0.003	0.003	Compact
C7	Story4	89X89X6SHS	0.382 = 0.382 + 0.011 + 0.012	Ult 06 (1.2G-Wy+0.4Q)	0.001	0.001	Compact
C8	Story4	89X89X6SHS	0.645 = 0.645 + 0.097 + 0.008	Ult 04 (1.2G-Wx+0.4Q)	0.004	0.003	Compact
C11	Story4	89X89X6SHS	0.046 = 0.015 + 0.046 + 0	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	0.002	0.001	Compact
C12	Story4	89X89X6SHS	0.236 = 0.236 + 0.001 + 0.019	Ult 04 (1.2G-Wx+0.4Q)	0.001	0.002	Compact
C13	Story4	89X89X6SHS	0.108 = 0.094 + 0.108 + 0	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	0.004	0.0004124	Compact
C14	Story4	89X89X6SHS	0.015 = 0.015 + 0.003 + 3.092E-04	Ult 09 (0.9G+Wy)	0.0004332	0.0002789	Compact
C15	Story4	89X89X6SHS	0.074 = 0.074 + 0.003 + 0.004	Ult 04 (1.2G-Wx+0.4Q)	0.0003487	0.0003007	Compact
C19	Story4	89X89X6SHS	0.055 = 0.033 + 0.055 + 0	Ult 02 (1.2G+1.5Q)	0.002	0.0003829	Compact
C20	Story4	89X89X6SHS	0.739 = 0.739 + 0.076 + 0.074	Ult 04 (1.2G-Wx+0.4Q)	0.003	0.004	Compact
C21	Story4	89X89X6SHS	0.531 = 0.531 + 0.113 + 0.04	Ult 06 (1.2G-Wy+0.4Q)	0.005	0.003	Compact
C22	Story4	89X89X6SHS	0.331 = 0.134 + 0.031 + 0.331	Ult 06 (1.2G-Wy+0.4Q)	0.001	0.011	Compact
C23	Story4	89X89X6SHS	0.33 = 0.107 + 0.044 + 0.33	Ult 04 (1.2G-Wx+0.4Q)	0.002	0.012	Compact
C25	Story4	89X89X6SHS	0.047 = 0.018 + 0.037 + 0.047	Ult 04 (1.2G-Wx+0.4Q)	0.002	0.002	Compact
C26	Story4	89X89X6SHS	0.215 = 0.215 + 0.018 + 0.017	Ult 02 (1.2G+1.5Q)	0.001	0.002	Compact
C27	Story4	89X89X6SHS	0.545 = 0.545 + 0.001 + 0.215	Ult 02 (1.2G+1.5Q)	0.0001105	0.012	Compact
C24	Story4	89X89X6SHS	0.114 = 0.114 + 0.005 + 0.009	Ult 04 (1.2G-Wx+0.4Q)	0.001	0.001	Compact
C28	Story4	89X89X6SHS	0.155 = 0.155 + 0.066 + 0.005	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	0.003	0.0004254	Compact
C29	Story4	89X89X6SHS	0.047 = 0.047 + 0.04 + 0.014	Ult 06 (1.2G-Wy+0.4Q)	0.002	0.001	Compact

Roof Column - critical member

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Envelope)



Element Details

Level	Element	Unique Name	Section	Combo	Location	Frame Type	Classification
Story4	C20	20	89X89X6SHS	Ult 04 (1.2G-Wx+0.4Q)	0	Sway Frame	Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
18.7	206	33.2	46.3	10.7	56.6

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	C_w (cm⁶)
354	206	33.2	46.3	10.7	56.6	

Material Properties

E (MPa)	f_y (MPa)	α
199948	450	NA

LLRF and Demand/Capacity Ratio

L (mm)	LLRF	Stress Ratio Limit
4200.0	0.734	0.95

Demand/Capacity (D/C) Ratio (6.1b)

D/C Ratio = $N^* / \phi N_s$ or $N^* / \phi N_c$
0.739 = 0.739

Stress Check Forces and Moments

Location (mm)	N* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
0	-38.6652	-1.7467	1.6996	-0.8682	0.9272

Basic Factors (6.1b)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	0.957	4020	121.119
Minor Bending	2.063	0.957	4020	249.835
Major Braced	1	0.957	4020	121.119
Minor Braced	0.758	0.957	4020	91.766

RC16

Basic Factors (6.1b) (continued)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
LTB	1.4	0.957	4020	169.567

Axial Force & Biaxial Moment Design Factors (6.1b)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	0.957	1	1	1	1	0.201	0.997
Minor Bending	0.957	0.758	2.063	1	1	0.267	0.832

	L_{llb}	k_t	k_l	k_r	α_m	α_s
LTB	0.957	1	1.4	1	2.408	0.961

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	6.182	-1	0.069

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	17.218	30	45	180	0.383	Compact
Major Web	17.218	82	115	180	0.15	Compact
Minor Flange	17.218	82	115	180	0.15	Compact
Minor Web	17.218	30	45	180	0.383	Compact
Axial Flange	17.218		45.000		0.383	Compact
Axial Web	17.218		45.000		0.383	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	$b - b_e$ (mm)	$d - d_e$ (mm)	A_{eff} (cm²)
56.6	56.6	0	0	18.7

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_l (kN-m)	N_c (kN)
Major Moment	1.7467	25.47	25.47	25.47	245.6915
Minor Moment	1.6996	25.47	25.47	25.47	411.3281

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_t (kN-m)
Major Moment	186.9224	25.47	22.8098	22.8098	22.8098

Axial Capacities

	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	38.6652	841.5	58.1607	794.75	123563.8322

Shear Design

	V* Force (kN)	V_v Resistance (kN)	Stress Ratio
Major Shear	0.8682	259.524	0.003
Minor Shear	0.9272	259.524	0.004

ETABS TABLE: Roof Brace Envelope

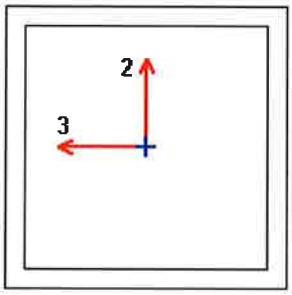
Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class
D1	Story4	89X89X6SHS	0.314 = 0.314 + 0 + 0	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	0.001	0	Compact
D2	Story4	89X89X6SHS	0.083 = 0.083 + 0 + 0	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	0.001	0	Compact
D3	Story4	89X89X6SHS	0.115 = 0.115 + 0 + 0	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	0.001	0	Compact
D4	Story4	89X89X6SHS	0.145 = 0.145 + 0 + 0	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	0.0004499	0	Compact
D5	Story4	89X89X6SHS	0.063 = 0.063 + 0 + 0	Ult 03 (1.2G+Wx+0.4Q)	0.0004637	0	Compact
D6	Story4	89X89X6SHS	0.073 = 0.073 + 0 + 0	Ult 05 (1.2G+Wy+0.4Q)	0.0004681	0	Compact
D9	Story4	89X89X6SHS	0.488 = 0.488 + 0 + 0	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	0.001	0	Compact
D29	Story4	89X89X6SHS	0.059 = 0.059 + 0 + 0	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	0.001	0	Compact
D30	Story4	89X89X6SHS	0.11 = 0.11 + 0 + 0	Ult 02 (1.2G+1.5Q)	0.001	0.0001899	Compact

RC18

Roof wall Braces - critical member

ETABS 2016 Steel Frame Design

AS 4100-1998 Steel Section Check (Strength Envelope)



Element Details

Level	Element	Unique Name	Section	Combo	Location	Frame Type	Classification
Story4	D9	304	89X89X6SHS	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	0	Sway Frame	Compact

Design Code Parameters

Φ_B	Φ_C	Φ_{TY}	Φ_{TF}	Φ_S
0.9	0.9	0.9	0.9	0.9

Section Properties

A (cm²)	I_{33} (cm⁴)	r_{33} (mm)	S_{33} (cm³)	A_{v3} (cm²)	Z_{33} (cm³)
18.7	206	33.2	46.3	10.7	56.6

J (cm⁴)	I_{22} (cm⁴)	r_{22} (mm)	S_{22} (cm³)	A_{v2} (cm²)	Z_{22} (cm³)	C_w (cm⁶)
354	206	33.2	46.3	10.7	56.6	

Material Properties

E (MPa)	f_y (MPa)	α
199948	450	NA

LLRF and Demand/Capacity Ratio

L (mm)	LLRF	Stress Ratio Limit
5731.5	1	0.95

Demand/Capacity (D/C) Ratio (6.1b)

D/C Ratio = $N^* / \phi N_s$ or $N^* / \phi N_c$
0.488 = 0.488

Stress Check Forces and Moments

Location (mm)	N* (kN)	M^*_{33} (kN-m)	M^*_{22} (kN-m)	V^*_2 (kN)	V^*_3 (kN)
0	-53.3074	0	0	-0.2844	-0.0044

Basic Factors (6.1b)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Major Bending	1	1	5731.5	172.685
Minor Bending	1	1	5731.5	172.685
Major Braced	1	1	5731.5	172.685

Basic Factors (6.1b) (continued)

Buckling Mode	K Factor	L Factor	L Length (mm)	KL/r
Minor Braced	1	1	5731.5	172.685
LTB	1.4	1	5731.5	241.759

Axial Force & Biaxial Moment Design Factors (6.1b)

	L Factor	Braced k_e	Sway k_e	Δ_b	Δ_s	C_m	β_m
Major Bending	1	1	1	1.757	1	1	-1
Minor Bending	1	1	1	1.757	1	1	-1

	L_{ltb}	k_t	k_l	k_f	α_m	α_s
LTB	1	1	1.4	1	1.388	0.929

Axial Factors

Steel Type	K_f	K_t	α_a	α_b	α_c
Hot Rolled	1	1	8.781	-1	0.144

Slenderness Factors

Slenderness	λ_e	λ_{ep}	λ_{ey}	λ_{ew}	λ_e / λ_{ey}	Compactness
Major Flange	17.218	30	45	180	0.383	Compact
Major Web	17.218	82	115	180	0.15	Compact
Minor Flange	17.218	82	115	180	0.15	Compact
Minor Web	17.218	30	45	180	0.383	Compact
Axial Flange	17.218		45.000		0.383	Compact
Axial Web	17.218		45.000		0.383	Compact

Effective Properties

Z_{eMajor} (cm³)	Z_{eMinor} (cm³)	$b - b_e$ (mm)	$d - d_e$ (mm)	A_{eff} (cm²)
56.6	56.6	0	0	18.7

Moments and Capacities

	M* (kN-m)	M_s (kN-m)	M_r (kN-m)	M_i (kN-m)	N_c (kN)
Major Moment	0	25.47	25.47	13.0433	121.3996
Minor Moment	0	25.47	25.47	13.0433	121.3996

Flexural Capacities

	$M_{o,cr}$ (kN-m)	M_b (kN-m)	M_o (kN-m)	M_c (kN-m)	M_t (kN-m)
Major Moment	131.1052	25.47	13.0433	13.0433	13.0433

Axial Capacities

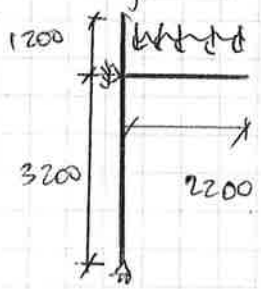
	N* (kN)	N_s (kN)	N_c (kN)	N_t (kN)	N_{oz} (kN)
Axial	53.3074	841.5	121.3996	794.75	123563.8322

Shear Design

	V* Force (kN)	V_v Resistance (kN)	Stress Ratio
Major Shear	0.2844	259.524	0.001
Minor Shear	0.0044	259.524	1.695E-05

Canopy Rafter CR1

Layout



Loads

Roof D = 0.40kPa × 6.5m = 2.60kN/m
Beam S.W. = 0.20kN/m
Roof U = 0.25kPa × 6.5m = 1.63kN/m ↓
Roof U = 0.96kPa × 1.2 × 6.5m = 7.49kN/m ↑

Serviceability Design

$\Delta_{lim} = L/180$ (D only) or $L/125$ ($D + 0.7U$)
= 12.2mm or 17.6mm

$I_{req} = \frac{1}{8} \times \frac{(2.6 + 0.20) \times 2200^4}{2 \times 10^5 \times 12.2}$ or $\frac{1}{8} \times \frac{(2.6 + 0.2 + 0.7 \times 1.63) \times 2200^4}{2 \times 10^5 \times 17.6}$
= 3.36×10^6 mm^4 or 3.28×10^6 mm^4

⇒ 150PFC ok for deflection

Strength Design

$w^* = 5.81$kN/m ↓, 4.97kN/m ↑

⇒ $M^* = 5.81 \times 2.2^2/2$
= 14.1kNm

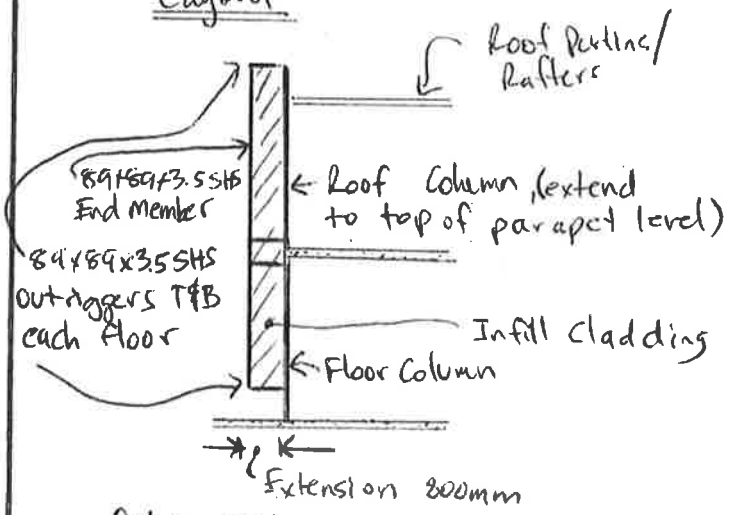
l_e = 1200mm
⇒ 150PFC ok for strength, ϕM_b = 31kNm

⇒ require 150PFC for CR1

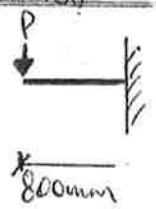
Checked : .....
Date : ..../..../.....

Blade frames

Layout



Outriggers



Loads

$P_{DL} = (0.60kPa \times 0.4m \times 5m + 0.50kPa \times 0.4m \times 8m) \times 1/4$ (4 stubs)
(Roof) (cladding)
$= 0.60kN$

$w_L = 0.84kPa \times 1.2 \times 2m$ (wL normal to blades)
$= 2.02kN/m$ (ult)

Strength (Check 0.9DL + wL ult)

$M^*_y = 2.02 \times 0.8^2/2$
$= 0.65\ kNm$

$M^*_x = 0.6kN \times 0.9 \times 0.8m$
$= 0.43kNm$

⇒ by inspection 89x89x3.5SHS outriggers ok

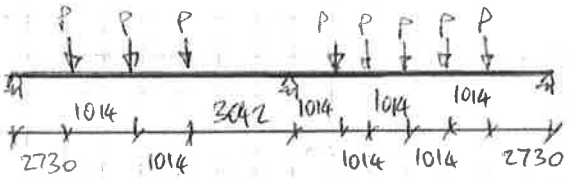
Impact on main columns

from above, outrigger forces minimal ⇒ consider main roof/floor columns or by inspection for blade support.

Checked : .....
Date : ..../..../.....

Purlins supporting plant

Layout



- Provide 4 consecutive purlins @ 400% under a/c unit - spread via skirails
- each unit 130kg

Loads

Roof $D = 0.40kPa \times 0.4m = 0.16kN/m$

Roof $U = \left(1.8/_{7.8\times0.4} + 0.12\right) \times 0.4m = 0.28\ kN/m$

$P = \left(130kg \times 9.81/_{1000}\right) kN \times 1/4 = 0.32\ kN$

Serviceability Design

- check SC20024 purlins

$\Delta_{lim} = L/250\ (D + 0.7U)$
$= 31.2mm$

$\Rightarrow$ from microstran $\Delta_{max} = 12mm$ $\therefore$ OK

Strength Design

M^* (from microstran) $= {}^-6.8kNm$, ${}^+4.17kNm$

$\Rightarrow w_{equiv} = \dfrac{10 \times M^*}{L^2} = 1.12kN/m$

$\Rightarrow$ from Lysaght tables allowable inward load capacity with 1 row bridging $= 2.37kN/m \downarrow$
$> 1.12kN/m \downarrow$ $\therefore$ OK.

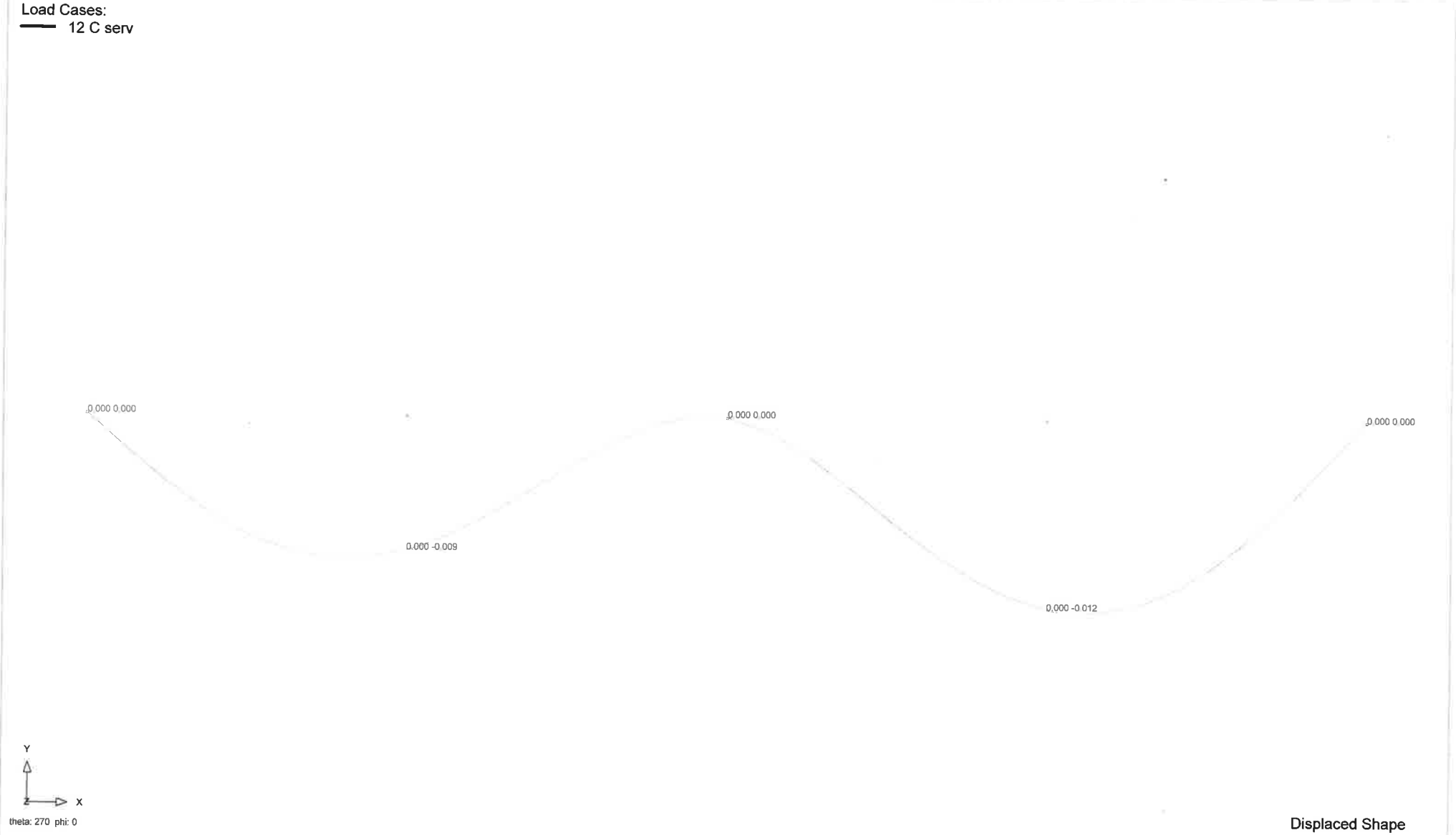
$\Rightarrow$ 4x SC20024 purlins @ 400% OK.

Checked : .....
Date : ..../..../.....

TMK Consulting Engineers
Job: Plant Purlins
168 Prospect Road 1702168
Purlins Supporting Plant

28 Jun 2017
10:28 AM

Load Cases:
12 C serv



Displaced Shape

Microstran [V8.11r]

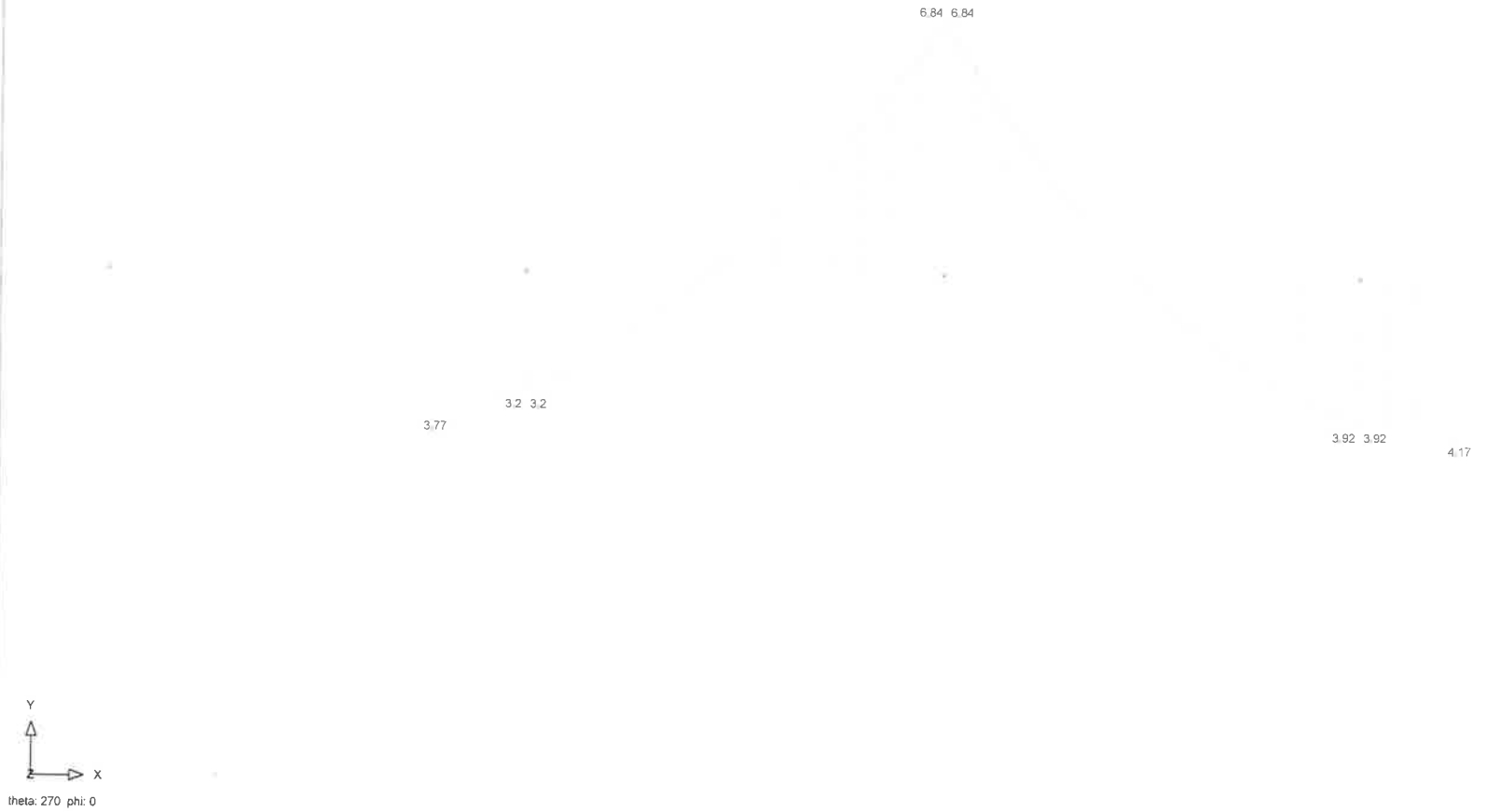
K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\Microstran\Plant Purlins

RC 23

TMK Consulting Engineers
Job: Plant Purlins
168 Prospect Road 1702168
Purlins Supporting Plant

28 Jun 2017
10:29 AM

Load Cases:
11 C ult



Bending Moment, Mz

R224

Microstran [V8.11r]

K:\2017\02\1702160\Structural Drawings and Calcs\Design Calculations and Details\Microstran\Plant Purlins

== I N P U T / A N A L Y S I S R E P O R T ==

Job: Plant Purlins

Title: 168 Prospect Road 1702168
Purlins Supporting Plant
Type: Plane frame
Date: 28 Jun 2017
Time: 10:29 AM

Nodes	5
Members	4
Spring supports	0
Sections	2
Materials	1
Primary load cases	2
Combination load cases	2

Analysis: Linear elastic

== L O A D C A S E S ==

Case	Type	Analysis	Title
1	P	L	dl
2	P	L	ll
11	C	L	ult
12	C	L	serv

Analysis Types:
S - Skipped (not analysed)
L - Linear
N - Non-linear

== N O D E C O O R D I N A T E S ==

Node	X m	Y m	Z m	Restraint
101	0.000	0.000	0.000	111000
102	7.800	0.000	0.000	010000
103	15.600	0.000	0.000	010000
104	3.900	0.000	0.000	000000
105	11.700	0.000	0.000	000000

== M E M B E R D E F I N I T I O N ==

Member	A	B	C	Prop	Matl	Rel-A	Rel-B	Length m
103	101	104	Y	1	1	000000	000000	3.900
104	104	102	Y	1	1	000000	000000	3.900
105	102	105	Y	1	1	000000	000000	3.900
106	105	103	Y	1	1	000000	000000	3.900

== L I B R A R Y S E C T I O N S ==

Section	Library	Name	Axis	Comment
1	asw	C200-24	Y	

== S E C T I O N S I N P U T B Y P R O P E R T Y V A L U E S ==

Section	Name	Comment
10	Nominal	All_spans

== S E C T I O N P R O P E R T I E S ==

Section	Ax m2	Ay m2	Az m2	J m4	Iy m4	Iz m4	fact
1	9.030E-04	0.000E+00	0.000E+00	1.728E-09	6.800E-07	5.690E-06	
10	3.230E-03	0.000E+00	0.000E+00	6.270E-08	3.060E-06	2.360E-05	

== M A T E R I A L P R O P E R T I E S ==

Material	E kN/m2	u	Density t/m3	Alpha /deg C
1	2.000E+08	0.2500	7.850E+00	1.170E-05

== T A B L E O F Q U A N T I T I E S ==

MATERIAL 1

Section	Name	Length m	Mass tonne	Comment
1	C200-24	15.600	0.111	
		15.600	0.111	

== C O N D I T I O N N U M B E R ==

Maximum condition number: 4.000E+00 at node: 103 DOFN: 1

CASE 1: dl

-- Gravitational Acceleration --

X Comp m/sec2	Y Comp m/sec2	Z Comp m/sec2
0.000	-9.810	0.000

-- Member Loads --

Member	Form	T	A	S	F1	X1	F2	X2
103	CONC	FY	GL	FR	-0.320	0.520		
103	CONC	FY	GL	FR	-0.320	0.780		
103	UNIF	FY	GL	FR	-0.120			
104	CONC	FY	GL	FR	-0.320	0.040		
104	UNIF	FY	GL	FR	-0.120			
105	CONC	FY	GL	FR	-0.320	0.260		
105	CONC	FY	GL	FR	-0.320	0.520		
105	CONC	FY	GL	FR	-0.320	0.780		
105	UNIF	FY	GL	FR	-0.120			
106	CONC	FY	GL	FR	-0.320	0.300		
106	CONC	FY	GL	FR	-0.320	0.040		
106	UNIF	FY	GL	FR	-0.120			

-- Sum of Applied Loads (Global Axes): --
FX: 0.000 FY: -5.517 FZ: 0.000
Moments about the global origin:
MX: 0.000 MY: 0.000 MZ: -43.331

== S I G N C O N V E N T I O N ==

Positive Forces (Member Axes):
Axial - Tension Shear - End A sagging
Torque - Right-hand twist Moment - Sagging
Deflections:
Global deflections are absolute.
Local deflections are relative to chord joining displaced end nodes.

== M E M B E R F O R C E S A N D D E F L E C T I O N S ==

CASE 1: dl

MEMBER 103: Nodes 101 - 104 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-0.94	0.00	0.00	0.00	0.00
2	0.78	0.00	-0.79	0.00	0.00	0.00	0.67
3	1.56	0.00	-0.64	0.00	0.00	0.00	1.23
4	2.03	0.00	-0.55	0.00	0.00	0.00	1.51
5	2.03	0.00	-0.23	0.00	0.00	0.00	1.51
6	2.34	0.00	-0.17	0.00	0.00	0.00	1.57
7	3.04	0.00	-0.04	0.00	0.00	0.00	1.64
8	3.04	0.00	0.28	0.00	0.00	0.00	1.64
9	3.12	0.00	0.30	0.00	0.00	0.00	1.62
10	3.90	0.00	0.44	0.00	0.00	0.00	1.33

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0022	0.0000	-0.0012	0.0000
3	1.6	0.0000	-0.0041	0.0000	-0.0020	0.0000
4	2.0	0.0000	-0.0049	0.0000	-0.0022	0.0000
5	2.0	0.0000	-0.0049	0.0000	-0.0022	0.0000
6	2.3	0.0000	-0.0053	0.0000	-0.0022	0.0000
7	3.0	0.0000	-0.0057	0.0000	-0.0016	0.0000
8	3.0	0.0000	-0.0057	0.0000	-0.0016	0.0000
9	3.1	0.0000	-0.0057	0.0000	-0.0015	0.0000
10	3.9	0.0000	-0.0052	0.0000	0.0000	0.0000

MEMBER 104: Nodes 104 - 102 Section 1: C200-24 Y

PC25

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	0.44	0.00	0.00	0.00	1.33
2	0.16	0.00	0.47	0.00	0.00	0.00	1.26
3	0.16	0.00	0.79	0.00	0.00	0.00	1.26
4	0.78	0.00	0.91	0.00	0.00	0.00	0.73
5	1.56	0.00	1.06	0.00	0.00	0.00	-0.04
6	2.34	0.00	1.21	0.00	0.00	0.00	-0.92
7	3.12	0.00	1.36	0.00	0.00	0.00	-1.92
8	3.90	0.00	1.50	0.00	0.00	0.00	-3.04

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0052	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0050	0.0000	0.0000	0.0000
3	0.2	0.0000	-0.0050	0.0000	0.0000	0.0000
4	0.8	0.0000	-0.0041	0.0000	0.0001	0.0000
5	1.6	0.0000	-0.0025	0.0000	0.0006	0.0000
6	2.3	0.0000	-0.0010	0.0000	0.0011	0.0000
7	3.1	0.0000	0.0000	0.0000	0.0011	0.0000
8	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

MEMBER 105: Nodes 102 - 105 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-2.10	0.00	0.00	0.00	-3.04
2	0.78	0.00	-1.96	0.00	0.00	0.00	-1.45
3	1.01	0.00	-1.91	0.00	0.00	0.00	-1.00
4	1.01	0.00	-1.59	0.00	0.00	0.00	-1.00
5	1.56	0.00	-1.49	0.00	0.00	0.00	-0.16
6	2.03	0.00	-1.40	0.00	0.00	0.00	0.52
7	2.03	0.00	-1.08	0.00	0.00	0.00	0.52
8	2.34	0.00	-1.02	0.00	0.00	0.00	0.84
9	3.04	0.00	-0.89	0.00	0.00	0.00	1.51
10	3.04	0.00	-0.57	0.00	0.00	0.00	1.51
11	3.12	0.00	-0.55	0.00	0.00	0.00	1.56
12	3.90	0.00	-0.41	0.00	0.00	0.00	1.93

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0014	0.0000	0.0003	0.0000
3	1.0	0.0000	-0.0020	0.0000	0.0003	0.0000
4	1.0	0.0000	-0.0020	0.0000	0.0003	0.0000
5	1.6	0.0000	-0.0036	0.0000	-0.0001	0.0000
6	2.0	0.0000	-0.0050	0.0000	-0.0004	0.0000
7	2.0	0.0000	-0.0050	0.0000	-0.0004	0.0000
8	2.3	0.0000	-0.0059	0.0000	-0.0006	0.0000
9	3.0	0.0000	-0.0075	0.0000	-0.0007	0.0000
10	3.0	0.0000	-0.0075	0.0000	-0.0007	0.0000
11	3.1	0.0000	-0.0077	0.0000	-0.0007	0.0000
12	3.9	0.0000	-0.0087	0.0000	0.0000	0.0000

MEMBER 106: Nodes 105 - 103 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-0.41	0.00	0.00	0.00	1.93
2	0.16	0.00	-0.38	0.00	0.00	0.00	1.99
3	0.16	0.00	-0.06	0.00	0.00	0.00	1.99
4	0.78	0.00	0.06	0.00	0.00	0.00	1.99
5	1.17	0.00	0.14	0.00	0.00	0.00	1.95
6	1.17	0.00	0.46	0.00	0.00	0.00	1.95
7	1.56	0.00	0.53	0.00	0.00	0.00	1.76
8	2.34	0.00	0.68	0.00	0.00	0.00	1.29
9	3.12	0.00	0.83	0.00	0.00	0.00	0.70
10	3.90	0.00	0.97	0.00	0.00	0.00	0.00

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0087	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0088	0.0000	-0.0004	0.0000
3	0.2	0.0000	-0.0088	0.0000	-0.0004	0.0000
4	0.8	0.0000	-0.0087	0.0000	-0.0018	0.0000
5	1.2	0.0000	-0.0083	0.0000	-0.0022	0.0000
6	1.2	0.0000	-0.0083	0.0000	-0.0022	0.0000
7	1.6	0.0000	-0.0077	0.0000	-0.0024	0.0000
8	2.3	0.0000	-0.0057	0.0000	-0.0022	0.0000
9	3.1	0.0000	-0.0030	0.0000	-0.0013	0.0000
10	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

== S U P P O R T R E A C T I O N S ==

CASE 1: dl

Node	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
101	0.00	0.94	0.00	0.00	0.00	0.00
102	0.00	3.61	0.00	0.00	0.00	0.00
103	0.00	0.97	0.00	0.00	0.00	0.00
SUM:	0.00	5.52	0.00 (all nodes)			

Max. residual: -6.661E-16 at DOFN: 8

(Reactions act on structure in positive global axis directions.)

CASE 2: 11

-- Member Loads --

Member	Form	T	A	S	F1	X1	F2	X2
103	UNIF	FY	GL	FR	-0.280			
104	UNIF	FY	GL	FR	-0.280			
105	UNIF	FY	GL	FR	-0.280			
106	UNIF	FY	GL	FR	-0.280			

-- Sum of Applied Loads (Global Axes): --
FX: 0.000 FY: -4.368 FZ: 0.000
Moments about the global origin:
MX: 0.000 MY: 0.000 MZ: -34.070

== S I G N C O N V E N T I O N ==

Positive Forces (Member Axes):
Axial - Tension Shear - End A sagging
Torque - Right-hand twist Moment - Sagging
Deflections:
Global deflections are absolute.
Local deflections are relative to chord joining displaced end nodes.

== M E M B E R F O R C E S A N D D E F L E C T I O N S ==

CASE 2: 11

MEMBER 103: Nodes 101 - 104 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-0.82	0.00	0.00	0.00	0.00
2	0.78	0.00	-0.60	0.00	0.00	0.00	0.55
3	1.56	0.00	-0.38	0.00	0.00	0.00	0.94
4	2.03	0.00	-0.25	0.00	0.00	0.00	1.09
5	2.03	0.00	-0.25	0.00	0.00	0.00	1.09
6	2.34	0.00	-0.16	0.00	0.00	0.00	1.15
7	3.04	0.00	0.03	0.00	0.00	0.00	1.20
8	3.04	0.00	0.03	0.00	0.00	0.00	1.20
9	3.12	0.00	0.05	0.00	0.00	0.00	1.19
10	3.90	0.00	0.27	0.00	0.00	0.00	1.06

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0018	0.0000	-0.0009	0.0000
3	1.6	0.0000	-0.0034	0.0000	-0.0015	0.0000
4	2.0	0.0000	-0.0041	0.0000	-0.0016	0.0000
5	2.0	0.0000	-0.0041	0.0000	-0.0016	0.0000
6	2.3	0.0000	-0.0045	0.0000	-0.0016	0.0000
7	3.0	0.0000	-0.0049	0.0000	-0.0012	0.0000
8	3.0	0.0000	-0.0049	0.0000	-0.0012	0.0000
9	3.1	0.0000	-0.0049	0.0000	-0.0011	0.0000
10	3.9	0.0000	-0.0047	0.0000	0.0000	0.0000

MEMBER 104: Nodes 104 - 102 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	0.27	0.00	0.00	0.00	1.06
2	0.16	0.00	0.32	0.00	0.00	0.00	1.02
3	0.16	0.00	0.32	0.00	0.00	0.00	1.02
4	0.78	0.00	0.49	0.00	0.00	0.00	0.77
5	1.56	0.00	0.71	0.00	0.00	0.00	0.30
6	2.34	0.00	0.93	0.00	0.00	0.00	-0.34
7	3.12	0.00	1.15	0.00	0.00	0.00	-1.15
8	3.90	0.00	1.37	0.00	0.00	0.00	-2.13

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0047	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0046	0.0000	-0.0001	0.0000

PC26

3	0.2	0.0000	-0.0046	0.0000	-0.0001	0.0000
4	0.8	0.0000	-0.0040	0.0000	-0.0002	0.0000
5	1.6	0.0000	-0.0029	0.0000	0.0000	0.0000
6	2.3	0.0000	-0.0016	0.0000	0.0003	0.0000
7	3.1	0.0000	-0.0005	0.0000	0.0005	0.0000
8	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

MEMBER 105: Nodes 102 - 105 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-1.37	0.00	0.00	0.00	-2.13
2	0.78	0.00	-1.15	0.00	0.00	0.00	-1.15
3	1.01	0.00	-1.08	0.00	0.00	0.00	-0.89
4	1.01	0.00	-1.08	0.00	0.00	0.00	-0.89
5	1.56	0.00	-0.93	0.00	0.00	0.00	-0.34
6	2.03	0.00	-0.80	0.00	0.00	0.00	0.06
7	2.03	0.00	-0.80	0.00	0.00	0.00	0.06
8	2.34	0.00	-0.71	0.00	0.00	0.00	0.30
9	3.04	0.00	-0.51	0.00	0.00	0.00	0.73
10	3.04	0.00	-0.51	0.00	0.00	0.00	0.73
11	3.12	0.00	-0.49	0.00	0.00	0.00	0.77
12	3.90	0.00	-0.27	0.00	0.00	0.00	1.06

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0005	0.0000	0.0005	0.0000
3	1.0	0.0000	-0.0008	0.0000	0.0005	0.0000
4	1.0	0.0000	-0.0008	0.0000	0.0005	0.0000
5	1.6	0.0000	-0.0016	0.0000	0.0003	0.0000
6	2.0	0.0000	-0.0024	0.0000	0.0001	0.0000
7	2.0	0.0000	-0.0024	0.0000	0.0001	0.0000
8	2.3	0.0000	-0.0029	0.0000	0.0000	0.0000
9	3.0	0.0000	-0.0039	0.0000	-0.0002	0.0000
10	3.0	0.0000	-0.0039	0.0000	-0.0002	0.0000
11	3.1	0.0000	-0.0040	0.0000	-0.0002	0.0000
12	3.9	0.0000	-0.0047	0.0000	0.0000	0.0000

MEMBER 106: Nodes 105 - 103 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-0.27	0.00	0.00	0.00	1.06
2	0.16	0.00	-0.23	0.00	0.00	0.00	1.10
3	0.16	0.00	-0.23	0.00	0.00	0.00	1.10
4	0.78	0.00	-0.05	0.00	0.00	0.00	1.19
5	1.17	0.00	0.05	0.00	0.00	0.00	1.19
6	1.17	0.00	0.05	0.00	0.00	0.00	1.19
7	1.56	0.00	0.16	0.00	0.00	0.00	1.15
8	2.34	0.00	0.38	0.00	0.00	0.00	0.94
9	3.12	0.00	0.60	0.00	0.00	0.00	0.55
10	3.90	0.00	0.82	0.00	0.00	0.00	0.00

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0047	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0048	0.0000	-0.0003	0.0000
3	0.2	0.0000	-0.0048	0.0000	-0.0003	0.0000
4	0.8	0.0000	-0.0049	0.0000	-0.0011	0.0000
5	1.2	0.0000	-0.0048	0.0000	-0.0014	0.0000
6	1.2	0.0000	-0.0048	0.0000	-0.0014	0.0000
7	1.6	0.0000	-0.0045	0.0000	-0.0016	0.0000
8	2.3	0.0000	-0.0034	0.0000	-0.0015	0.0000
9	3.1	0.0000	-0.0018	0.0000	-0.0009	0.0000
10	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

== S U P P O R T R E A C T I O N S ==

CASE 2: 11

Node	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
101	0.00	0.82	0.00	0.00	0.00	0.00
102	0.00	2.73	0.00	0.00	0.00	0.00
103	0.00	0.82	0.00	0.00	0.00	0.00
SUM:	0.00	4.37	0.00 (all nodes)			

Max. residual: -3.331E-16 at DOFN: 3

(Reactions act on structure in positive global axis directions.)

CASE 11: ult

-- Load Combinations --

Case	Factor	
1	1.200	dl
2	1.500	ll

-- Sum of Applied Loads (Global Axes): --
FX: 0.000 FY: -13.172 FZ: 0.000
Moments about the global origin:
MX: 0.000 MY: 0.000 MZ: -103.102

== S I G N C O N V E N T I O N ==

Positive Forces (Member Axes):
Axial - Tension Shear - End A sagging
Torque - Right-hand twist Moment - Sagging
Deflections:
Global deflections are absolute.
Local deflections are relative to chord joining displaced end nodes.

== M E M B E R F O R C E S A N D D E F L E C T I O N S ==

CASE 11: ult

MEMBER 103: Nodes 101 - 104 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-2.35	0.00	0.00	0.00	0.00
2	0.78	0.00	-1.85	0.00	0.00	0.00	1.64
3	1.56	0.00	-1.34	0.00	0.00	0.00	2.88
4	2.03	0.00	-1.04	0.00	0.00	0.00	3.44
5	2.03	0.00	-0.65	0.00	0.00	0.00	3.44
6	2.34	0.00	-0.45	0.00	0.00	0.00	3.61
7	3.04	0.00	0.00	0.00	0.00	0.00	3.77
8	3.04	0.00	0.39	0.00	0.00	0.00	3.77
9	3.12	0.00	0.44	0.00	0.00	0.00	3.73
10	3.90	0.00	0.94	0.00	0.00	0.00	3.20

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0054	0.0000	-0.0028	0.0000
3	1.6	0.0000	-0.0100	0.0000	-0.0046	0.0000
4	2.0	0.0000	-0.0120	0.0000	-0.0051	0.0000
5	2.0	0.0000	-0.0120	0.0000	-0.0051	0.0000
6	2.3	0.0000	-0.0130	0.0000	-0.0050	0.0000
7	3.0	0.0000	-0.0142	0.0000	-0.0037	0.0000
8	3.0	0.0000	-0.0142	0.0000	-0.0037	0.0000
9	3.1	0.0000	-0.0142	0.0000	-0.0035	0.0000
10	3.9	0.0000	-0.0134	0.0000	0.0000	0.0000

MEMBER 104: Nodes 104 - 102 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	0.94	0.00	0.00	0.00	3.20
2	0.16	0.00	1.04	0.00	0.00	0.00	3.04
3	0.16	0.00	1.43	0.00	0.00	0.00	3.04
4	0.78	0.00	1.83	0.00	0.00	0.00	2.02
5	1.56	0.00	2.34	0.00	0.00	0.00	0.40
6	2.34	0.00	2.84	0.00	0.00	0.00	-1.62
7	3.12	0.00	3.35	0.00	0.00	0.00	-4.03
8	3.90	0.00	3.85	0.00	0.00	0.00	-6.84

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0134	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0130	0.0000	-0.0002	0.0000
3	0.2	0.0000	-0.0130	0.0000	-0.0002	0.0000
4	0.8	0.0000	-0.0109	0.0000	-0.0002	0.0000
5	1.6	0.0000	-0.0073	0.0000	0.0007	0.0000
6	2.3	0.0000	-0.0036	0.0000	0.0018	0.0000
7	3.1	0.0000	-0.0007	0.0000	0.0020	0.0000
8	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

MEMBER 105: Nodes 102 - 105 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-4.57	0.00	0.00	0.00	-6.84
2	0.78	0.00	-4.07	0.00	0.00	0.00	-3.47
3	1.01	0.00	-3.92	0.00	0.00	0.00	-2.54
4	1.01	0.00	-3.53	0.00	0.00	0.00	-2.53
5	1.56	0.00	-3.18	0.00	0.00	0.00	-0.70
6	2.03	0.00	-2.88	0.00	0.00	0.00	0.71

P(27)

7	2.03	0.00	-2.49	0.00	0.00	0.00	0.71
8	2.34	0.00	-2.29	0.00	0.00	0.00	1.46
9	3.04	0.00	-1.84	0.00	0.00	0.00	2.91
10	3.04	0.00	-1.45	0.00	0.00	0.00	2.91
11	3.12	0.00	-1.40	0.00	0.00	0.00	3.02
12	3.90	0.00	-0.90	0.00	0.00	0.00	3.92

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0024	0.0000	0.0011	0.0000
3	1.0	0.0000	-0.0035	0.0000	0.0010	0.0000
4	1.0	0.0000	-0.0036	0.0000	0.0010	0.0000
5	1.6	0.0000	-0.0067	0.0000	0.0004	0.0000
6	2.0	0.0000	-0.0095	0.0000	-0.0004	0.0000
7	2.0	0.0000	-0.0095	0.0000	-0.0004	0.0000
8	2.3	0.0000	-0.0113	0.0000	-0.0008	0.0000
9	3.0	0.0000	-0.0149	0.0000	-0.0012	0.0000
10	3.0	0.0000	-0.0149	0.0000	-0.0012	0.0000
11	3.1	0.0000	-0.0152	0.0000	-0.0012	0.0000
12	3.9	0.0000	-0.0176	0.0000	0.0000	0.0000

MEMBER 106: Nodes 105 - 103 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-0.90	0.00	0.00	0.00	3.92
2	0.16	0.00	-0.80	0.00	0.00	0.00	4.05
3	0.16	0.00	-0.41	0.00	0.00	0.00	4.05
4	0.78	0.00	-0.01	0.00	0.00	0.00	4.18
5	1.17	0.00	0.25	0.00	0.00	0.00	4.13
6	1.17	0.00	0.63	0.00	0.00	0.00	4.13
7	1.56	0.00	0.88	0.00	0.00	0.00	3.84
8	2.34	0.00	1.39	0.00	0.00	0.00	2.95
9	3.12	0.00	1.89	0.00	0.00	0.00	1.67
10	3.90	0.00	2.40	0.00	0.00	0.00	0.00

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0176	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0178	0.0000	-0.0009	0.0000
3	0.2	0.0000	-0.0178	0.0000	-0.0009	0.0000
4	0.8	0.0000	-0.0178	0.0000	-0.0038	0.0000
5	1.2	0.0000	-0.0172	0.0000	-0.0048	0.0000
6	1.2	0.0000	-0.0172	0.0000	-0.0048	0.0000
7	1.6	0.0000	-0.0159	0.0000	-0.0054	0.0000
8	2.3	0.0000	-0.0119	0.0000	-0.0049	0.0000
9	3.1	0.0000	-0.0064	0.0000	-0.0029	0.0000
10	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

== S U P P O R T R E A C T I O N S ==

CASE 11: ult

Node	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
101	0.00	2.35	0.00	0.00	0.00	0.00
102	0.00	8.42	0.00	0.00	0.00	0.00
103	0.00	2.40	0.00	0.00	0.00	0.00
SUM:	0.00	13.17	0.00 (all nodes)			

(Reactions act on structure in positive global axis directions.)

CASE 12: serv

-- Load Combinations --

Case	Factor	
1	1.000	dl
2	0.700	ll

-- Sum of Applied Loads (Global Axes): --
FX: 0.000 FY: -8.574 FZ: 0.000
Moments about the global origin:
MX: 0.000 MY: 0.000 MZ: -67.180

== S I G N C O N V E N T I O N ==

Positive Forces (Member Axes):
Axial - Tension Shear - End A sagging
Torque - Right-hand twist Moment - Sagging
Deflections:
Global deflections are absolute.
Local deflections are relative to chord joining displaced end nodes.

== M E M B E R F O R C E S A N D D E F L E C T I O N S ==

CASE 12: serv

MEMBER 103: Nodes 101 - 104 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-1.51	0.00	0.00	0.00	0.00
2	0.78	0.00	-1.21	0.00	0.00	0.00	1.06
3	1.56	0.00	-0.91	0.00	0.00	0.00	1.88
4	2.03	0.00	-0.73	0.00	0.00	0.00	2.27
5	2.03	0.00	-0.41	0.00	0.00	0.00	2.27
6	2.34	0.00	-0.29	0.00	0.00	0.00	2.37
7	3.04	0.00	-0.02	0.00	0.00	0.00	2.48
8	3.04	0.00	0.30	0.00	0.00	0.00	2.48
9	3.12	0.00	0.33	0.00	0.00	0.00	2.46
10	3.90	0.00	0.63	0.00	0.00	0.00	2.08

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0035	0.0000	-0.0018	0.0000
3	1.6	0.0000	-0.0065	0.0000	-0.0030	0.0000
4	2.0	0.0000	-0.0078	0.0000	-0.0033	0.0000
5	2.0	0.0000	-0.0078	0.0000	-0.0033	0.0000
6	2.3	0.0000	-0.0084	0.0000	-0.0033	0.0000
7	3.0	0.0000	-0.0091	0.0000	-0.0025	0.0000
8	3.0	0.0000	-0.0091	0.0000	-0.0025	0.0000
9	3.1	0.0000	-0.0091	0.0000	-0.0023	0.0000
10	3.9	0.0000	-0.0085	0.0000	0.0000	0.0000

MEMBER 104: Nodes 104 - 102 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	0.63	0.00	0.00	0.00	2.08
2	0.16	0.00	0.70	0.00	0.00	0.00	1.97
3	0.16	0.00	1.02	0.00	0.00	0.00	1.97
4	0.78	0.00	1.26	0.00	0.00	0.00	1.27
5	1.56	0.00	1.56	0.00	0.00	0.00	0.17
6	2.34	0.00	1.86	0.00	0.00	0.00	-1.16
7	3.12	0.00	2.16	0.00	0.00	0.00	-2.73
8	3.90	0.00	2.46	0.00	0.00	0.00	-4.53

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0085	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0083	0.0000	-0.0001	0.0000
3	0.2	0.0000	-0.0083	0.0000	-0.0001	0.0000
4	0.8	0.0000	-0.0069	0.0000	0.0000	0.0000
5	1.6	0.0000	-0.0045	0.0000	0.0006	0.0000
6	2.3	0.0000	-0.0021	0.0000	0.0013	0.0000
7	3.1	0.0000	-0.0003	0.0000	0.0014	0.0000
8	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

MEMBER 105: Nodes 102 - 105 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-3.06	0.00	0.00	0.00	-4.53
2	0.78	0.00	-2.76	0.00	0.00	0.00	-2.26
3	1.01	0.00	-2.67	0.00	0.00	0.00	-1.62
4	1.01	0.00	-2.35	0.00	0.00	0.00	-1.62
5	1.56	0.00	-2.14	0.00	0.00	0.00	-0.40
6	2.03	0.00	-1.96	0.00	0.00	0.00	0.56
7	2.03	0.00	-1.64	0.00	0.00	0.00	0.56
8	2.34	0.00	-1.52	0.00	0.00	0.00	1.05
9	3.04	0.00	-1.25	0.00	0.00	0.00	2.02
10	3.04	0.00	-0.93	0.00	0.00	0.00	2.02
11	3.12	0.00	-0.90	0.00	0.00	0.00	2.09
12	3.90	0.00	-0.60	0.00	0.00	0.00	2.68

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8	0.0000	-0.0017	0.0000	0.0007	0.0000
3	1.0	0.0000	-0.0025	0.0000	0.0006	0.0000
4	1.0	0.0000	-0.0025	0.0000	0.0006	0.0000
5	1.6	0.0000	-0.0047	0.0000	0.0001	0.0000
6	2.0	0.0000	-0.0066	0.0000	-0.0004	0.0000
7	2.0	0.0000	-0.0066	0.0000	-0.0004	0.0000
8	2.3	0.0000	-0.0079	0.0000	-0.0006	0.0000
9	3.0	0.0000	-0.0103	0.0000	-0.0009	0.0000
10	3.0	0.0000	-0.0103	0.0000	-0.0009	0.0000

B2A

11	3.1	0.0000	-0.0105	0.0000	-0.0009	0.0000
12	3.9	0.0000	-0.0120	0.0000	0.0000	0.0000

MEMBER 106: Nodes 105 - 103 Section 1: C200-24 Y

Point	Offset m	Axial kN	Shear-y kN	Shear-z kN	Torque kNm	Moment-y kNm	Moment-z kNm
1	0.00	0.00	-0.60	0.00	0.00	0.00	2.68
2	0.16	0.00	-0.54	0.00	0.00	0.00	2.77
3	0.16	0.00	-0.22	0.00	0.00	0.00	2.77
4	0.78	0.00	0.02	0.00	0.00	0.00	2.83
5	1.17	0.00	0.17	0.00	0.00	0.00	2.79
6	1.17	0.00	0.49	0.00	0.00	0.00	2.79
7	1.56	0.00	0.64	0.00	0.00	0.00	2.56
8	2.34	0.00	0.95	0.00	0.00	0.00	1.94
9	3.12	0.00	1.25	0.00	0.00	0.00	1.09
10	3.90	0.00	1.55	0.00	0.00	0.00	0.00

Point	Offset m	X-glob m	Y-glob m	Z-glob m	y-local m	z-local m
1	0.0	0.0000	-0.0120	0.0000	0.0000	0.0000
2	0.2	0.0000	-0.0122	0.0000	-0.0006	0.0000
3	0.2	0.0000	-0.0122	0.0000	-0.0006	0.0000
4	0.8	0.0000	-0.0122	0.0000	-0.0025	0.0000
5	1.2	0.0000	-0.0117	0.0000	-0.0032	0.0000
6	1.2	0.0000	-0.0117	0.0000	-0.0032	0.0000
7	1.6	0.0000	-0.0108	0.0000	-0.0036	0.0000
8	2.3	0.0000	-0.0081	0.0000	-0.0033	0.0000
9	3.1	0.0000	-0.0043	0.0000	-0.0019	0.0000
10	3.9	0.0000	0.0000	0.0000	0.0000	0.0000

== S U P P O R T R E A C T I O N S ==

CASE 12: serv

Node	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
101	0.00	1.51	0.00	0.00	0.00	0.00
102	0.00	5.52	0.00	0.00	0.00	0.00
103	0.00	1.55	0.00	0.00	0.00	0.00
SUM:	0.00	8.57	0.00 (all nodes)			

(Reactions act on structure in positive global axis directions.)

R229

Building Lateral Stability Analysis

- Refer to ETABS output report for building analysis for wind and earthquake loading.
- General stability mechanism comprises of:
  - Combination of steel diagonal braces and concrete shear walls to front block & diagonal steel braces to rear block.
  - below transfer floor a combination of shear walls & concrete beam/column framing action.
- Refer to ETABS design output sections for concrete wall panels, concrete beams, concrete columns, steel beams, steel columns & steel braces for individual member checks and confirmations.
- From wall panel design section, 150 thick precast concrete wall panels structurally adequate for lateral stability
- From ETABS lateral stability report, building appears sufficiently rigid to resist lateral wind and seismic loads in either direction as well as modal analysis; see Table 3.3 - maximum lateral displacement at roof level ≈ 4mm in either direction.
- From ETABS lateral stability report Table 3.6 modal mass participation ratios greater than 98% in both directions ⇒ satisfying requirement from AS1170.4, section 7.4.2.
- Similarly, from Table 3.5 - modal frequencies & periods, first mode comfortably above 1Hz (2.46Hz), satisfying the requirements of AS1170.2 Cl. 6.1.

⇒ $\boxed{\text{lateral load resisting capacity of structure considered structurally adequate.}}$

WIND SPEED CALCULATION

These calculations comply with the requirements of AS/NZS 1170.2:2011 - Wind Actions (Amendments 1 & 2) and the Building Code of Australia (BCA Volume 1).

Site : **168 Prospect Road**
Description : **Proposed Residential Apartments**

DESIGN WIND SPEEDS

Importance Level :	2	BCA Vol.1 - 2013 Table B1.2a
$R_{strength}$:	500 years	BCA Vol.1 - 2013 Table B1.2b
$R_{serviceability}$:	**20** years	
Wind region :	A	Figure 3.1
Terrain category :	3	Clause 4.2.1
Reference height, z :	**15** metres	
Terrain/height, $M_{z,cat}$:	0.89	Table 4.1
Direction, M_d :	**1.00**	Table 3.2
Shielding, M_s :	**1.00**	Clause 4.3
Topography, M_t :	**1.00**	Clause 4.4
$V_{R,strength}$:	45 m/s	Table 3.1
$V_{R,serviceability}$:	37 m/s	
=> $V_{des,strength}$:	**40.0 m/s**	Clause 2.3
=> $V_{des,serviceability}$:	**32.9 m/s**	

→ **For Designs to AS 4055-2012 Wind loads for housing (Table 2.2) use Wind Class N2**

Notes on comparing results from AS/NZS 1170.2:2011 with AS 4055 - 2012 (Refer to Appendix A3 of AS 4055 - 2012)

AS 4055 - 2012 Wind Classifications were derived from a range of design scenarios evaluated using AS/NZS 1170.2:2011 - Wind Actions (incl. Amendments 1 & 2), in which the following criteria were applied:

1. The annual probability of exceedance - 1/500 (approximately equivalent to $R_{strength}$ = 500 years);
2. A factor of 0.95 on (strength) wind speed accounted for various effects unique to housing;
3. A 5% margin was allowed on the wind speed for assigning N and C classes;
4. Average roof height was taken as 6.5 metres;
5. In AS 4055 - 2012, $M_{z,cat}$ was derived from AS/NZS 1170.2:2011 using a reference height of 6.5 metres;
6. The topographic multiplier, M_t, was derived from the hill shape multiplier defined in Table A2 of AS 4055 - 2012, except that the **separation zone at the crest** (AS/NZS 1170.2:2011, Figure 4.4) was not included in AS 4055 - 2012 .

Consequently, although the **Design Gust Speeds $V_{h,u}$ and $V_{h,s}$ for N and C class sites for housing** do not exactly correspond to the values of **$V_{des,strength}$ and $V_{des,serviceability}$ from AS/NZS 1170.2:2011**, the correlation shown above between the **Design Wind Speeds** determined from AS/NZS 1170.2:2011 and the **N and C Wind Classifications** determined from AS 4055 - 2012 is acceptable for design purposes.

Wind Loading (Used in ETABS model)

Job No	1702160
Date	30/05/2017
Designer	FK
Sheet	LS

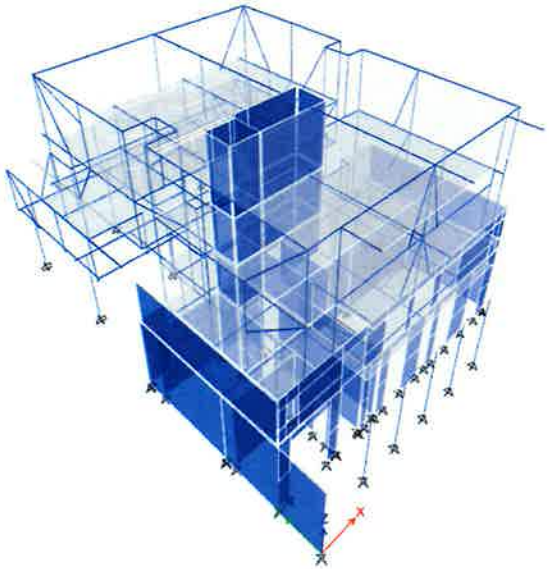
qz_{ult} 0.93615 kPa

C_{pn} 1.2

Level	Height	(X) Direction		(Y) Direction		kpa applied on floor	
		Width	Force	Width	Force	x	y
R	4	27	121.3	16	71.9	0.28	0.17
3	3.2	27	97.1	16	57.5	0.22	0.13
2	3.2	27	97.1	20	71.9	0.18	0.13
1	5.4	27	163.8	20	121.3	0.30	0.22

LS3

ETABS® 2016
Integrated Building Design Software



Lateral Stability Model

Proposed Apartments
Model File: Model 01, Revision 0
30/05/2017

Table of Contents

1. Structure Data 4
   - 1.1 Story Data 4
   - 1.2 Mass 4
2. Loads 6
   - 2.1 Load Patterns 6
   - 2.2 Auto Seismic Loading 6
   - 2.3 Load Cases 11
   - 2.4 Load Combinations 11
3. Analysis Results 19
   - 3.1 Structure Results 19
   - 3.2 Modal Results 66

454

List of Tables

Table 1.1 Story Data 4
Table 1.2 Mass Source 4
Table 1.3 Centers of Mass and Rigidity 4
Table 1.4 Mass Summary by Diaphragm 4
Table 1.5 Mass Summary by Story 4
Table 2.1 Load Patterns 6
Table 2.2 Auto Seismic - AS 1170:2007 6
Table 2.5 Load Cases - Summary 11
Table 2.6 Load Cases - Static - Linear 11
Table 2.7 Load Cases - Modal - Ritz 11
Table 2.8 P-delta Options 11
Table 2.9 Load Combinations 11
Table 3.1 Base Reactions 19
Table 3.2 Centers of Mass and Rigidity 23
Table 3.3 Diaphragm Center of Mass Displacements 23
Table 3.4 Diaphragm Max/Avg Drifts 36
Table 3.5 Modal Periods and Frequencies 66
Table 3.6 Modal Participating Mass Ratios 66

1 Structure Data

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

1.1 Story Data

Table 1.1 - Story Data

Name	Height mm	Elevation mm	Master Story	Similar To	Splice Story
Story4	4200	16000	Yes	None	No
Story3	3200	11800	No	Story4	No
Story2	3200	8600	No	Story4	No
Story1	5400	5400	No	Story4	No
Base	0	0	No	None	No

1.2 Mass

Table 1.2 - Mass Source

Name	Include Elements	Include Added Mass	Include Loads	Include Lateral	Include Vertical	Lump at Stories	IsDefault	Load Pattern	Multiplier
MsSrc1	No	No	Yes	Yes	No	Yes	Yes	Dead	1
MsSrc1	No	No	Yes	Yes	No	Yes	Yes	Live	0.3
MsSrc1	No	No	Yes	Yes	No	Yes	Yes	SDead	1

Table 1.3 - Centers of Mass and Rigidity

Story	Diaphragm	Mass X kg	Mass Y kg	XCM m	YCM m	Cumulative X kg	Cumulative Y kg	XCCM m	YCCM m	XCR m	YCR m
Story4	D1	0	0	9.75	12.7	0	0	0	0		
Story3	D1	0	0	9.8702	12.5762	0	0	0	0		
Story2	D1	0	0	9.8785	15.4779	0	0	0	0		
Story1	D1	0	0	9.9615	16.2678	0	0	0	0		
Story4	Rigid Roof	21313.35	21313.35	9.6693	12.8835	21313.35	21313.35	9.6693	12.8835		

Table 1.4 - Mass Summary by Diaphragm

Story	Diaphragm	Mass X kg	Mass Y kg	Mass Moment of Inertia ton-m²	X Mass Center m	Y Mass Center m
Story4	D1	0	0	0	9.75	12.7
Story4	Rigid Roof	21313.35	21313.35	1470.3594	9.6693	12.8835
Story3	D1	0	0	0	9.8702	12.5762
Story2	D1	0	0	0	9.8785	15.4779
Story1	D1	0	0	0	9.9615	16.2678

Table 1.5 - Mass Summary by Story

Story	UX kg	UY kg	UZ kg
Story4	43933.9	43933.9	0
Story3	229921.71	229921.71	0
Story2	454383.8	454383.8	0

455

Table 1.5 - Mass Summary by Story (continued)

Story	UX kg	UY kg	UZ kg
Story1	694527.77	694527.77	0
Base	27445.76	27445.76	0

2 Loads

This chapter provides loading information as applied to the model.

2.1 Load Patterns

Table 2.1 - Load Patterns

Name	Type	Self Weight Multiplier	Auto Load
Dead	Dead	1	
Live	Live	0	
SDead	Superimposed Dead	0	
Wind x	Wind	0	User Loads
Wind y	Wind	0	User Loads
EQ X	Seismic	0	AS 1170 2007
EQ Y	Seismic	0	AS 1170 2007

2.2 Auto Seismic Loading

Table 2.2 - Auto Seismic - AS 1170:2007 (Part 1 of 2)

Load Pattern	Type	Direction	Eccentricity %	Ecc. Overridden	Period Method	kt	Top Story	Bottom Story	Site Class
EQ X	Seismic	X		No	Program Calculated	0.06	Story4	Base	D
EQ X	Seismic	X + Ecc. Y	10	No	Program Calculated	0.06	Story4	Base	D
EQ X	Seismic	X - Ecc. Y	10	No	Program Calculated	0.06	Story4	Base	D
EQ Y	Seismic	Y		No	Program Calculated	0.06	Story4	Base	D
EQ Y	Seismic	Y + Ecc. X	10	No	Program Calculated	0.06	Story4	Base	D
EQ Y	Seismic	Y - Ecc. X	10	No	Program Calculated	0.06	Story4	Base	D

Table 2.2 - Auto Seismic - AS 1170:2007 (Part 2 of 2)

kp	Z	Sp	μ	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN
1	0.1	0.67	3	0.265	0.082187	13952.58	1146.716
1	0.1	0.67	3	0.265	0.082187	13952.58	1146.716
1	0.1	0.67	3	0.265	0.082187	13952.58	1146.716
1	0.1	0.67	3	0.306	0.082187	13952.58	1146.716
1	0.1	0.67	3	0.306	0.082187	13952.58	1146.716
1	0.1	0.67	3	0.306	0.082187	13952.58	1146.716

956

AS 1170 2007 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ X according to AS 1170 2007, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 10% for all diaphragms

Structural Period

Period Calculation Method = Program Calculated

Coefficient, k_t [AS 6.2.3] $k_t = 0.06m$

Structure Height Above Base, h_n $h_n = 16\ m$

Factors and Coefficients

Probability Factor, k_p [AS Table 3.1] $k_p = 1$

Hazard Factor, Z [AS Table 3.2] $Z = 0.1$

Structural Performance Factor, Sp [AS Table 6.5(A)] $S_p = 0.67$

Structural Ductility Factor, μ [AS Table 6.5(A)] $\mu = 3$

Site Sub-soil Class [AS 4.1.1] = De - Deep or Soft Soil

Equivalent Lateral Forces

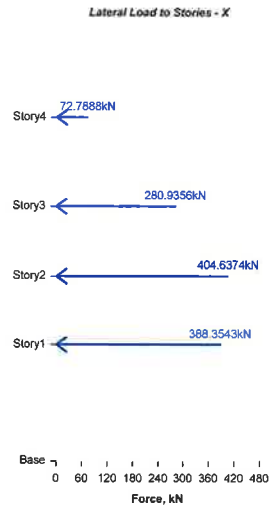
Seismic Design Action Coefficient, $C_{d(T)}$ [AS 6.2.1]

$$C_d(T_1) = \frac{k_p Z C_h(T_1) S_p}{\mu}$$

Calculated Base Shear

Direction	Period Used (sec)	$C_{d(T}$	W (kN)	V (kN)
X	0.265	0.082187	13952.58	1146.716
X + Ecc. Y	0.265	0.082187	13952.58	1146.716
X - Ecc. Y	0.265	0.082187	13952.58	1146.716

Applied Story Forces



Story	Elevation m	X-Dir kN	Y-Dir kN
Story4	16	72.7888	0
Story3	11.8	280.9356	0
Story2	8.6	404.6374	0
Story1	5.4	388.3543	0
Base	0	0	0

157

AS 1170 2007 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ Y according to AS 1170 2007, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 10% for all diaphragms

Structural Period

Period Calculation Method = Program Calculated

Coefficient, k_t [AS 6.2.3] $k_t = 0.06m$

Structure Height Above Base, h_n $h_n = 16\ m$

Factors and Coefficients

Probability Factor, k_p [AS Table 3.1] $k_p = 1$

Hazard Factor, Z [AS Table 3.2] $Z = 0.1$

Structural Performance Factor, Sp [AS Table 6.5(A)] $S_p = 0.67$

Structural Ductility Factor, μ [AS Table 6.5(A)] $\mu = 3$

Site Sub-soil Class [AS 4.1.1] = De - Deep or Soft Soil

Equivalent Lateral Forces

Seismic Design Action Coefficient, $C_{d(T}$ [AS 6.2.1]

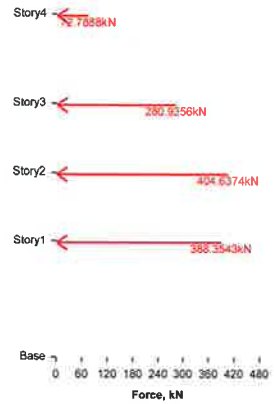
$$C_d(T_1) = \frac{k_p Z C_h(T_1) S_p}{\mu}$$

Calculated Base Shear

Direction	Period Used (sec)	$C_{d(T}$	W (kN)	V (kN)
Y	0.306	0.082187	13952.58	1146.716
Y + Ecc. X	0.306	0.082187	13952.58	1146.716
Y - Ecc. X	0.306	0.082187	13952.58	1146.716

Applied Story Forces

Lateral Load to Stories - Y



Story	Elevation m	X-Dir kN	Y-Dir kN
Story4	16	0	72.7888
Story3	11.8	0	280.9356
Story2	8.6	0	404.6374
Story1	5.4	0	388.3543
Base	0	0	0

158

2.3 Load Cases

Table 2.5 - Load Cases - Summary

Name	Type
Dead	Linear Static
Live	Linear Static
SDead	Linear Static
Wind x	Linear Static
Wind y	Linear Static
EQ X	Linear Static
EQ Y	Linear Static

Table 2.6 - Load Cases - Static - Linear

Name	Stiffness From	Mass Source	Load Type	Load Name	Scale Factor	Design Load Type
Dead	Preset P-delta	MsSrc1	Load Pattern	Dead	1	Program Determined
Live	Preset P-delta	MsSrc1	Load Pattern	Live	1	Program Determined
SDead	Preset P-delta	MsSrc1	Load Pattern	SDead	1	Program Determined
Wind x	Preset P-delta	MsSrc1	Load Pattern	Wind x	1	Program Determined
Wind y	Preset P-delta	MsSrc1	Load Pattern	Wind y	1	Program Determined
EQ X	Preset P-delta	MsSrc1	Load Pattern	EQ X	1	Program Determined
EQ Y	Preset P-delta	MsSrc1	Load Pattern	EQ Y	1	Program Determined

Table 2.7 - Load Cases - Modal - Ritz

Name	Stiffness From	Mass Source	Load Type	Load Name	Max Cycles	Target Participation %	Max Number Modes	Min Number Modes	Design Load Type
Modal	Preset P-delta	MsSrc1	Acceleration	UX	0	99	20	1	Program Determined
Modal			Acceleration	UY	0	99			

Table 2.8 - P-delta Options

Automation Method	Load Pattern	Scale Factor	Convergence Tolerance
Iterative - Loads	Dead	1	1E-07
	Live	0.5	
	SDead	1	

2.4 Load Combinations

Table 2.9 - Load Combinations

Name	Load Case/Combo	Scale Factor	Type	Auto
Serv 01 (G)	Dead	1	Linear Add	No
Serv 01 (G)	SDead	1		No
Serv 02 (G+0.7Q)	Dead	1	Linear Add	No
Serv 02 (G+0.7Q)	SDead	1		No
Serv 02 (G+0.7Q)	Live	0.7		No
Serv 03 (G+Wx)	Dead	1	Linear Add	No
Serv 03 (G+Wx)	SDead	1		No
Serv 03 (G+Wx)	Wind x	0.67		No
Serv 04 (G-Wx)	Dead	1	Linear Add	No
Serv 04 (G-Wx)	SDead	1		No
Serv 04 (G-Wx)	Wind x	-0.67		No

Table 2.9 - Load Combinations (continued)

Name	Load Case/Combo	Scale Factor	Type	Auto
Serv 05 (G+Wy)	Dead	1	Linear Add	No
Serv 05 (G+Wy)	SDead	1		No
Serv 05 (G+Wy)	Wind y	0.67		No
Serv 06 (G-Wy)	Dead	1	Linear Add	No
Serv 06 (G-Wy)	SDead	1		No
Serv 06 (G-Wy)	Wind y	-0.67		No
Serv 07 (G+0.7Wx+0.3Wy)	Dead	1	Linear Add	No
Serv 07 (G+0.7Wx+0.3Wy)	SDead	1		No
Serv 07 (G+0.7Wx+0.3Wy)	Wind x	0.47		No
Serv 07 (G+0.7Wx+0.3Wy)	Wind y	0.2		No
Serv 08 (G+0.5Wx+0.5Wy)	Dead	1	Linear Add	No
Serv 08 (G+0.5Wx+0.5Wy)	SDead	1		No
Serv 08 (G+0.5Wx+0.5Wy)	Wind x	0.34		No
Serv 08 (G+0.5Wx+0.5Wy)	Wind y	0.34		No
Serv 09 (G+0.3Wx+0.7Wy)	Dead	1	Linear Add	No
Serv 09 (G+0.3Wx+0.7Wy)	SDead	1		No
Serv 09 (G+0.3Wx+0.7Wy)	Wind x	0.2		No
Serv 09 (G+0.3Wx+0.7Wy)	Wind y	0.47		No
Serv 10 (G-0.7Wx-0.3Wy)	Dead	1	Linear Add	No
Serv 10 (G-0.7Wx-0.3Wy)	SDead	1		No
Serv 10 (G-0.7Wx-0.3Wy)	Wind x	-0.47		No
Serv 10 (G-0.7Wx-0.3Wy)	Wind y	-0.2		No
Serv 11 (G-0.5Wx-0.5Wy)	Dead	1	Linear Add	No
Serv 11 (G-0.5Wx-0.5Wy)	SDead	1		No
Serv 11 (G-0.5Wx-0.5Wy)	Wind x	-0.34		No
Serv 11 (G-0.5Wx-0.5Wy)	Wind y	-0.34		No
Serv 12 (G-0.3Wx-0.7Wy)	Dead	1	Linear Add	No
Serv 12 (G-0.3Wx-0.7Wy)	SDead	1		No
Serv 12 (G-0.3Wx-0.7Wy)	Wind x	-0.2		No
Serv 12 (G-0.3Wx-0.7Wy)	Wind y	-0.47		No
Serv 13 (G+0.7Wx-0.3Wy)	Dead	1	Linear Add	No
Serv 13 (G+0.7Wx-0.3Wy)	SDead	1		No
Serv 13 (G+0.7Wx-0.3Wy)	Wind x	0.47		No
Serv 13 (G+0.7Wx-0.3Wy)	Wind y	-0.2		No
Serv 14 (G+0.5Wx-0.5Wy)	Dead	1	Linear Add	No
Serv 14 (G+0.5Wx-0.5Wy)	SDead	1		No
Serv 14 (G+0.5Wx-0.5Wy)	Wind x	0.34		No
Serv 14 (G+0.5Wx-0.5Wy)	Wind y	-0.34		No
Serv 15 (G+0.3Wx-0.7Wy)	Dead	1	Linear Add	No
Serv 15 (G+0.3Wx-0.7Wy)	SDead	1		No
Serv 15 (G+0.3Wx-0.7Wy)	Wind x	0.2		No
Serv 15 (G+0.3Wx-0.7Wy)	Wind y	-0.47		No
Serv 16 (G-0.7Wx+0.3Wy)	Dead	1	Linear Add	No
Serv 16 (G-0.7Wx+0.3Wy)	SDead	1		No
Serv 16 (G-0.7Wx+0.3Wy)	Wind x	-0.47		No
Serv 16 (G-0.7Wx+0.3Wy)	Wind y	0.2		No
Serv 17 (G-0.5Wx+0.5Wy)	Dead	1	Linear Add	No
Serv 17 (G-0.5Wx+0.5Wy)	SDead	1		No
Serv 17 (G-0.5Wx+0.5Wy)	Wind x	-0.34		No

159

Table 2.9 - Load Combinations (continued)

Name	Load Case/Combo	Scale Factor	Type	Auto
Serv 17 (G-0.5Wx+0.5Wy)	Wind y	0.34		No
Serv 18 (G-0.3Wx+0.7Wy)	Dead	1	Linear Add	No
Serv 18 (G-0.3Wx+0.7Wy)	SDead	1		No
Serv 18 (G-0.3Wx+0.7Wy)	Wind x	-0.2		No
Serv 18 (G-0.3Wx+0.7Wy)	Wind y	0.47		No
Ult 01 (1.35G)	Dead	1.35	Linear Add	No
Ult 01 (1.35G)	SDead	1.35		No
Ult 02 (1.2G+1.5Q)	Dead	1.2	Linear Add	No
Ult 02 (1.2G+1.5Q)	SDead	1.2		No
Ult 02 (1.2G+1.5Q)	Live	1.5		No
Ult 03 (1.2G+Wx+0.4Q)	Dead	1.2	Linear Add	No
Ult 03 (1.2G+Wx+0.4Q)	SDead	1.2		No
Ult 03 (1.2G+Wx+0.4Q)	Wind x	1		No
Ult 03 (1.2G+Wx+0.4Q)	Live	0.4		No
Ult 04 (1.2G-Wx+0.4Q)	Dead	1.2	Linear Add	No
Ult 04 (1.2G-Wx+0.4Q)	SDead	1.2		No
Ult 04 (1.2G-Wx+0.4Q)	Wind x	-1		No
Ult 04 (1.2G-Wx+0.4Q)	Live	0.4		No
Ult 05 (1.2G+Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 05 (1.2G+Wy+0.4Q)	SDead	1.2		No
Ult 05 (1.2G+Wy+0.4Q)	Wind y	1		No
Ult 05 (1.2G+Wy+0.4Q)	Live	0.4		No
Ult 06 (1.2G-Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 06 (1.2G-Wy+0.4Q)	SDead	1.2		No
Ult 06 (1.2G-Wy+0.4Q)	Wind y	-1		No
Ult 06 (1.2G-Wy+0.4Q)	Live	0.4		No
Ult 07 (0.9G+Wx)	Dead	0.9	Linear Add	No
Ult 07 (0.9G+Wx)	SDead	0.9		No
Ult 07 (0.9G+Wx)	Wind x	1		No
Ult 08 (0.9G-Wx)	Dead	0.9	Linear Add	No
Ult 08 (0.9G-Wx)	SDead	0.9		No
Ult 08 (0.9G-Wx)	Wind x	-1		No
Ult 09 (0.9G+Wy)	Dead	0.9	Linear Add	No
Ult 09 (0.9G+Wy)	SDead	0.9		No
Ult 09 (0.9G+Wy)	Wind y	1		No
Ult 10 (0.9G-Wy)	Dead	0.9	Linear Add	No
Ult 10 (0.9G-Wy)	SDead	0.9		No
Ult 10 (0.9G-Wy)	Wind y	-1		No
Ult 11 (0.9G+0.7Wx+0.3Wy)	Dead	0.9	Linear Add	No
Ult 11 (0.9G+0.7Wx+0.3Wy)	SDead	0.9		No
Ult 11 (0.9G+0.7Wx+0.3Wy)	Wind x	0.7		No
Ult 11 (0.9G+0.7Wx+0.3Wy)	Wind y	0.3		No
Ult 12 (0.9G+0.5Wx+0.5Wy)	Dead	0.9	Linear Add	No
Ult 12 (0.9G+0.5Wx+0.5Wy)	SDead	0.9		No
Ult 12 (0.9G+0.5Wx+0.5Wy)	Wind x	0.5		No
Ult 12 (0.9G+0.5Wx+0.5Wy)	Wind y	0.5		No
Ult 13 (0.9G+0.3Wx+0.7Wy)	Dead	0.9	Linear Add	No
Ult 13 (0.9G+0.3Wx+0.7Wy)	SDead	0.9		No
Ult 13 (0.9G+0.3Wx+0.7Wy)	Wind x	0.3		No

Table 2.9 - Load Combinations (continued)

Name	Load Case/Combo	Scale Factor	Type	Auto
Ult 13 (0.9G+0.3Wx+0.7Wy)	Wind y	0.7		No
Ult 14 (0.9G-0.7Wx-0.3Wy)	Dead	0.9	Linear Add	No
Ult 14 (0.9G-0.7Wx-0.3Wy)	SDead	0.9		No
Ult 14 (0.9G-0.7Wx-0.3Wy)	Wind x	-0.7		No
Ult 14 (0.9G-0.7Wx-0.3Wy)	Wind y	-0.3		No
Ult 15 (0.9G-0.5Wx-0.5Wy)	Dead	0.9	Linear Add	No
Ult 15 (0.9G-0.5Wx-0.5Wy)	SDead	0.9		No
Ult 15 (0.9G-0.5Wx-0.5Wy)	Wind x	-0.5		No
Ult 15 (0.9G-0.5Wx-0.5Wy)	Wind y	-0.5		No
Ult 16 (0.9G-0.3Wx-0.7Wy)	Dead	0.9	Linear Add	No
Ult 16 (0.9G-0.3Wx-0.7Wy)	SDead	0.9		No
Ult 16 (0.9G-0.3Wx-0.7Wy)	Wind x	-0.3		No
Ult 16 (0.9G-0.3Wx-0.7Wy)	Wind y	-0.7		No
Ult 17 (0.9G+0.7Wx-0.3Wy)	Dead	0.9	Linear Add	No
Ult 17 (0.9G+0.7Wx-0.3Wy)	SDead	0.9		No
Ult 17 (0.9G+0.7Wx-0.3Wy)	Wind x	0.7		No
Ult 17 (0.9G+0.7Wx-0.3Wy)	Wind y	-0.3		No
Ult 18 (0.9G+0.5Wx-0.5Wy)	Dead	0.9	Linear Add	No
Ult 18 (0.9G+0.5Wx-0.5Wy)	SDead	0.9		No
Ult 18 (0.9G+0.5Wx-0.5Wy)	Wind x	0.5		No
Ult 18 (0.9G+0.5Wx-0.5Wy)	Wind y	-0.5		No
Ult 19 (0.9G+0.3Wx-0.7Wy)	Dead	0.9	Linear Add	No
Ult 19 (0.9G+0.3Wx-0.7Wy)	SDead	0.9		No
Ult 19 (0.9G+0.3Wx-0.7Wy)	Wind x	0.3		No
Ult 19 (0.9G+0.3Wx-0.7Wy)	Wind y	-0.7		No
Ult 20 (0.9G-0.7Wx+0.3Wy)	Dead	0.9	Linear Add	No
Ult 20 (0.9G-0.7Wx+0.3Wy)	SDead	0.9		No
Ult 20 (0.9G-0.7Wx+0.3Wy)	Wind x	-0.7		No
Ult 20 (0.9G-0.7Wx+0.3Wy)	Wind y	0.3		No
Ult 21 (0.9G-0.5Wx+0.5Wy)	Dead	0.9	Linear Add	No
Ult 21 (0.9G-0.5Wx+0.5Wy)	SDead	0.9		No
Ult 21 (0.9G-0.5Wx+0.5Wy)	Wind x	-0.5		No
Ult 21 (0.9G-0.5Wx+0.5Wy)	Wind y	0.5		No
Ult 22 (0.9G-0.3Wx+0.7Wy)	Dead	0.9	Linear Add	No
Ult 22 (0.9G-0.3Wx+0.7Wy)	SDead	0.9		No
Ult 22 (0.9G-0.3Wx+0.7Wy)	Wind x	-0.3		No
Ult 22 (0.9G-0.3Wx+0.7Wy)	Wind y	0.7		No
Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	SDead	1.2		No
Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Wind x	0.7		No
Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Wind y	0.3		No
Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Live	0.4		No
Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	SDead	1.2		No
Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Wind x	0.5		No
Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Wind y	0.5		No
Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Live	0.4		No
Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	SDead	1.2		No

LS10

Table 2.9 - Load Combinations (continued)

Name	Load Case/Combo	Scale Factor	Type	Auto
Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Wind x	0.3		No
Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Wind y	0.7		No
Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Live	0.4		No
Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	SDead	1.2		No
Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Wind x	-0.7		No
Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Wind y	-0.3		No
Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Live	0.4		No
Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	SDead	1.2		No
Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Wind x	-0.5		No
Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Wind y	-0.5		No
Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Live	0.4		No
Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	SDead	1.2		No
Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Wind x	-0.3		No
Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Wind y	-0.7		No
Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Live	0.4		No
Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	SDead	1.2		No
Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Wind x	0.7		No
Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Wind y	-0.3		No
Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Live	0.4		No
Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	SDead	1.2		No
Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Wind x	0.5		No
Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Wind y	-0.5		No
Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Live	0.4		No
Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	SDead	1.2		No
Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Wind x	0.3		No
Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Wind y	-0.7		No
Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Live	0.4		No
Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	SDead	1.2		No
Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Wind x	-0.7		No
Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Wind y	0.3		No
Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Live	0.4		No
Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	SDead	1.2		No
Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Wind x	-0.5		No
Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Wind y	0.5		No
Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Live	0.4		No
Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Dead	1.2	Linear Add	No
Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	SDead	1.2		No
Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Wind x	-0.3		No
Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Wind y	0.7		No
Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Live	0.4		No
Ult 35 (G+EQX+0.3Q)	Dead	1	Linear Add	No

Table 2.9 - Load Combinations (continued)

Name	Load Case/Combo	Scale Factor	Type	Auto
Ult 35 (G+EQX+0.3Q)	SDead	1		No
Ult 35 (G+EQX+0.3Q)	Live	0.3		No
Ult 35 (G+EQX+0.3Q)	EQ X	1		No
Ult 36 (G-EQX+0.3Q)	Dead	1	Linear Add	No
Ult 36 (G-EQX+0.3Q)	SDead	1		No
Ult 36 (G-EQX+0.3Q)	Live	0.3		No
Ult 36 (G-EQX+0.3Q)	EQ X	-1		No
Ult 37 (G+EQY+0.3Q)	Dead	1	Linear Add	No
Ult 37 (G+EQY+0.3Q)	SDead	1		No
Ult 37 (G+EQY+0.3Q)	Live	0.3		No
Ult 37 (G+EQY+0.3Q)	EQ Y	1		No
Ult 38 (G-EQY+0.3Q)	Dead	1	Linear Add	No
Ult 38 (G-EQY+0.3Q)	SDead	1		No
Ult 38 (G-EQY+0.3Q)	Live	0.3		No
Ult 38 (G-EQY+0.3Q)	EQ Y	-1		No
Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	Dead	1	Linear Add	No
Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	SDead	1		No
Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	Live	0.3		No
Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	EQ X	1		No
Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	EQ Y	0.3		No
Ult 40 (G+0.5EQX+0.5EQY+0.3Q)	Dead	1	Linear Add	No
Ult 40 (G+0.5EQX+0.5EQY+0.3Q)	SDead	1		No
Ult 40 (G+0.5EQX+0.5EQY+0.3Q)	Live	0.3		No
Ult 40 (G+0.5EQX+0.5EQY+0.3Q)	EQ X	0.5		No
Ult 40 (G+0.5EQX+0.5EQY+0.3Q)	EQ Y	0.5		No
Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	Dead	1	Linear Add	No
Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	SDead	1		No
Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	Live	0.3		No
Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	EQ X	0.3		No
Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	EQ Y	1		No
Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	Dead	1	Linear Add	No
Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	SDead	1		No
Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	Live	0.3		No
Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	EQ X	-1		No
Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	EQ Y	-0.3		No
Ult 43 (G-0.5EQX-0.5EQY+0.3Q)	Dead	1	Linear Add	No
Ult 43 (G-0.5EQX-0.5EQY+0.3Q)	SDead	1		No
Ult 43 (G-0.5EQX-0.5EQY+0.3Q)	Live	0.3		No
Ult 43 (G-0.5EQX-0.5EQY+0.3Q)	EQ X	-0.5		No
Ult 43 (G-0.5EQX-0.5EQY+0.3Q)	EQ Y	-0.5		No
Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	Dead	1	Linear Add	No
Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	SDead	1		No
Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	Live	0.3		No
Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	EQ X	-0.3		No
Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	EQ Y	-1		No
Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	Dead	1	Linear Add	No
Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	SDead	1		No
Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	Live	0.3		No
Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	EQ X	1		No

1157

Table 2.9 - Load Combinations (continued)

Name	Load Case/Combo	Scale Factor	Type	Auto
Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	EQ Y	-0.3		No
Ult 46 (G+0.5EQX-0.5EQY+0.3Q)	Dead	1	Linear Add	No
Ult 46 (G+0.5EQX-0.5EQY+0.3Q)	SDead	1		No
Ult 46 (G+0.5EQX-0.5EQY+0.3Q)	Live	0.3		No
Ult 46 (G+0.5EQX-0.5EQY+0.3Q)	EQ X	0.5		No
Ult 46 (G+0.5EQX-0.5EQY+0.3Q)	EQ Y	-0.5		No
Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	Dead	1	Linear Add	No
Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	SDead	1		No
Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	Live	0.3		No
Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	EQ X	0.3		No
Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	EQ Y	-1		No
Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	Dead	1	Linear Add	No
Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	SDead	1		No
Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	Live	0.3		No
Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	EQ Y	0.3		No
Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	EQ X	-1		No
Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	Dead	1	Linear Add	No
Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	SDead	1		No
Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	Live	0.3		No
Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	EQ Y	0.5		No
Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	EQ X	-0.5		No
Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	Dead	1	Linear Add	No
Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	SDead	1		No
Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	Live	0.3		No
Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	EQ Y	1		No
Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	EQ X	-0.3		No
ENVELOPE	Ult 01 (1.35G)	1	Envelope	No
ENVELOPE	Ult 02 (1.2G+1.5Q)	1		No
ENVELOPE	Ult 03 (1.2G+Wx+0.4Q)	1		No
ENVELOPE	Ult 04 (1.2G-Wx+0.4Q)	1		No
ENVELOPE	Ult 05 (1.2G+Wy+0.4Q)	1		No
ENVELOPE	Ult 06 (1.2G-Wy+0.4Q)	1		No
ENVELOPE	Ult 07 (0.9G+Wx)	1		No
ENVELOPE	Ult 08 (0.9G-Wx)	1		No
ENVELOPE	Ult 09 (0.9G+Wy)	1		No
ENVELOPE	Ult 10 (0.9G-Wy)	1		No
ENVELOPE	Ult 11 (0.9G+0.7Wx+0.3Wy)	1		No
ENVELOPE	Ult 12 (0.9G+0.5Wx+0.5Wy)	1		No
ENVELOPE	Ult 13 (0.9G+0.3Wx+0.7Wy)	1		No
ENVELOPE	Ult 14 (0.9G-0.7Wx-0.3Wy)	1		No
ENVELOPE	Ult 15 (0.9G-0.5Wx-0.5Wy)	1		No
ENVELOPE	Ult 16 (0.9G-0.3Wx-0.7Wy)	1		No
ENVELOPE	Ult 17 (0.9G+0.7Wx-0.3Wy)	1		No
ENVELOPE	Ult 18 (0.9G+0.5Wx-0.5Wy)	1		No
ENVELOPE	Ult 19 (0.9G+0.3Wx-0.7Wy)	1		No
ENVELOPE	Ult 20 (0.9G-0.7Wx+0.3Wy)	1		No
ENVELOPE	Ult 21 (0.9G-0.5Wx+0.5Wy)	1		No
ENVELOPE	Ult 22 (0.9G-0.3Wx+0.7Wy)	1		No
ENVELOPE	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	1		No

Table 2.9 - Load Combinations (continued)

Name	Load Case/Combo	Scale Factor	Type	Auto
ENVELOPE	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	1		No
ENVELOPE	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	1		No
ENVELOPE	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	1		No
ENVELOPE	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	1		No
ENVELOPE	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	1		No
ENVELOPE	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	1		No
ENVELOPE	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	1		No
ENVELOPE	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	1		No
ENVELOPE	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	1		No
ENVELOPE	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	1		No
ENVELOPE	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	1		No
ENVELOPE	Ult 35 (G+EQX+0.3Q)	1		No
ENVELOPE	Ult 36 (G-EQX+0.3Q)	1		No
ENVELOPE	Ult 37 (G+EQY+0.3Q)	1		No
ENVELOPE	Ult 38 (G-EQY+0.3Q)	1		No
ENVELOPE	Ult 39 (G+1.0EQX+0.3EQY+0.3Q)	1		No
ENVELOPE	Ult 40 (G+0.5EQX+0.5EQY+0.3Q)	1		No
ENVELOPE	Ult 41 (G+0.3EQX+1.0EQY+0.3Q)	1		No
ENVELOPE	Ult 42 (G-1.0EQX-0.3EQY+0.3Q)	1		No
ENVELOPE	Ult 43 (G-0.5EQX-0.5EQY+0.3Q)	1		No
ENVELOPE	Ult 44 (G-0.3EQX-1.0EQY+0.3Q)	1		No
ENVELOPE	Ult 45 (G+1.0EQX-0.3EQY+0.3Q)	1		No
ENVELOPE	Ult 46 (G+0.5EQX-0.5EQY+0.3Q)	1		No
ENVELOPE	Ult 47 (G+0.3EQX-1.0EQY+0.3Q)	1		No
ENVELOPE	Ult 48 (G-1.0EQX+0.3EQY+0.3Q)	1		No
ENVELOPE	Ult 49 (G-0.5EQX+0.5EQY+0.3Q)	1		No
ENVELOPE	Ult 50 (G-0.3EQX+1.0EQY+0.3Q)	1		No
DStlD1	Dead	1	Linear Add	Yes
DStlD1	SDead	1		No
DStlD2	Dead	1	Linear Add	Yes
DStlD2	Live	1		No
DStlD2	SDead	1		No
DCmpD1	Dead	1	Linear Add	Yes
DCmpD1	SDead	1		No
DCmpD2	Dead	1	Linear Add	Yes
DCmpD2	Live	1		No
DCmpD2	SDead	1		No
DCmpS1	Dead	1.35	Linear Add	Yes
DCmpS1	SDead	1.35		No
DCmpS2	Dead	1.35	Linear Add	Yes
DCmpS2	Live	1.5		No
DCmpS2	SDead	1.35		No
DCmpC1	Dead	1.5	Linear Add	Yes

LS12

3 Analysis Results

This chapter provides analysis results.

3.1 Structure Results

Table 3.1 - Base Reactions (Part 1 of 2)

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m
Dead	0	2.936E-06	11613.7148	161246.3663	-110048.1253	-0.0245
Live	0	6.662E-07	3091.9075	46777.5085	-31450.9863	-0.0126
SDead	0	0	1680.444	27128.6448	-16641.3956	-0.0098
Wind x	-340.8774	-83.3148	-395.5339	-4390.7077	419.8078	3971.2141
Wind y	0	-272.789	-395.5339	-2531.9971	3899.7267	-2693.0029
EQ X 1	-1146.716	-3.108E-06	0	-1.2897	-9726.4171	16025.05
EQ X 2	-1146.716	-5.15E-06	0	-2.149	-9728.3556	18634.7864
EQ X 3	-1146.716	-1.067E-06	0	-0.4304	-9724.4786	13415.3135
EQ Y 1	0	-1146.716	0	9722.6158	1.2812	-10991.681
EQ Y 2	0	-1146.716	0	9723.1967	2.5975	-12777.2216
EQ Y 3	0	-1146.716	0	9722.0348	-0.0351	-9206.1404
Serv 01 (G)	0	3.023E-06	13294.1588	188375.0111	-126689.5209	-0.0343
Serv 02 (G+0.7Q)	0	3.489E-06	15458.494	221119.267	-148705.2113	-0.0431
Serv 03 (G+Wx)	-228.3879	-55.8209	13029.1511	185433.2369	-126408.2497	2660.6792
Serv 04 (G-Wx)	228.3879	55.8209	13559.1665	191316.7852	-126970.7922	-2660.7477
Serv 05 (G+Wy)	0	-182.7686	13029.1511	186678.573	-124076.704	-1804.3462
Serv 06 (G-Wy)	0	182.7686	13559.1665	190071.4491	-129302.3378	1804.2777
Serv 07 (G+0.7Wx+0.3Wy)	-160.2124	-93.7158	13029.1511	185804.979	-125712.2659	1327.8358
Serv 08 (G+0.5Wx+0.5Wy)	-115.8983	-121.0753	13025.1957	186021.2914	-125220.8792	434.5575
Serv 09 (G+0.3Wx+0.7Wy)	-68.1755	-144.8738	13029.1511	186306.8309	-124772.6878	-471.5028
Serv 10 (G-0.7Wx-0.3Wy)	160.2124	93.7158	13559.1665	190945.0431	-127666.776	-1327.9043
Serv 11 (G-0.5Wx-0.5Wy)	115.8983	121.0753	13563.1218	190728.7307	-128158.1627	-434.6261
Serv 12 (G-0.3Wx-0.7Wy)	68.1755	144.8738	13559.1665	190443.1913	-128606.3541	471.4343
Serv 13 (G+0.7Wx-0.3Wy)	-160.2124	15.3998	13187.3646	186817.7779	-127272.1566	2405.0369
Serv 14 (G+0.5Wx-0.5Wy)	-115.8983	64.4212	13294.1588	187743.0495	-127872.6934	2265.7995
Serv 15 (G+0.3Wx-0.7Wy)	-68.1755	111.5479	13400.9529	188686.9082	-128438.4309	2059.9199
Serv 16 (G-0.7Wx+0.3Wy)	160.2124	-15.3998	13400.9529	189932.2443	-126106.8853	-2405.1055
Serv 17 (G-0.5Wx+0.5Wy)	115.8983	-64.4212	13294.1588	189006.9727	-125506.3485	-2265.868
Serv 18 (G-0.3Wx+0.7Wy)	68.1755	-111.5479	13187.3646	188063.114	-124940.6109	-2059.9885
Ult 01 (1.35G)	0	4.081E-06	17947.1144	254306.265	-171030.8533	-0.0463
Ult 02 (1.2G+1.5Q)	0	4.627E-06	20590.8518	296216.276	-199203.9046	-0.06
Ult 03 (1.2G+Wx+0.4Q)	-340.8774	-83.3148	16794.2196	240370.309	-164188.0118	3971.1679
Ult 04 (1.2G-Wx+0.4Q)	340.8774	83.3148	17585.2874	249151.7244	-165027.6275	-3971.2602
Ult 05 (1.2G+Wy+0.4Q)	0	-272.789	16794.2196	242229.0196	-160708.0929	-2693.0491
Ult 06 (1.2G-Wy+0.4Q)	0	272.789	17585.2874	247293.0138	-168507.5464	2692.9568
Ult 07 (0.9G+Wx)	-340.8774	-83.3148	11569.209	165146.8023	-113600.761	3971.1833
Ult 08 (0.9G-Wx)	340.8774	83.3148	12360.2768	173928.2177	-114440.3767	-3971.2449
Ult 09 (0.9G+Wy)	0	-272.789	11569.209	167005.5129	-110120.8421	-2693.0338
Ult 10 (0.9G-Wy)	0	272.789	12360.2768	172069.5071	-117920.2956	2692.9721
Ult 11 (0.9G+0.7Wx+0.3Wy)	-238.6142	-140.1571	11569.209	165704.4155	-112556.7853	1971.9182
Ult 12 (0.9G+0.5Wx+0.5Wy)	-170.4387	-178.0519	11569.209	166076.1576	-111860.8016	639.0747
Ult 13 (0.9G+0.3Wx+0.7Wy)	-102.2632	-215.9467	11569.209	166447.8997	-111164.8178	-693.7687
Ult 14 (0.9G-0.7Wx-0.3Wy)	238.6142	140.1571	12360.2768	173370.6045	-115484.3523	-1971.9798
Ult 15 (0.9G-0.5Wx-0.5Wy)	170.4387	178.0519	12360.2768	172998.8624	-116180.3361	-639.1364
Ult 16 (0.9G-0.3Wx-0.7Wy)	102.2632	215.9467	12360.2768	172627.1203	-116876.3199	693.707

Table 3.1 - Base Reactions (Part 1 of 2, continued)

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m
Ult 17 (0.9G+0.7Wx-0.3Wy)	-238.6142	23.5163	11806.5293	167223.6137	-114896.6214	3587.7199
Ult 18 (0.9G+0.5Wx-0.5Wy)	-170.4387	94.7371	11964.7429	168608.1547	-115760.5283	3332.0777
Ult 19 (0.9G+0.3Wx-0.7Wy)	-102.2632	165.9579	12122.9565	169992.6956	-116624.4352	3076.4354
Ult 20 (0.9G-0.7Wx+0.3Wy)	238.6142	-23.5163	12122.9565	171851.4062	-113144.5163	-3587.7816
Ult 21 (0.9G-0.5Wx+0.5Wy)	170.4387	-94.7371	11964.7429	170466.8653	-112280.6094	-3332.1393
Ult 22 (0.9G-0.3Wx+0.7Wy)	102.2632	-165.9579	11806.5293	169082.3243	-111416.7025	-3076.4971
Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	-238.6142	-140.1571	16794.2196	240927.9222	-163144.0361	1971.9028
Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	-170.4387	-178.0519	16794.2196	241299.6643	-162448.0524	639.0594
Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	-102.2632	-215.9467	16794.2196	241671.4064	-161752.0686	-693.784
Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	238.6142	140.1571	17585.2874	248594.1112	-166071.6031	-1971.9951
Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	170.4387	178.0519	17585.2874	248222.3691	-166767.5869	-639.1517
Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	102.2632	215.9467	17585.2874	247850.627	-167463.5707	693.6917
Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	-238.6142	23.5163	17031.54	242447.1204	-165483.8722	3587.7046
Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	-170.4387	94.7371	17189.7535	243831.6614	-166347.7791	3332.0624
Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	-102.2632	165.9579	17347.9671	245216.2024	-167211.686	3076.4201
Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	238.6142	-23.5163	17347.9671	247074.9129	-163731.7671	-3587.7969
Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	170.4387	-94.7371	17189.7535	245690.372	-162867.8602	-3332.1546
Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	102.2632	-165.9579	17031.54	244305.831	-162003.9533	-3076.5124
Ult 35 (G+EQX+0.3Q) Max	-1146.716	2.156E-06	14221.731	202407.8333	-145849.2954	18634.7484
Ult 35 (G+EQX+0.3Q) Min	-1146.716	-1.927E-06	14221.731	202406.1146	-145853.1724	13415.2755
Ult 36 (G-EQX+0.3Q) Max	1146.716	8.373E-06	14221.731	202410.4126	-126396.4612	-13415.3515
Ult 36 (G-EQX+0.3Q) Min	1146.716	4.29E-06	14221.731	202408.694	-126400.3382	-18634.8245
Ult 37 (G+EQY+0.3Q) Max	0	-1146.716	14221.731	212131.4603	-136122.2193	-9206.1784
Ult 37 (G+EQY+0.3Q) Min	0	-1146.716	14221.731	212130.2984	-136124.8519	-12777.2596
Ult 38 (G-EQY+0.3Q) Max	0	1146.716	14221.731	192686.2288	-136124.7817	12777.1836
Ult 38 (G-EQY+0.3Q) Min	0	1146.716	14221.731	192685.0669	-136127.4143	9206.1023
Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	-1146.716	-344.0148	14221.731	205324.7923	-145848.5162	15872.9063
Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	-1146.716	-344.0148	14221.731	205322.7251	-145853.183	9582.109
Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	-573.358	-573.358	14221.731	207269.6468	-140985.7574	4714.285
Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	-573.358	-573.358	14221.731	207268.2065	-140989.0122	319.0079
Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	-344.0148	-1146.716	14221.731	212131.3312	-139039.5629	-3615.7425
Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	-344.0148	-1146.716	14221.731	212129.6537	-139043.3586	-8752.6656
Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	1146.716	344.0148	14221.731	199493.8022	-126396.4507	-9582.1851
Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	1146.716	344.0148	14221.731	199491.735	-126401.1175	-15872.9824
Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	573.358	573.358	14221.731	197548.3207	-131260.6215	-319.084
Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	573.358	573.358	14221.731	197546.8804	-131263.8763	-4714.3611
Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	344.0148	1146.716	14221.731	192686.8735	-133206.275	8752.5895
Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	344.0148	1146.716	14221.731	192685.196	-133210.0707	3615.6664
Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	-1146.716	344.0148	14221.731	199491.2228	-145849.2849	22467.9149
Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	-1146.716	344.0148	14221.731	199489.1556	-145853.9517	16177.1176
Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	-573.358	573.358	14221.731	197547.0311	-140987.0386	15705.966
Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	-573.358	573.358	14221.731	197545.5908	-140990.2934	11310.6889
Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	-344.0148	1146.716	14221.731	192686.0997	-139042.1253	18367.6195
Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	-344.0148	1146.716	14221.731	192684.4222	-139045.921	13230.6964
Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	1146.716	-344.0148	14221.731	205327.3717	-126395.682	-16177.1937
Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	1146.716	-344.0148	14221.731	205325.3044	-126400.3487	-22467.9909
Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	573.358	-573.358	14221.731	207270.9365	-131259.3403	-11310.765
Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	573.358	-573.358	14221.731	207269.4962	-131262.5951	-15706.0421
Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	344.0148	-1146.716	14221.731	212132.105	-133203.7127	-13230.7725

L513

Table 3.1 - Base Reactions (Part 1 of 2, continued)

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m
Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	344.0148	-1146.716	14221.731	212130.4275	-133207.5083	-18367.6956
ENVELOPE Max	1146.716	1146.716	20590.8518	296216.276	-110120.8421	22467.9149
ENVELOPE Min	-1146.716	-1146.716	11569.209	165146.8023	-199203.9046	-22467.9909
DStlD1	0	3.023E-06	13294.1588	188375.0111	-126689.5209	-0.0343
DStlD2	0	3.689E-06	16386.0663	235152.5196	-158140.5072	-0.0468
DCmpD1	0	3.023E-06	13294.1588	188375.0111	-126689.5209	-0.0343
DCmpD2	0	3.689E-06	16386.0663	235152.5196	-158140.5072	-0.0468
DCmpS1	0	4.081E-06	17947.1144	254306.265	-171030.8533	-0.0463
DCmpS2	0	5.08E-06	22584.9756	324472.5277	-218207.3327	-0.0651
DCmpC1	0	4.404E-06	17420.5722	241869.5494	-165072.188	-0.0368

Table 3.1 - Base Reactions (Part 2 of 2)

Load Case/Combo	X m	Y m	Z m
Dead	0	0	0
Live	0	0	0
SDead	0	0	0
Wind x	0	0	0
Wind y	0	0	0
EQ X 1	0	0	0
EQ X 2	0	0	0
EQ X 3	0	0	0
EQ Y 1	0	0	0
EQ Y 2	0	0	0
EQ Y 3	0	0	0
Serv 01 (G)	0	0	0
Serv 02 (G+0.7Q)	0	0	0
Serv 03 (G+Wx)	0	0	0
Serv 04 (G-Wx)	0	0	0
Serv 05 (G+Wy)	0	0	0
Serv 06 (G-Wy)	0	0	0
Serv 07 (G+0.7Wx+0.3Wy)	0	0	0
Serv 08 (G+0.5Wx+0.5Wy)	0	0	0
Serv 09 (G+0.3Wx+0.7Wy)	0	0	0
Serv 10 (G-0.7Wx-0.3Wy)	0	0	0
Serv 11 (G-0.5Wx-0.5Wy)	0	0	0
Serv 12 (G-0.3Wx-0.7Wy)	0	0	0
Serv 13 (G+0.7Wx-0.3Wy)	0	0	0
Serv 14 (G+0.5Wx-0.5Wy)	0	0	0
Serv 15 (G+0.3Wx-0.7Wy)	0	0	0
Serv 16 (G-0.7Wx+0.3Wy)	0	0	0
Serv 17 (G-0.5Wx+0.5Wy)	0	0	0
Serv 18 (G-0.3Wx+0.7Wy)	0	0	0
Ult 01 (1.35G)	0	0	0
Ult 02 (1.2G+1.5Q)	0	0	0
Ult 03 (1.2G+Wx+0.4Q)	0	0	0
Ult 04 (1.2G-Wx+0.4Q)	0	0	0
Ult 05 (1.2G+Wy+0.4Q)	0	0	0
Ult 06 (1.2G-Wy+0.4Q)	0	0	0

Table 3.1 - Base Reactions (Part 2 of 2, continued)

Load Case/Combo	X m	Y m	Z m
Ult 07 (0.9G+Wx)	0	0	0
Ult 08 (0.9G-Wx)	0	0	0
Ult 09 (0.9G+Wy)	0	0	0
Ult 10 (0.9G-Wy)	0	0	0
Ult 11 (0.9G+0.7Wx+0.3Wy)	0	0	0
Ult 12 (0.9G+0.5Wx+0.5Wy)	0	0	0
Ult 13 (0.9G+0.3Wx+0.7Wy)	0	0	0
Ult 14 (0.9G-0.7Wx-0.3Wy)	0	0	0
Ult 15 (0.9G-0.5Wx-0.5Wy)	0	0	0
Ult 16 (0.9G-0.3Wx-0.7Wy)	0	0	0
Ult 17 (0.9G+0.7Wx-0.3Wy)	0	0	0
Ult 18 (0.9G+0.5Wx-0.5Wy)	0	0	0
Ult 19 (0.9G+0.3Wx-0.7Wy)	0	0	0
Ult 20 (0.9G-0.7Wx+0.3Wy)	0	0	0
Ult 21 (0.9G-0.5Wx+0.5Wy)	0	0	0
Ult 22 (0.9G-0.3Wx+0.7Wy)	0	0	0
Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	0	0	0
Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	0	0	0
Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	0	0	0
Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	0	0	0
Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	0	0	0
Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	0	0	0
Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	0	0	0
Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	0	0	0
Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	0	0	0
Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	0	0	0
Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	0	0	0
Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	0	0	0
Ult 35 (G+EQX+0.3Q) Max	0	0	0
Ult 35 (G+EQX+0.3Q) Min	0	0	0
Ult 36 (G-EQX+0.3Q) Max	0	0	0
Ult 36 (G-EQX+0.3Q) Min	0	0	0
Ult 37 (G+EQY+0.3Q) Max	0	0	0
Ult 37 (G+EQY+0.3Q) Min	0	0	0
Ult 38 (G-EQY+0.3Q) Max	0	0	0
Ult 38 (G-EQY+0.3Q) Min	0	0	0
Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	0	0	0
Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	0	0	0
Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	0	0	0
Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	0	0	0
Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	0	0	0
Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	0	0	0
Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	0	0	0
Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	0	0	0
Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	0	0	0
Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	0	0	0
Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	0	0	0
Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	0	0	0
Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	0	0	0

L514

Table 3.1 - Base Reactions (Part 2 of 2, continued)

Load Case/Combo	X m	Y m	Z m
Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	0	0	0
Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	0	0	0
Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	0	0	0
Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	0	0	0
Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	0	0	0
Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	0	0	0
Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	0	0	0
Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	0	0	0
Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	0	0	0
Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	0	0	0
Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	0	0	0
ENVELOPE Max	0	0	0
ENVELOPE Min	0	0	0
DStlD1	0	0	0
DStlD2	0	0	0
DCmpD1	0	0	0
DCmpD2	0	0	0
DCmpS1	0	0	0
DCmpS2	0	0	0
DCmpC1	0	0	0

Table 3.2 - Centers of Mass and Rigidity

Story	Diaphragm	Mass X kg	Mass Y kg	XCM m	YCM m	Cumulative X kg	Cumulative Y kg	XCCM m	YCCM m	XCR m	YCR m
Story4	D1	0	0	9.75	12.7	0	0	0	0		
Story3	D1	0	0	9.8702	12.5762	0	0	0	0		
Story2	D1	0	0	9.8785	15.4779	0	0	0	0		
Story1	D1	0	0	9.9615	16.2678	0	0	0	0		
Story4	Rigid Roof	21313.35	21313.35	9.6693	12.8835	21313.35	21313.35	9.6693	12.8835		

Table 3.3 - Diaphragm Center of Mass Displacements

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story4	D1	Dead	0	0	0	47	9.75	12.7	16
Story4	D1	Live	0	0	0	47	9.75	12.7	16
Story4	D1	SDead	0	0	0	47	9.75	12.7	16
Story4	D1	Wind x	0	0	0	47	9.75	12.7	16
Story4	D1	Wind y	0	0	0	47	9.75	12.7	16
Story4	D1	EQ X 1	0	0	0	47	9.75	12.7	16
Story4	D1	EQ X 2	0	0	0	47	9.75	12.7	16
Story4	D1	EQ X 3	0	0	0	47	9.75	12.7	16
Story4	D1	EQ Y 1	0	0	0	47	9.75	12.7	16
Story4	D1	EQ Y 2	0	0	0	47	9.75	12.7	16
Story4	D1	EQ Y 3	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 01 (G)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 02 (G+0.7Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 03 (G+Wx)	0	0	0	47	9.75	12.7	16

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story4	D1	Serv 04 (G-Wx)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 05 (G+Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 06 (G-Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 07 (G+0.7Wx+0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 08 (G+0.5Wx+0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 09 (G+0.3Wx+0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 10 (G-0.7Wx-0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 11 (G-0.5Wx-0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 12 (G-0.3Wx-0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 13 (G+0.7Wx-0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 14 (G+0.5Wx-0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 15 (G+0.3Wx-0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 16 (G-0.7Wx+0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 17 (G-0.5Wx+0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Serv 18 (G-0.3Wx+0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 01 (1.35G)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 02 (1.2G+1.5Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 03 (1.2G+Wx+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 04 (1.2G-Wx+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 05 (1.2G+Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 06 (1.2G-Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 07 (0.9G+Wx)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 08 (0.9G-Wx)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 09 (0.9G+Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 10 (0.9G-Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 11 (0.9G+0.7Wx+0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 12 (0.9G+0.5Wx+0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 13 (0.9G+0.3Wx+0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 14 (0.9G-0.7Wx-0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 15 (0.9G-0.5Wx-0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 16 (0.9G-0.3Wx-0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 17 (0.9G+0.7Wx-0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 18 (0.9G+0.5Wx-0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 19 (0.9G+0.3Wx-0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 20 (0.9G-0.7Wx+0.3Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 21 (0.9G-0.5Wx+0.5Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 22 (0.9G-0.3Wx+0.7Wy)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	0	0	0	47	9.75	12.7	16

5157

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story4	D1	Ult 35 (G+EQX+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 35 (G+EQX+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 36 (G-EQX+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 36 (G-EQX+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 37 (G+EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 37 (G+EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 38 (G-EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 38 (G-EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	0	0	0	47	9.75	12.7	16

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story4	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	0	0	0	47	9.75	12.7	16
Story4	D1	ENVELOPE Max	0	0	0	47	9.75	12.7	16
Story4	D1	ENVELOPE Min	0	0	0	47	9.75	12.7	16
Story4	D1	DStlD1	0	0	0	47	9.75	12.7	16
Story4	D1	DStlD2	0	0	0	47	9.75	12.7	16
Story4	D1	DCmpD1	0	0	0	47	9.75	12.7	16
Story4	D1	DCmpD2	0	0	0	47	9.75	12.7	16
Story4	D1	DCmpS1	0	0	0	47	9.75	12.7	16
Story4	D1	DCmpS2	0	0	0	47	9.75	12.7	16
Story4	D1	DCmpC1	0	0	0	47	9.75	12.7	16
Story4	Rigid Roof	Dead	1.462	0.855	-5.1E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Live	0.507	0.214	-2.3E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	SDead	0.315	0.052	-2.4E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Wind x	0.922	-0.171	-9.9E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Wind y	-0.292	1.093	8.6E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	EQ X 1	1.97	-0.528	-0.0002	48	9.6693	12.8835	16
Story4	Rigid Roof	EQ X 2	2.28	-0.913	-0.000329	48	9.6693	12.8835	16
Story4	Rigid Roof	EQ X 3	1.66	-0.144	-7E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	EQ Y 1	-0.277	2.297	0.000141	48	9.6693	12.8835	16
Story4	Rigid Roof	EQ Y 2	-0.486	2.556	0.000228	48	9.6693	12.8835	16
Story4	Rigid Roof	EQ Y 3	-0.069	2.038	5.4E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 01 (G)	1.778	0.907	-7.5E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 02 (G+0.7Q)	2.133	1.057	-9.1E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 03 (G+Wx)	2.395	0.793	-0.000141	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 04 (G-Wx)	1.16	1.021	-9E-06	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 05 (G+Wy)	1.582	1.639	-1.7E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 06 (G-Wy)	1.973	0.175	-0.000133	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 07 (G+0.7Wx+0.3Wy)	2.153	1.045	-0.000104	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 08 (G+0.5Wx+0.5Wy)	1.992	1.22	-7.9E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 09 (G+0.3Wx+0.7Wy)	1.825	1.386	-5.4E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 10 (G-0.7Wx-0.3Wy)	1.403	0.769	-4.6E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 11 (G-0.5Wx-0.5Wy)	1.563	0.593	-7.1E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 12 (G-0.3Wx-0.7Wy)	1.73	0.428	-9.6E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 13 (G+0.7Wx-0.3Wy)	2.269	0.608	-0.000138	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 14 (G+0.5Wx-0.5Wy)	2.19	0.477	-0.000138	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 15 (G+0.3Wx-0.7Wy)	2.099	0.359	-0.000135	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 16 (G-0.7Wx+0.3Wy)	1.286	1.206	-1.1E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 17 (G-0.5Wx+0.5Wy)	1.365	1.336	-1.2E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Serv 18 (G-0.3Wx+0.7Wy)	1.456	1.455	-1.4E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 01 (1.35G)	2.4	1.224	-0.000101	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 02 (1.2G+1.5Q)	2.894	1.409	-0.000124	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 03 (1.2G+Wx+0.4Q)	3.258	1.003	-0.000198	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 04 (1.2G-Wx+0.4Q)	1.414	1.344	-2.413E-07	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 05 (1.2G+Wy+0.4Q)	2.044	2.266	-1.3E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 06 (1.2G-Wy+0.4Q)	2.628	0.081	-0.000185	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 07 (0.9G+Wx)	2.522	0.646	-0.000166	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 08 (0.9G-Wx)	0.678	0.987	3.1E-05	48	9.6693	12.8835	16

L 516

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story4	Rigid Roof	Ult 09 (0.9G+Wy)	1.308	1.909	1.9E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 10 (0.9G-Wy)	1.891	-0.276	-0.000154	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 11 (0.9G+0.7Wx+0.3Wy)	2.158	1.025	-0.00011	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 12 (0.9G+0.5Wx+0.5Wy)	1.915	1.277	-7.3E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 13 (0.9G+0.3Wx+0.7Wy)	1.672	1.53	-3.6E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 14 (0.9G-0.7Wx-0.3Wy)	1.042	0.608	-2.4E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 15 (0.9G-0.5Wx-0.5Wy)	1.285	0.355	-6.1E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 16 (0.9G-0.3Wx-0.7Wy)	1.527	0.103	-9.8E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 17 (0.9G+0.7Wx-0.3Wy)	2.333	0.369	-0.000162	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 18 (0.9G+0.5Wx-0.5Wy)	2.207	0.185	-0.00016	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 19 (0.9G+0.3Wx-0.7Wy)	2.081	0.0003034	-0.000157	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 20 (0.9G-0.7Wx+0.3Wy)	0.867	1.263	2.8E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 21 (0.9G-0.5Wx+0.5Wy)	0.993	1.448	2.5E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 22 (0.9G-0.3Wx+0.7Wy)	1.119	1.632	2.3E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	2.894	1.382	-0.000142	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	2.651	1.635	-0.000105	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	2.409	1.887	-6.8E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	1.778	0.965	-5.6E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	2.021	0.713	-9.3E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	2.263	0.46	-0.00013	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	3.069	0.727	-0.000194	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	2.943	0.542	-0.000191	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	2.817	0.358	-0.000189	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	1.603	1.621	-4E-06	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	1.729	1.805	-6E-06	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	1.855	1.99	-9E-06	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 35 (G+EQX+0.3Q) Max	4.21	0.828	-0.000152	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 35 (G+EQX+0.3Q) Min	3.59	0.058	-0.00041	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 36 (G-EQX+0.3Q) Max	0.27	1.884	0.000247	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 36 (G-EQX+0.3Q) Min	-0.35	1.115	-1.1E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 37 (G+EQY+0.3Q) Max	1.861	3.527	0.000146	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 37 (G+EQY+0.3Q) Min	1.444	3.009	-2.7E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 38 (G-EQY+0.3Q) Max	2.416	-1.067	-0.000136	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 38 (G-EQY+0.3Q) Min	1.999	-1.585	-0.00031	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	4.189	1.594	-8.4E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	3.444	0.669	-0.000394	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	3.035	2.177	-3E-06	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	2.517	1.534	-0.000219	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	2.545	3.484	0.000125	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	1.942	2.735	-0.000126	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	0.415	1.273	0.000231	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	-0.33	0.348	-8E-05	48	9.6693	12.8835	16

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story4	Rigid Roof	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	1.343	0.408	5.6E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	0.824	-0.235	-0.00016	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	1.918	-0.793	-3.7E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	1.315	-1.542	-0.000289	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	4.356	0.216	-0.000168	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	3.611	-0.709	-0.000479	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	3.313	-0.12	-0.000144	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	2.794	-0.764	-0.00036	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	3.1	-1.11	-0.000157	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	2.497	-1.859	-0.000408	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	0.249	2.651	0.000316	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	-0.496	1.726	5E-06	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	1.065	2.706	0.000197	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	0.547	2.062	-1.9E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	1.363	3.801	0.000245	48	9.6693	12.8835	16
Story4	Rigid Roof	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	0.76	3.052	-6E-06	48	9.6693	12.8835	16
Story4	Rigid Roof	ENVELOPE Max	4.356	3.801	0.000316	48	9.6693	12.8835	16
Story4	Rigid Roof	ENVELOPE Min	-0.496	-1.859	-0.000479	48	9.6693	12.8835	16
Story4	Rigid Roof	DStlD1	1.778	0.907	-7.5E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	DStlD2	2.285	1.121	-9.8E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	DCmpD1	1.778	0.907	-7.5E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	DCmpD2	2.285	1.121	-9.8E-05	48	9.6693	12.8835	16
Story4	Rigid Roof	DCmpS1	2.4	1.224	-0.000101	48	9.6693	12.8835	16
Story4	Rigid Roof	DCmpS2	3.16	1.545	-0.000136	48	9.6693	12.8835	16
Story4	Rigid Roof	DCmpC1	2.193	1.282	-7.6E-05	48	9.6693	12.8835	16
Story3	D1	Dead	0.015	-1.047	-0.000102	66	9.8702	12.5762	11.8
Story3	D1	Live	-0.206	-0.569	-4.5E-05	66	9.8702	12.5762	11.8
Story3	D1	SDead	-0.218	-0.589	-3.8E-05	66	9.8702	12.5762	11.8
Story3	D1	Wind x	1.121	0.508	-0.000128	66	9.8702	12.5762	11.8
Story3	D1	Wind y	0.072	1.249	6.2E-05	66	9.8702	12.5762	11.8
Story3	D1	EQ X 1	3.435	-0.262	-0.000253	66	9.8702	12.5762	11.8
Story3	D1	EQ X 2	2.831	-0.438	-0.000471	66	9.8702	12.5762	11.8
Story3	D1	EQ X 3	4.039	-0.087	-3.6E-05	66	9.8702	12.5762	11.8
Story3	D1	EQ Y 1	-0.036	3.918	0.000104	66	9.8702	12.5762	11.8
Story3	D1	EQ Y 2	0.371	4.036	0.00025	66	9.8702	12.5762	11.8
Story3	D1	EQ Y 3	-0.443	3.8	-4.2E-05	66	9.8702	12.5762	11.8

L517

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story3	D1	Serv 01 (G)	-0.203	-1.636	-0.00014	66	9.8702	12.5762	11.8
Story3	D1	Serv 02 (G+0.7Q)	-0.347	-2.035	-0.000171	66	9.8702	12.5762	11.8
Story3	D1	Serv 03 (G+Wx)	0.548	-1.296	-0.000226	66	9.8702	12.5762	11.8
Story3	D1	Serv 04 (G-Wx)	-0.954	-1.977	-5.4E-05	66	9.8702	12.5762	11.8
Story3	D1	Serv 05 (G+Wy)	-0.155	-0.799	-9.8E-05	66	9.8702	12.5762	11.8
Story3	D1	Serv 06 (G-Wy)	-0.251	-2.473	-0.000181	66	9.8702	12.5762	11.8
Story3	D1	Serv 07 (G+0.7Wx+0.3Wy)	0.338	-1.147	-0.000188	66	9.8702	12.5762	11.8
Story3	D1	Serv 08 (G+0.5Wx+0.5Wy)	0.202	-1.039	-0.000162	66	9.8702	12.5762	11.8
Story3	D1	Serv 09 (G+0.3Wx+0.7Wy)	0.055	-0.947	-0.000136	66	9.8702	12.5762	11.8
Story3	D1	Serv 10 (G-0.7Wx-0.3Wy)	-0.744	-2.125	-9.2E-05	66	9.8702	12.5762	11.8
Story3	D1	Serv 11 (G-0.5Wx-0.5Wy)	-0.608	-2.234	-0.000117	66	9.8702	12.5762	11.8
Story3	D1	Serv 12 (G-0.3Wx-0.7Wy)	-0.461	-2.325	-0.000143	66	9.8702	12.5762	11.8
Story3	D1	Serv 13 (G+0.7Wx-0.3Wy)	0.309	-1.647	-0.000212	66	9.8702	12.5762	11.8
Story3	D1	Serv 14 (G+0.5Wx-0.5Wy)	0.154	-1.888	-0.000205	66	9.8702	12.5762	11.8
Story3	D1	Serv 15 (G+0.3Wx-0.7Wy)	-0.013	-2.122	-0.000195	66	9.8702	12.5762	11.8
Story3	D1	Serv 16 (G-0.7Wx+0.3Wy)	-0.715	-1.625	-6.7E-05	66	9.8702	12.5762	11.8
Story3	D1	Serv 17 (G-0.5Wx+0.5Wy)	-0.559	-1.384	-7.5E-05	66	9.8702	12.5762	11.8
Story3	D1	Serv 18 (G-0.3Wx+0.7Wy)	-0.393	-1.151	-8.5E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 01 (1.35G)	-0.274	-2.209	-0.000189	66	9.8702	12.5762	11.8
Story3	D1	Ult 02 (1.2G+1.5Q)	-0.553	-2.817	-0.000235	66	9.8702	12.5762	11.8
Story3	D1	Ult 03 (1.2G+Wx+0.4Q)	0.795	-1.683	-0.000314	66	9.8702	12.5762	11.8
Story3	D1	Ult 04 (1.2G-Wx+0.4Q)	-1.447	-2.699	-5.8E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 05 (1.2G+Wy+0.4Q)	-0.254	-0.942	-0.000124	66	9.8702	12.5762	11.8
Story3	D1	Ult 06 (1.2G-Wy+0.4Q)	-0.398	-3.44	-0.000248	66	9.8702	12.5762	11.8
Story3	D1	Ult 07 (0.9G+Wx)	0.938	-0.964	-0.000254	66	9.8702	12.5762	11.8
Story3	D1	Ult 08 (0.9G-Wx)	-1.303	-1.981	2E-06	66	9.8702	12.5762	11.8
Story3	D1	Ult 09 (0.9G+Wy)	-0.111	-0.223	-6.4E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 10 (0.9G-Wy)	-0.255	-2.722	-0.000188	66	9.8702	12.5762	11.8
Story3	D1	Ult 11 (0.9G+0.7Wx+0.3Wy)	0.623	-0.742	-0.000197	66	9.8702	12.5762	11.8
Story3	D1	Ult 12 (0.9G+0.5Wx+0.5Wy)	0.414	-0.594	-0.000159	66	9.8702	12.5762	11.8
Story3	D1	Ult 13 (0.9G+0.3Wx+0.7Wy)	0.204	-0.446	-0.000121	66	9.8702	12.5762	11.8
Story3	D1	Ult 14 (0.9G-0.7Wx-0.3Wy)	-0.989	-2.203	-5.5E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 15 (0.9G-0.5Wx-0.5Wy)	-0.779	-2.351	-9.3E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 16 (0.9G-0.3Wx-0.7Wy)	-0.569	-2.499	-0.000131	66	9.8702	12.5762	11.8
Story3	D1	Ult 17 (0.9G+0.7Wx-0.3Wy)	0.58	-1.492	-0.000234	66	9.8702	12.5762	11.8
Story3	D1	Ult 18 (0.9G+0.5Wx-0.5Wy)	0.342	-1.843	-0.000221	66	9.8702	12.5762	11.8
Story3	D1	Ult 19 (0.9G+0.3Wx-0.7Wy)	0.103	-2.195	-0.000208	66	9.8702	12.5762	11.8
Story3	D1	Ult 20 (0.9G-0.7Wx+0.3Wy)	-0.945	-1.454	-1.7E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 21 (0.9G-0.5Wx+0.5Wy)	-0.707	-1.102	-3.1E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 22 (0.9G-0.3Wx+0.7Wy)	-0.468	-0.751	-4.4E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	0.48	-1.461	-0.000257	66	9.8702	12.5762	11.8
Story3	D1	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	0.27	-1.312	-0.000219	66	9.8702	12.5762	11.8
Story3	D1	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	0.061	-1.164	-0.000181	66	9.8702	12.5762	11.8
Story3	D1	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	-1.132	-2.922	-0.000115	66	9.8702	12.5762	11.8
Story3	D1	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	-0.922	-3.07	-0.000153	66	9.8702	12.5762	11.8
Story3	D1	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	-0.713	-3.218	-0.000191	66	9.8702	12.5762	11.8
Story3	D1	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	0.437	-2.21	-0.000294	66	9.8702	12.5762	11.8
Story3	D1	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	0.198	-2.562	-0.000281	66	9.8702	12.5762	11.8
Story3	D1	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	-0.04	-2.913	-0.000268	66	9.8702	12.5762	11.8

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story3	D1	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	-1.089	-2.172	-7.7E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	-0.85	-1.821	-9.1E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	-0.612	-1.469	-0.000104	66	9.8702	12.5762	11.8
Story3	D1	Ult 35 (G+EQX+0.3Q) Max	3.775	-1.894	-0.000189	66	9.8702	12.5762	11.8
Story3	D1	Ult 35 (G+EQX+0.3Q) Min	2.566	-2.245	-0.000624	66	9.8702	12.5762	11.8
Story3	D1	Ult 36 (G-EQX+0.3Q) Max	-3.096	-1.369	0.000317	66	9.8702	12.5762	11.8
Story3	D1	Ult 36 (G-EQX+0.3Q) Min	-4.304	-1.72	-0.000117	66	9.8702	12.5762	11.8
Story3	D1	Ult 37 (G+EQY+0.3Q) Max	0.106	2.229	9.7E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 37 (G+EQY+0.3Q) Min	-0.708	1.993	-0.000195	66	9.8702	12.5762	11.8
Story3	D1	Ult 38 (G-EQY+0.3Q) Max	0.178	-5.607	-0.000111	66	9.8702	12.5762	11.8
Story3	D1	Ult 38 (G-EQY+0.3Q) Min	-0.635	-5.843	-0.000403	66	9.8702	12.5762	11.8
Story3	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	3.886	-0.683	-0.000114	66	9.8702	12.5762	11.8
Story3	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	2.433	-1.105	-0.000637	66	9.8702	12.5762	11.8
Story3	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	1.94	0.168	-4.6E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	0.929	-0.126	-0.00041	66	9.8702	12.5762	11.8
Story3	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	1.318	2.203	8.6E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	0.141	1.861	-0.000336	66	9.8702	12.5762	11.8
Story3	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	-2.963	-2.509	0.00033	66	9.8702	12.5762	11.8
Story3	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	-4.415	-2.931	-0.000192	66	9.8702	12.5762	11.8
Story3	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	-1.459	-3.488	0.000103	66	9.8702	12.5762	11.8
Story3	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	-2.47	-3.782	-0.00026	66	9.8702	12.5762	11.8
Story3	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	-0.671	-5.475	3E-05	66	9.8702	12.5762	11.8
Story3	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	-1.847	-5.817	-0.000392	66	9.8702	12.5762	11.8
Story3	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	3.907	-3.034	-0.000177	66	9.8702	12.5762	11.8
Story3	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	2.455	-3.456	-0.000699	66	9.8702	12.5762	11.8
Story3	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	1.976	-3.75	-0.00015	66	9.8702	12.5762	11.8
Story3	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	0.965	-4.044	-0.000514	66	9.8702	12.5762	11.8
Story3	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	1.39	-5.633	-0.000122	66	9.8702	12.5762	11.8
Story3	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	0.214	-5.975	-0.000544	66	9.8702	12.5762	11.8
Story3	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	-2.984	-0.158	0.000392	66	9.8702	12.5762	11.8
Story3	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	-4.437	-0.58	-0.00013	66	9.8702	12.5762	11.8
Story3	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	-1.495	0.43	0.000207	66	9.8702	12.5762	11.8

158

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story3	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	-2.506	0.136	-0.000156	66	9.8702	12.5762	11.8
Story3	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	-0.743	2.361	0.000238	66	9.8702	12.5762	11.8
Story3	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	-1.92	2.019	-0.000185	66	9.8702	12.5762	11.8
Story3	D1	ENVELOPE Max	3.907	2.361	0.000392	66	9.8702	12.5762	11.8
Story3	D1	ENVELOPE Min	-4.437	-5.975	-0.000699	66	9.8702	12.5762	11.8
Story3	D1	DStlD1	-0.203	-1.636	-0.00014	66	9.8702	12.5762	11.8
Story3	D1	DStlD2	-0.409	-2.206	-0.000185	66	9.8702	12.5762	11.8
Story3	D1	DCmpD1	-0.203	-1.636	-0.00014	66	9.8702	12.5762	11.8
Story3	D1	DCmpD2	-0.409	-2.206	-0.000185	66	9.8702	12.5762	11.8
Story3	D1	DCmpS1	-0.274	-2.209	-0.000189	66	9.8702	12.5762	11.8
Story3	D1	DCmpS2	-0.583	-3.063	-0.000256	66	9.8702	12.5762	11.8
Story3	D1	DCmpC1	0.023	-1.571	-0.000153	66	9.8702	12.5762	11.8
Story2	D1	Dead	0.025	-0.461	1.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Live	-0.029	-0.205	2E-06	78	9.8785	15.4779	8.6
Story2	D1	SDead	-0.006	-0.254	-2E-06	78	9.8785	15.4779	8.6
Story2	D1	Wind x	0.413	0.241	-7E-06	78	9.8785	15.4779	8.6
Story2	D1	Wind y	-0.015	0.457	8E-06	78	9.8785	15.4779	8.6
Story2	D1	EQ X 1	2.159	-0.13	-6.7E-05	78	9.8785	15.4779	8.6
Story2	D1	EQ X 2	2.006	-0.166	-0.000132	78	9.8785	15.4779	8.6
Story2	D1	EQ X 3	2.312	-0.094	-2E-06	78	9.8785	15.4779	8.6
Story2	D1	EQ Y 1	-0.088	1.968	1.8E-05	78	9.8785	15.4779	8.6
Story2	D1	EQ Y 2	0.017	1.992	6.2E-05	78	9.8785	15.4779	8.6
Story2	D1	EQ Y 3	-0.192	1.944	-2.7E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 01 (G)	0.019	-0.716	9E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 02 (G+0.7Q)	-0.001	-0.859	1.1E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 03 (G+Wx)	0.296	-0.554	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 04 (G-Wx)	-0.258	-0.877	1.4E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 05 (G+Wy)	0.009	-0.409	1.5E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 06 (G-Wy)	0.029	-1.022	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 07 (G+0.7Wx+0.3Wy)	0.21	-0.511	8E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 08 (G+0.5Wx+0.5Wy)	0.154	-0.478	1E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 09 (G+0.3Wx+0.7Wy)	0.094	-0.452	1.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 10 (G-0.7Wx-0.3Wy)	-0.173	-0.92	1.1E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 11 (G-0.5Wx-0.5Wy)	-0.117	-0.953	9E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 12 (G-0.3Wx-0.7Wy)	-0.057	-0.979	7E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 13 (G+0.7Wx-0.3Wy)	0.216	-0.693	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 14 (G+0.5Wx-0.5Wy)	0.164	-0.789	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 15 (G+0.3Wx-0.7Wy)	0.108	-0.882	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Serv 16 (G-0.7Wx+0.3Wy)	-0.179	-0.738	1.4E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 17 (G-0.5Wx+0.5Wy)	-0.127	-0.642	1.5E-05	78	9.8785	15.4779	8.6
Story2	D1	Serv 18 (G-0.3Wx+0.7Wy)	-0.071	-0.549	1.5E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 01 (1.35G)	0.025	-0.966	1.3E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 02 (1.2G+1.5Q)	-0.021	-1.166	1.4E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 03 (1.2G+Wx+0.4Q)	0.424	-0.699	5E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 04 (1.2G-Wx+0.4Q)	-0.403	-1.182	1.9E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 05 (1.2G+Wy+0.4Q)	-0.004	-0.483	2E-05	78	9.8785	15.4779	8.6

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story2	D1	Ult 06 (1.2G-Wy+0.4Q)	0.026	-1.398	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 07 (0.9G+Wx)	0.43	-0.402	1E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 08 (0.9G-Wx)	-0.397	-0.885	1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 09 (0.9G+Wy)	0.002	-0.187	1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 10 (0.9G-Wy)	0.032	-1.101	1E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 11 (0.9G+0.7Wx+0.3Wy)	0.302	-0.338	6E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 12 (0.9G+0.5Wx+0.5Wy)	0.216	-0.295	9E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 13 (0.9G+0.3Wx+0.7Wy)	0.13	-0.251	1.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 14 (0.9G-0.7Wx-0.3Wy)	-0.268	-0.95	1.1E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 15 (0.9G-0.5Wx-0.5Wy)	-0.183	-0.993	8E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 16 (0.9G-0.3Wx-0.7Wy)	-0.097	-1.037	5E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 17 (0.9G+0.7Wx-0.3Wy)	0.311	-0.612	1E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 18 (0.9G+0.5Wx-0.5Wy)	0.231	-0.752	1E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 19 (0.9G+0.3Wx-0.7Wy)	0.151	-0.892	1E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 20 (0.9G-0.7Wx+0.3Wy)	-0.277	-0.676	1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 21 (0.9G-0.5Wx+0.5Wy)	-0.197	-0.536	1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 22 (0.9G-0.3Wx+0.7Wy)	-0.118	-0.396	1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	0.296	-0.634	9E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	0.21	-0.591	1.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	0.124	-0.548	1.5E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	-0.274	-1.247	1.5E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	-0.188	-1.29	1.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	-0.103	-1.333	9E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	0.305	-0.909	5E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	0.225	-1.049	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	0.145	-1.188	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	-0.283	-0.973	2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	-0.203	-0.833	2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	-0.124	-0.693	2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 35 (G+EQX+0.3Q) Max	2.322	-0.871	8E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 35 (G+EQX+0.3Q) Min	2.016	-0.943	-0.000122	78	9.8785	15.4779	8.6
Story2	D1	Ult 36 (G-EQX+0.3Q) Max	-1.996	-0.611	0.000142	78	9.8785	15.4779	8.6
Story2	D1	Ult 36 (G-EQX+0.3Q) Min	-2.302	-0.683	1.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 37 (G+EQY+0.3Q) Max	0.027	1.215	7.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 37 (G+EQY+0.3Q) Min	-0.182	1.167	-1.7E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 38 (G-EQY+0.3Q) Max	0.202	-2.721	3.7E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 38 (G-EQY+0.3Q) Min	-0.007	-2.769	-5.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	2.327	-0.274	2.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	1.958	-0.359	-0.00013	78	9.8785	15.4779	8.6
Story2	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	1.175	0.172	4E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	0.917	0.112	-6.9E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	0.721	1.186	7.1E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	0.419	1.117	-5.6E-05	78	9.8785	15.4779	8.6

6157

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story2	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	-1.938	-1.195	0.00015	78	9.8785	15.4779	8.6
Story2	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	-2.307	-1.28	-6E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	-0.897	-1.666	8.9E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	-1.155	-1.726	-2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	-0.399	-2.672	7.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	-0.701	-2.741	-5.1E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	2.38	-1.455	1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	2.011	-1.54	-0.00014	78	9.8785	15.4779	8.6
Story2	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	1.262	-1.796	2.2E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	1.004	-1.856	-8.7E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	0.896	-2.75	3.6E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	0.594	-2.818	-9.1E-05	78	9.8785	15.4779	8.6
Story2	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	-1.991	-0.014	0.00016	78	9.8785	15.4779	8.6
Story2	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	-2.36	-0.1	4E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	-0.984	0.302	0.000107	78	9.8785	15.4779	8.6
Story2	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	-1.242	0.242	-2E-06	78	9.8785	15.4779	8.6
Story2	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	-0.574	1.264	0.000111	78	9.8785	15.4779	8.6
Story2	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	-0.876	1.195	-1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	ENVELOPE Max	2.38	1.264	0.00016	78	9.8785	15.4779	8.6
Story2	D1	ENVELOPE Min	-2.36	-2.818	-0.00014	78	9.8785	15.4779	8.6
Story2	D1	DStlD1	0.019	-0.716	9E-06	78	9.8785	15.4779	8.6
Story2	D1	DStlD2	-0.01	-0.921	1.1E-05	78	9.8785	15.4779	8.6
Story2	D1	DCmpD1	0.019	-0.716	9E-06	78	9.8785	15.4779	8.6
Story2	D1	DCmpD2	-0.01	-0.921	1.1E-05	78	9.8785	15.4779	8.6
Story2	D1	DCmpS1	0.025	-0.966	1.3E-05	78	9.8785	15.4779	8.6
Story2	D1	DCmpS2	-0.018	-1.274	1.6E-05	78	9.8785	15.4779	8.6
Story2	D1	DCmpC1	0.037	-0.692	1.8E-05	78	9.8785	15.4779	8.6
Story1	D1	Dead	0.003	-0.026	-3E-06	111	9.9615	16.2678	5.4
Story1	D1	Live	0.001	-0.014	-1E-06	111	9.9615	16.2678	5.4
Story1	D1	SDead	-0.001	-0.007	-1E-06	111	9.9615	16.2678	5.4
Story1	D1	Wind x	0.112	-0.001	-7E-06	111	9.9615	16.2678	5.4
Story1	D1	Wind y	-0.015	0.06	3E-06	111	9.9615	16.2678	5.4
Story1	D1	EQ X 1	0.401	-0.064	-2.9E-05	111	9.9615	16.2678	5.4
Story1	D1	EQ X 2	0.458	-0.084	-4.4E-05	111	9.9615	16.2678	5.4
Story1	D1	EQ X 3	0.345	-0.044	-1.4E-05	111	9.9615	16.2678	5.4

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story1	D1	EQ Y 1	-0.06	0.248	1.1E-05	111	9.9615	16.2678	5.4
Story1	D1	EQ Y 2	-0.099	0.261	2.1E-05	111	9.9615	16.2678	5.4
Story1	D1	EQ Y 3	-0.021	0.234	1E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 01 (G)	0.001	-0.032	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 02 (G+0.7Q)	0.002	-0.042	-5E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 03 (G+Wx)	0.076	-0.033	-9E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 04 (G-Wx)	-0.073	-0.032	1E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 05 (G+Wy)	-0.009	0.008	-2E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 06 (G-Wy)	0.011	-0.073	-6E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 07 (G+0.7Wx+0.3Wy)	0.051	-0.021	-7E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 08 (G+0.5Wx+0.5Wy)	0.034	-0.012	-5E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 09 (G+0.3Wx+0.7Wy)	0.017	-0.004	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 10 (G-0.7Wx-0.3Wy)	-0.048	-0.044	-1E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 11 (G-0.5Wx-0.5Wy)	-0.031	-0.053	-3E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 12 (G-0.3Wx-0.7Wy)	-0.014	-0.061	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 13 (G+0.7Wx-0.3Wy)	0.057	-0.045	-8E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 14 (G+0.5Wx-0.5Wy)	0.044	-0.053	-8E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 15 (G+0.3Wx-0.7Wy)	0.031	-0.061	-7E-06	111	9.9615	16.2678	5.4
Story1	D1	Serv 16 (G-0.7Wx+0.3Wy)	-0.054	-0.02	-8.993E-09	111	9.9615	16.2678	5.4
Story1	D1	Serv 17 (G-0.5Wx+0.5Wy)	-0.042	-0.012	-4.822E-07	111	9.9615	16.2678	5.4
Story1	D1	Serv 18 (G-0.3Wx+0.7Wy)	-0.028	-0.004	-1E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 01 (1.35G)	0.002	-0.044	-5E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 02 (1.2G+1.5Q)	0.003	-0.059	-7E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 03 (1.2G+Wx+0.4Q)	0.114	-0.045	-1.3E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 04 (1.2G-Wx+0.4Q)	-0.11	-0.044	2E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 05 (1.2G+Wy+0.4Q)	-0.013	0.016	-2E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 06 (1.2G-Wy+0.4Q)	0.017	-0.105	-9E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 07 (0.9G+Wx)	0.113	-0.03	-1.1E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 08 (0.9G-Wx)	-0.11	-0.029	4E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 09 (0.9G+Wy)	-0.014	0.031	-3.344E-07	111	9.9615	16.2678	5.4
Story1	D1	Ult 10 (0.9G-Wy)	0.016	-0.09	-7E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 11 (0.9G+0.7Wx+0.3Wy)	0.075	-0.011	-8E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 12 (0.9G+0.5Wx+0.5Wy)	0.05	0.001	-6E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 13 (0.9G+0.3Wx+0.7Wy)	0.024	0.013	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 14 (0.9G-0.7Wx-0.3Wy)	-0.072	-0.047	3.953E-07	111	9.9615	16.2678	5.4
Story1	D1	Ult 15 (0.9G-0.5Wx-0.5Wy)	-0.047	-0.059	-2E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 16 (0.9G-0.3Wx-0.7Wy)	-0.022	-0.071	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 17 (0.9G+0.7Wx-0.3Wy)	0.084	-0.048	-1E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 18 (0.9G+0.5Wx-0.5Wy)	0.065	-0.06	-9E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 19 (0.9G+0.3Wx-0.7Wy)	0.045	-0.072	-8E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 20 (0.9G-0.7Wx+0.3Wy)	-0.081	-0.011	2E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 21 (0.9G-0.5Wx+0.5Wy)	-0.062	0.001	2E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 22 (0.9G-0.3Wx+0.7Wy)	-0.043	0.013	1E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	0.076	-0.027	-9E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	0.05	-0.014	-7E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	0.025	-0.002	-5E-06	111	9.9615	16.2678	5.4

L570

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story1	D1	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	-0.072	-0.062	-1E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	-0.046	-0.074	-3E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	-0.021	-0.086	-6E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	0.085	-0.063	-1.1E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	0.065	-0.075	-1.1E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	0.046	-0.087	-1E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	-0.081	-0.026	1E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	-0.061	-0.014	-1.529E-07	111	9.9615	16.2678	5.4
Story1	D1	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	-0.042	-0.002	-1E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 35 (G+EQX+0.3Q) Max	0.46	-0.08	-1.9E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 35 (G+EQX+0.3Q) Min	0.346	-0.121	-4.9E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 36 (G-EQX+0.3Q) Max	-0.343	0.048	4E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 36 (G-EQX+0.3Q) Min	-0.457	0.007	1E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 37 (G+EQY+0.3Q) Max	-0.019	0.225	1.7E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 37 (G+EQY+0.3Q) Min	-0.097	0.197	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 38 (G-EQY+0.3Q) Max	0.1	-0.27	-5E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 38 (G-EQY+0.3Q) Min	0.023	-0.298	-2.6E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	0.453	-0.002	-1.2E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	0.317	-0.051	-4.8E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	0.22	0.072	-1E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	0.125	0.038	-2.6E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	0.118	0.212	1.3E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	0.006	0.172	-1.7E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	-0.314	-0.022	4E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	-0.45	-0.071	3E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	-0.121	-0.111	1.7E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	-0.217	-0.145	-8E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	-0.003	-0.245	8E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	-0.115	-0.285	-2.2E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	0.489	-0.15	-1.9E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	0.353	-0.199	-5.5E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	0.28	-0.175	-1.2E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	0.184	-0.209	-3.7E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	0.238	-0.283	-1E-05	111	9.9615	16.2678	5.4

Table 3.3 - Diaphragm Center of Mass Displacements (continued)

Story	Diaphragm	Load Case/Combo	UX mm	UY mm	RZ rad	Point	X m	Y m	Z m
Story1	D1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	0.126	-0.323	-3.9E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	-0.349	0.126	4.6E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	-0.486	0.077	1E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	-0.181	0.136	2.8E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	-0.277	0.102	3E-06	111	9.9615	16.2678	5.4
Story1	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	-0.123	0.25	3E-05	111	9.9615	16.2678	5.4
Story1	D1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	-0.234	0.21	1E-06	111	9.9615	16.2678	5.4
Story1	D1	ENVELOPE Max	0.489	0.25	4.6E-05	111	9.9615	16.2678	5.4
Story1	D1	ENVELOPE Min	-0.486	-0.323	-5.5E-05	111	9.9615	16.2678	5.4
Story1	D1	DStlD1	0.001	-0.032	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	DStlD2	0.002	-0.046	-5E-06	111	9.9615	16.2678	5.4
Story1	D1	DCmpD1	0.001	-0.032	-4E-06	111	9.9615	16.2678	5.4
Story1	D1	DCmpD2	0.002	-0.046	-5E-06	111	9.9615	16.2678	5.4
Story1	D1	DCmpS1	0.002	-0.044	-5E-06	111	9.9615	16.2678	5.4
Story1	D1	DCmpS2	0.003	-0.064	-8E-06	111	9.9615	16.2678	5.4
Story1	D1	DCmpC1	0.004	-0.039	-5E-06	111	9.9615	16.2678	5.4

Table 3.4 - Diaphragm Max/Avg Drifts

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Dead	Diaph Rigid Roof X	0.000312	0.000197	1.582	3	17.8	15.3	16
Story4	Dead	Diaph Rigid Roof Y	0.000553	0.000299	1.847	24	17.8	19.6	16
Story4	Live	Diaph Rigid Roof X	0.000155	8.7E-05	1.779	16	1.7	15.3	16
Story4	Live	Diaph Rigid Roof Y	0.000229	0.000114	2.003	24	17.8	19.6	16
Story4	SDead	Diaph Rigid Roof X	0.000118	5.6E-05	2.129	16	1.7	15.3	16
Story4	SDead	Diaph Rigid Roof Y	0.000178	7.5E-05	2.381	24	17.8	19.6	16
Story4	Wind x	Diaph Rigid Roof X	0.000139	1.4E-05	9.788	2	17.8	24.4	16
Story4	Wind x	Diaph Rigid Roof Y	0.000226	6.5E-05	3.448	16	1.7	15.3	16
Story4	Wind y	Diaph Rigid Roof X	0.000149	1.6E-05	9.465	1	1.7	24.4	16
Story4	Wind y	Diaph Rigid Roof Y	0.000261	8.9E-05	2.926	7	17.8	3	16
Story4	EQ X 1	Diaph Rigid Roof X	0.000517	0.00015	3.444	2	17.8	24.4	16

1257

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	EQ X 1	Diaph Rigid Roof Y	0.000386	0.000104	3.724	7	17.8	3	16
Story4	EQ X 2	Diaph Rigid Roof X	0.000558	0.000153	3.652	2	17.8	24.4	16
Story4	EQ X 2	Diaph Rigid Roof Y	0.000561	0.000153	3.666	7	17.8	3	16
Story4	EQ X 3	Diaph Rigid Roof X	0.000554	0.000186	2.972	16	1.7	15.3	16
Story4	EQ X 3	Diaph Rigid Roof Y	0.00021	5.1E-05	4.093	7	17.8	3	16
Story4	EQ Y 1	Diaph Rigid Roof X	0.000171	9E-06	18.412	18	16.4	1	16
Story4	EQ Y 1	Diaph Rigid Roof Y	0.000454	2.8E-05	16.297	16	1.7	15.3	16
Story4	EQ Y 2	Diaph Rigid Roof X	0.000272	4.8E-05	5.725	10	3.6	1	16
Story4	EQ Y 2	Diaph Rigid Roof Y	0.000517	6.4E-05	8.013	32	17.8	9.4	16
Story4	EQ Y 3	Diaph Rigid Roof X	0.00018	5.5E-05	3.287	2	17.8	24.4	16
Story4	EQ Y 3	Diaph Rigid Roof Y	0.00061	0.000165	3.701	16	1.7	15.3	16
Story4	Serv 01 (G)	Diaph Rigid Roof X	0.000427	0.000251	1.701	16	1.7	15.3	16
Story4	Serv 01 (G)	Diaph Rigid Roof Y	0.000731	0.000374	1.954	24	17.8	19.6	16
Story4	Serv 02 (G+0.7Q)	Diaph Rigid Roof X	0.000535	0.000312	1.716	16	1.7	15.3	16
Story4	Serv 02 (G+0.7Q)	Diaph Rigid Roof Y	0.000891	0.000454	1.962	24	17.8	19.6	16
Story4	Serv 03 (G+Wx)	Diaph Rigid Roof X	0.00038	0.000195	1.951	3	17.8	15.3	16
Story4	Serv 03 (G+Wx)	Diaph Rigid Roof Y	0.000657	0.00028	2.348	24	17.8	19.6	16
Story4	Serv 04 (G-Wx)	Diaph Rigid Roof X	0.000475	0.000288	1.647	16	1.7	15.3	16
Story4	Serv 04 (G-Wx)	Diaph Rigid Roof Y	0.000805	0.000461	1.745	24	17.8	19.6	16
Story4	Serv 05 (G+Wy)	Diaph Rigid Roof X	0.000363	0.000251	1.442	16	1.7	15.3	16
Story4	Serv 05 (G+Wy)	Diaph Rigid Roof Y	0.000739	0.000465	1.588	24	17.8	19.6	16
Story4	Serv 06 (G-Wy)	Diaph Rigid Roof X	0.000491	0.000244	2.015	3	17.8	15.3	16
Story4	Serv 06 (G-Wy)	Diaph Rigid Roof Y	0.000724	0.000283	2.558	24	17.8	19.6	16
Story4	Serv 07 (G+0.7Wx+0.3Wy)	Diaph Rigid Roof X	0.000374	0.000213	1.753	3	17.8	15.3	16

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Serv 07 (G+0.7Wx+0.3Wy)	Diaph Rigid Roof Y	0.000681	0.000335	2.032	24	17.8	19.6	16
Story4	Serv 08 (G+0.5Wx+0.5Wy)	Diaph Rigid Roof X	0.00037	0.000226	1.638	16	1.7	15.3	16
Story4	Serv 08 (G+0.5Wx+0.5Wy)	Diaph Rigid Roof Y	0.000697	0.000373	1.871	24	17.8	19.6	16
Story4	Serv 09 (G+0.3Wx+0.7Wy)	Diaph Rigid Roof X	0.000367	0.000239	1.537	16	1.7	15.3	16
Story4	Serv 09 (G+0.3Wx+0.7Wy)	Diaph Rigid Roof Y	0.000714	0.00041	1.742	24	17.8	19.6	16
Story4	Serv 10 (G-0.7Wx-0.3Wy)	Diaph Rigid Roof X	0.000479	0.000288	1.662	16	1.7	15.3	16
Story4	Serv 10 (G-0.7Wx-0.3Wy)	Diaph Rigid Roof Y	0.000781	0.000413	1.89	24	17.8	19.6	16
Story4	Serv 11 (G-0.5Wx-0.5Wy)	Diaph Rigid Roof X	0.000484	0.000276	1.752	16	1.7	15.3	16
Story4	Serv 11 (G-0.5Wx-0.5Wy)	Diaph Rigid Roof Y	0.000765	0.000376	2.035	24	17.8	19.6	16
Story4	Serv 12 (G-0.3Wx-0.7Wy)	Diaph Rigid Roof X	0.000486	0.000263	1.85	16	1.7	15.3	16
Story4	Serv 12 (G-0.3Wx-0.7Wy)	Diaph Rigid Roof Y	0.000748	0.000338	2.211	24	17.8	19.6	16
Story4	Serv 13 (G+0.7Wx-0.3Wy)	Diaph Rigid Roof X	0.000413	0.000209	1.973	3	17.8	15.3	16
Story4	Serv 13 (G+0.7Wx-0.3Wy)	Diaph Rigid Roof Y	0.000677	0.000281	2.411	24	17.8	19.6	16
Story4	Serv 14 (G+0.5Wx-0.5Wy)	Diaph Rigid Roof X	0.000435	0.000219	1.991	3	17.8	15.3	16
Story4	Serv 14 (G+0.5Wx-0.5Wy)	Diaph Rigid Roof Y	0.00069	0.00028	2.463	24	17.8	19.6	16
Story4	Serv 15 (G+0.3Wx-0.7Wy)	Diaph Rigid Roof X	0.000458	0.000229	1.999	3	17.8	15.3	16
Story4	Serv 15 (G+0.3Wx-0.7Wy)	Diaph Rigid Roof Y	0.000704	0.000282	2.496	24	17.8	19.6	16
Story4	Serv 16 (G-0.7Wx+0.3Wy)	Diaph Rigid Roof X	0.000441	0.000277	1.592	16	1.7	15.3	16
Story4	Serv 16 (G-0.7Wx+0.3Wy)	Diaph Rigid Roof Y	0.000785	0.000462	1.698	24	17.8	19.6	16
Story4	Serv 17 (G-0.5Wx+0.5Wy)	Diaph Rigid Roof X	0.000418	0.000269	1.553	16	1.7	15.3	16
Story4	Serv 17 (G-0.5Wx+0.5Wy)	Diaph Rigid Roof Y	0.000772	0.000464	1.664	24	17.8	19.6	16
Story4	Serv 18 (G-0.3Wx+0.7Wy)	Diaph Rigid Roof X	0.000396	0.000262	1.509	16	1.7	15.3	16
Story4	Serv 18 (G-0.3Wx+0.7Wy)	Diaph Rigid Roof Y	0.000758	0.000464	1.634	24	17.8	19.6	16
Story4	Ult 01 (1.35G)	Diaph Rigid Roof X	0.000576	0.000339	1.701	16	1.7	15.3	16

L5/22

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Ult 01 (1.35G)	Diaph Rigid Roof Y	0.000987	0.000505	1.954	24	17.8	19.6	16
Story4	Ult 02 (1.2G+1.5Q)	Diaph Rigid Roof X	0.000745	0.000432	1.724	16	1.7	15.3	16
Story4	Ult 02 (1.2G+1.5Q)	Diaph Rigid Roof Y	0.001221	0.000621	1.967	24	17.8	19.6	16
Story4	Ult 03 (1.2G+Wx+0.4Q)	Diaph Rigid Roof X	0.000504	0.000252	2	3	17.8	15.3	16
Story4	Ult 03 (1.2G+Wx+0.4Q)	Diaph Rigid Roof Y	0.000858	0.000354	2.425	24	17.8	19.6	16
Story4	Ult 04 (1.2G-Wx+0.4Q)	Diaph Rigid Roof X	0.000646	0.000384	1.682	16	1.7	15.3	16
Story4	Ult 04 (1.2G-Wx+0.4Q)	Diaph Rigid Roof Y	0.001079	0.000613	1.76	24	17.8	19.6	16
Story4	Ult 05 (1.2G+Wy+0.4Q)	Diaph Rigid Roof X	0.000478	0.000329	1.454	16	1.7	15.3	16
Story4	Ult 05 (1.2G+Wy+0.4Q)	Diaph Rigid Roof Y	0.00098	0.000626	1.567	24	17.8	19.6	16
Story4	Ult 06 (1.2G-Wy+0.4Q)	Diaph Rigid Roof X	0.00067	0.000325	2.061	3	17.8	15.3	16
Story4	Ult 06 (1.2G-Wy+0.4Q)	Diaph Rigid Roof Y	0.000958	0.000358	2.672	24	17.8	19.6	16
Story4	Ult 07 (0.9G+Wx)	Diaph Rigid Roof X	0.000314	0.000142	2.212	3	17.8	15.3	16
Story4	Ult 07 (0.9G+Wx)	Diaph Rigid Roof Y	0.000548	0.000196	2.793	3	17.8	15.3	16
Story4	Ult 08 (0.9G-Wx)	Diaph Rigid Roof X	0.000456	0.000255	1.786	16	1.7	15.3	16
Story4	Ult 08 (0.9G-Wx)	Diaph Rigid Roof Y	0.000768	0.00042	1.83	24	17.8	19.6	16
Story4	Ult 09 (0.9G+Wy)	Diaph Rigid Roof X	0.000288	0.000195	1.475	16	1.7	15.3	16
Story4	Ult 09 (0.9G+Wy)	Diaph Rigid Roof Y	0.000669	0.000443	1.511	24	17.8	19.6	16
Story4	Ult 10 (0.9G-Wy)	Diaph Rigid Roof X	0.00048	0.000215	2.232	3	17.8	15.3	16
Story4	Ult 10 (0.9G-Wy)	Diaph Rigid Roof Y	0.000647	0.0002	3.226	24	17.8	19.6	16
Story4	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph Rigid Roof X	0.000306	0.00017	1.798	3	17.8	15.3	16
Story4	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph Rigid Roof Y	0.000584	0.000279	2.092	24	17.8	19.6	16
Story4	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph Rigid Roof X	0.0003	0.000189	1.59	3	17.8	15.3	16
Story4	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph Rigid Roof Y	0.000608	0.000335	1.818	24	17.8	19.6	16
Story4	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph Rigid Roof X	0.000296	0.0002	1.474	16	1.7	15.3	16

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph Rigid Roof Y	0.000633	0.00039	1.622	24	17.8	19.6	16
Story4	Ult 14 (0.9G-0.7Wx-0.3Wy)	Diaph Rigid Roof X	0.000463	0.000278	1.665	16	1.7	15.3	16
Story4	Ult 14 (0.9G-0.7Wx-0.3Wy)	Diaph Rigid Roof Y	0.000732	0.000394	1.855	24	17.8	19.6	16
Story4	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph Rigid Roof X	0.000468	0.000263	1.781	16	1.7	15.3	16
Story4	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph Rigid Roof Y	0.000708	0.000339	2.087	24	17.8	19.6	16
Story4	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph Rigid Roof X	0.000473	0.000244	1.94	4	16.4	15.3	16
Story4	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph Rigid Roof Y	0.000683	0.000284	2.409	24	17.8	19.6	16
Story4	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph Rigid Roof X	0.000364	0.000164	2.22	3	17.8	15.3	16
Story4	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph Rigid Roof Y	0.000577	0.000197	2.926	24	17.8	19.6	16
Story4	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph Rigid Roof X	0.000397	0.000179	2.224	3	17.8	15.3	16
Story4	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph Rigid Roof Y	0.000597	0.000198	3.013	24	17.8	19.6	16
Story4	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph Rigid Roof X	0.000431	0.000193	2.228	3	17.8	15.3	16
Story4	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph Rigid Roof Y	0.000617	0.000199	3.099	24	17.8	19.6	16
Story4	Ult 20 (0.9G-0.7Wx+0.3Wy)	Diaph Rigid Roof X	0.000405	0.000239	1.699	16	1.7	15.3	16
Story4	Ult 20 (0.9G-0.7Wx+0.3Wy)	Diaph Rigid Roof Y	0.000739	0.000427	1.731	24	17.8	19.6	16
Story4	Ult 21 (0.9G-0.5Wx+0.5Wy)	Diaph Rigid Roof X	0.000372	0.000228	1.634	16	1.7	15.3	16
Story4	Ult 21 (0.9G-0.5Wx+0.5Wy)	Diaph Rigid Roof Y	0.000719	0.000431	1.666	24	17.8	19.6	16
Story4	Ult 22 (0.9G-0.3Wx+0.7Wy)	Diaph Rigid Roof X	0.000338	0.000217	1.563	16	1.7	15.3	16
Story4	Ult 22 (0.9G-0.3Wx+0.7Wy)	Diaph Rigid Roof Y	0.000699	0.000436	1.603	24	17.8	19.6	16
Story4	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Diaph Rigid Roof X	0.000495	0.00028	1.769	3	17.8	15.3	16
Story4	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Diaph Rigid Roof Y	0.000895	0.000437	2.047	24	17.8	19.6	16
Story4	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph Rigid Roof X	0.00049	0.000299	1.64	16	1.7	15.3	16
Story4	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph Rigid Roof Y	0.000919	0.000493	1.866	24	17.8	19.6	16
Story4	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph Rigid Roof X	0.000486	0.000318	1.526	16	1.7	15.3	16

L523

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph Rigid Roof Y	0.000944	0.000548	1.722	24	17.8	19.6	16
Story4	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph Rigid Roof X	0.000653	0.000392	1.666	16	1.7	15.3	16
Story4	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph Rigid Roof Y	0.001043	0.000552	1.888	24	17.8	19.6	16
Story4	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph Rigid Roof X	0.000658	0.000373	1.764	16	1.7	15.3	16
Story4	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph Rigid Roof Y	0.001018	0.000497	2.049	24	17.8	19.6	16
Story4	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph Rigid Roof X	0.000662	0.000354	1.873	16	1.7	15.3	16
Story4	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph Rigid Roof Y	0.000994	0.000442	2.251	24	17.8	19.6	16
Story4	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph Rigid Roof X	0.000554	0.000274	2.021	3	17.8	15.3	16
Story4	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph Rigid Roof Y	0.000888	0.000355	2.5	24	17.8	19.6	16
Story4	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph Rigid Roof X	0.000587	0.000288	2.034	3	17.8	15.3	16
Story4	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph Rigid Roof Y	0.000908	0.000356	2.549	24	17.8	19.6	16
Story4	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph Rigid Roof X	0.00062	0.000303	2.046	3	17.8	15.3	16
Story4	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph Rigid Roof Y	0.000928	0.000357	2.598	24	17.8	19.6	16
Story4	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Diaph Rigid Roof X	0.000595	0.000367	1.62	16	1.7	15.3	16
Story4	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Diaph Rigid Roof Y	0.001049	0.00062	1.693	24	17.8	19.6	16
Story4	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph Rigid Roof X	0.000562	0.000356	1.577	16	1.7	15.3	16
Story4	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph Rigid Roof Y	0.00103	0.000623	1.653	24	17.8	19.6	16
Story4	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph Rigid Roof X	0.000528	0.000345	1.53	16	1.7	15.3	16
Story4	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph Rigid Roof Y	0.00101	0.000624	1.619	24	17.8	19.6	16
Story4	Ult 35 (G+EQX+0.3Q) Max	Diaph Rigid Roof X	0.000486	0.00016	3.034	14	3.6	13.5	16
Story4	Ult 35 (G+EQX+0.3Q) Max	Diaph Rigid Roof Y	0.000947	0.000377	2.513	3	17.8	15.3	16
Story4	Ult 35 (G+EQX+0.3Q) Min	Diaph Rigid Roof X	0.000414	6E-05	6.934	13	1.7	13.5	16
Story4	Ult 35 (G+EQX+0.3Q) Min	Diaph Rigid Roof Y	0.00072	8.8E-05	8.19	24	17.8	19.6	16
Story4	Ult 36 (G-EQX+0.3Q) Max	Diaph Rigid Roof X	0.001027	0.000529	1.939	16	1.7	15.3	16

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Ult 36 (G-EQX+0.3Q) Max	Diaph Rigid Roof Y	0.000929	0.000511	1.817	16	1.7	15.3	16
Story4	Ult 36 (G-EQX+0.3Q) Min	Diaph Rigid Roof X	0.000792	0.000379	2.091	22	1.7	19.6	16
Story4	Ult 36 (G-EQX+0.3Q) Min	Diaph Rigid Roof Y	0.000678	0.000287	2.36	27	10	15.3	16
Story4	Ult 37 (G+EQY+0.3Q) Max	Diaph Rigid Roof X	0.000507	0.000337	1.503	16	1.7	15.3	16
Story4	Ult 37 (G+EQY+0.3Q) Max	Diaph Rigid Roof Y	0.000566	0.000394	1.438	24	17.8	19.6	16
Story4	Ult 37 (G+EQY+0.3Q) Min	Diaph Rigid Roof X	0.000298	0.00021	1.417	16	1.7	15.3	16
Story4	Ult 37 (G+EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000417	0.000163	2.554	24	17.8	19.6	16
Story4	Ult 38 (G-EQY+0.3Q) Max	Diaph Rigid Roof X	0.000649	0.00033	1.965	3	17.8	15.3	16
Story4	Ult 38 (G-EQY+0.3Q) Max	Diaph Rigid Roof Y	0.001185	0.000461	2.569	3	17.8	15.3	16
Story4	Ult 38 (G-EQY+0.3Q) Min	Diaph Rigid Roof X	0.000466	0.000137	3.394	22	1.7	19.6	16
Story4	Ult 38 (G-EQY+0.3Q) Min	Diaph Rigid Roof Y	0.001039	0.00027	3.848	4	16.4	15.3	16
Story4	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph Rigid Roof X	0.000481	0.000139	3.46	14	3.6	13.5	16
Story4	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph Rigid Roof Y	0.000877	0.000419	2.091	3	17.8	15.3	16
Story4	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph Rigid Roof X	0.000395	4.7E-05	8.485	13	1.7	13.5	16
Story4	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000605	7.2E-05	8.348	24	17.8	19.6	16
Story4	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph Rigid Roof X	0.000371	0.00019	1.95	3	17.8	15.3	16
Story4	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph Rigid Roof Y	0.000756	0.000463	1.633	3	17.8	15.3	16
Story4	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	Diaph Rigid Roof X	0.000292	0.00011	2.656	13	1.7	13.5	16
Story4	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000569	0.000223	2.555	24	17.8	19.6	16
Story4	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph Rigid Roof X	0.000434	0.000238	1.824	16	1.7	15.3	16
Story4	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph Rigid Roof Y	0.000609	0.000423	1.438	24	17.8	19.6	16
Story4	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph Rigid Roof X	0.000244	0.000104	2.358	426	4.5	10.725	16
Story4	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000393	9E-05	4.371	24	17.8	19.6	16
Story4	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph Rigid Roof X	0.001079	0.000564	1.913	16	1.7	15.3	16

L524

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph Rigid Roof Y	0.001112	0.00059	1.884	16	1.7	15.3	16
Story4	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph Rigid Roof X	0.000828	0.000398	2.079	1	1.7	24.4	16
Story4	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph Rigid Roof Y	0.00078	0.000306	2.553	27	10	15.3	16
Story4	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph Rigid Roof X	0.000838	0.000483	1.733	16	1.7	15.3	16
Story4	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph Rigid Roof Y	0.001031	0.000531	1.942	3	17.8	15.3	16
Story4	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	Diaph Rigid Roof X	0.000629	0.000306	2.058	22	1.7	19.6	16
Story4	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000858	0.000361	2.375	4	16.4	15.3	16
Story4	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	Diaph Rigid Roof X	0.000814	0.000469	1.736	16	1.7	15.3	16
Story4	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	Diaph Rigid Roof Y	0.001252	0.000579	2.163	16	1.7	15.3	16
Story4	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	Diaph Rigid Roof X	0.000584	0.000208	2.813	22	1.7	19.6	16
Story4	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	Diaph Rigid Roof Y	0.00101	0.000287	3.517	4	16.4	15.3	16
Story4	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	Diaph Rigid Roof X	0.000505	0.000196	2.568	14	3.6	13.5	16
Story4	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	Diaph Rigid Roof Y	0.001063	0.000393	2.705	3	17.8	15.3	16
Story4	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph Rigid Roof X	0.000418	2.1E-05	19.859	13	1.7	13.5	16
Story4	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph Rigid Roof Y	0.00079	4.6E-05	17.351	24	17.8	19.6	16
Story4	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph Rigid Roof X	0.000443	0.000226	1.961	3	17.8	15.3	16
Story4	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph Rigid Roof Y	0.001066	0.000419	2.544	3	17.8	15.3	16
Story4	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph Rigid Roof X	0.000331	4.4E-05	7.53	13	1.7	13.5	16
Story4	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000877	0.000178	4.937	24	17.8	19.6	16
Story4	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph Rigid Roof X	0.000579	0.000284	2.039	3	17.8	15.3	16
Story4	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph Rigid Roof Y	0.00123	0.000452	2.72	3	17.8	15.3	16
Story4	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	Diaph Rigid Roof Y	0.001018	0.000175	5.804	4	16.4	15.3	16
Story4	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph Rigid Roof X	0.001037	0.000533	1.945	16	1.7	15.3	16
Story4	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph Rigid Roof Y	0.000839	0.000494	1.7	16	1.7	15.3	16

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	Diaph Rigid Roof X	0.000747	0.000347	2.152	22	1.7	19.6	16
Story4	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000564	0.00022	2.569	4	16.4	15.3	16
Story4	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph Rigid Roof X	0.000767	0.000433	1.77	16	1.7	15.3	16
Story4	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph Rigid Roof Y	0.000723	0.00048	1.506	24	17.8	19.6	16
Story4	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph Rigid Roof X	0.000519	0.000282	1.843	22	1.7	19.6	16
Story4	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000537	0.000263	2.044	24	17.8	19.6	16
Story4	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	Diaph Rigid Roof X	0.000673	0.000399	1.689	16	1.7	15.3	16
Story4	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	Diaph Rigid Roof Y	0.000704	0.000524	1.343	32	17.8	9.4	16
Story4	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph Rigid Roof X	0.000371	0.000215	1.726	15	3.6	15.3	16
Story4	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph Rigid Roof Y	0.000374	0.000134	2.803	24	17.8	19.6	16
Story4	ENVELOPE Max	Diaph Rigid Roof X	0.001079	0.000679	1.59	16	1.7	15.3	16
Story4	ENVELOPE Max	Diaph Rigid Roof Y	0.001252	0.000805	1.555	16	1.7	15.3	16
Story4	ENVELOPE Min	Diaph Rigid Roof X	0.000376	0.000151	2.491	10	3.6	1	16
Story4	ENVELOPE Min	Diaph Rigid Roof Y	0.000699	0.000162	4.307	7	17.8	3	16
Story4	DStlD1	Diaph Rigid Roof X	0.000427	0.000251	1.701	16	1.7	15.3	16
Story4	DStlD1	Diaph Rigid Roof Y	0.000731	0.000374	1.954	24	17.8	19.6	16
Story4	DStlD2	Diaph Rigid Roof X	0.000582	0.000338	1.721	16	1.7	15.3	16
Story4	DStlD2	Diaph Rigid Roof Y	0.00096	0.000489	1.965	24	17.8	19.6	16
Story4	DCmpD1	Diaph Rigid Roof X	0.000427	0.000251	1.701	16	1.7	15.3	16
Story4	DCmpD1	Diaph Rigid Roof Y	0.000731	0.000374	1.954	24	17.8	19.6	16
Story4	DCmpD2	Diaph Rigid Roof X	0.000582	0.000338	1.721	16	1.7	15.3	16
Story4	DCmpD2	Diaph Rigid Roof Y	0.00096	0.000489	1.965	24	17.8	19.6	16
Story4	DCmpS1	Diaph Rigid Roof X	0.000576	0.000339	1.701	16	1.7	15.3	16
Story4	DCmpS1	Diaph Rigid Roof Y	0.000987	0.000505	1.954	24	17.8	19.6	16

L525

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story4	DCmpS2	Diaph Rigid Roof X	0.000809	0.000469	1.723	16	1.7	15.3	16
Story4	DCmpS2	Diaph Rigid Roof Y	0.00133	0.000677	1.966	24	17.8	19.6	16
Story4	DCmpC1	Diaph Rigid Roof X	0.000467	0.000295	1.582	3	17.8	15.3	16
Story4	DCmpC1	Diaph Rigid Roof Y	0.000829	0.000449	1.847	24	17.8	19.6	16
Story3	Dead	Diaph D1 X	0.000439	0.00026	1.691	54	12.5	25.2	11.8
Story3	Dead	Diaph D1 Y	0.000472	0.000161	2.935	24	17.8	19.6	11.8
Story3	Live	Diaph D1 X	0.000131	5.6E-05	2.337	54	12.5	25.2	11.8
Story3	Live	Diaph D1 Y	0.000235	9.4E-05	2.51	24	17.8	19.6	11.8
Story3	SDead	Diaph D1 X	7.7E-05	2E-05	3.814	54	12.5	25.2	11.8
Story3	SDead	Diaph D1 Y	0.000194	8.3E-05	2.344	24	17.8	19.6	11.8
Story3	Wind x	Diaph D1 X	0.000707	0.000357	1.978	54	12.5	25.2	11.8
Story3	Wind x	Diaph D1 Y	0.000395	8.8E-05	4.507	16	1.7	15.3	11.8
Story3	Wind y	Diaph D1 X	0.000196	6.1E-05	3.215	54	12.5	25.2	11.8
Story3	Wind y	Diaph D1 Y	0.000387	0.000216	1.79	24	17.8	19.6	11.8
Story3	EQ X 1	Diaph D1 X	0.001199	0.000622	1.928	54	12.5	25.2	11.8
Story3	EQ X 2	Diaph D1 X	0.001685	0.000787	2.14	54	12.5	25.2	11.8
Story3	EQ X 3	Diaph D1 X	0.000712	0.000343	2.079	54	12.5	25.2	11.8
Story3	EQ Y 1	Diaph D1 X	0.000341	7.3E-05	4.641	54	12.5	25.2	11.8
Story3	EQ Y 1	Diaph D1 Y	0.000825	0.000476	1.732	2	17.8	24.4	11.8
Story3	EQ Y 2	Diaph D1 X	0.000665	0.000179	3.707	54	12.5	25.2	11.8
Story3	EQ Y 2	Diaph D1 Y	0.001081	0.000573	1.887	3	17.8	15.3	11.8
Story3	EQ Y 3	Diaph D1 Y	0.000608	0.000396	1.536	16	1.7	15.3	11.8
Story3	Serv 01 (G)	Diaph D1 X	0.000516	0.000281	1.839	54	12.5	25.2	11.8
Story3	Serv 01 (G)	Diaph D1 Y	0.000666	0.000244	2.734	24	17.8	19.6	11.8
Story3	Serv 02 (G+0.7Q)	Diaph D1 X	0.000607	0.00032	1.9	54	12.5	25.2	11.8

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	Serv 02 (G+0.7Q)	Diaph D1 Y	0.00083	0.000309	2.687	24	17.8	19.6	11.8
Story3	Serv 03 (G+Wx)	Diaph D1 X	0.000989	0.000554	1.787	54	12.5	25.2	11.8
Story3	Serv 03 (G+Wx)	Diaph D1 Y	0.000811	0.000227	3.574	3	17.8	15.3	11.8
Story3	Serv 04 (G-Wx)	Diaph D1 Y	0.000521	0.000189	2.763	24	17.8	19.6	11.8
Story3	Serv 05 (G+Wy)	Diaph D1 X	0.000385	0.000206	1.867	54	12.5	25.2	11.8
Story3	Serv 05 (G+Wy)	Diaph D1 Y	0.000407	9.9E-05	4.129	24	17.8	19.6	11.8
Story3	Serv 06 (G-Wy)	Diaph D1 X	0.000647	0.000355	1.823	54	12.5	25.2	11.8
Story3	Serv 06 (G-Wy)	Diaph D1 Y	0.000925	0.000389	2.381	24	17.8	19.6	11.8
Story3	Serv 07 (G+0.7Wx+0.3Wy)	Diaph D1 X	0.000809	0.000469	1.723	54	12.5	25.2	11.8
Story3	Serv 07 (G+0.7Wx+0.3Wy)	Diaph D1 Y	0.00069	0.000195	3.54	24	17.8	19.6	11.8
Story3	Serv 08 (G+0.5Wx+0.5Wy)	Diaph D1 X	0.00069	0.000414	1.665	54	12.5	25.2	11.8
Story3	Serv 08 (G+0.5Wx+0.5Wy)	Diaph D1 Y	0.000608	0.000172	3.54	24	17.8	19.6	11.8
Story3	Serv 09 (G+0.3Wx+0.7Wy)	Diaph D1 X	0.000565	0.000332	1.704	54	12.5	25.2	11.8
Story3	Serv 09 (G+0.3Wx+0.7Wy)	Diaph D1 Y	0.000527	0.000152	3.472	24	17.8	19.6	11.8
Story3	Serv 10 (G-0.7Wx-0.3Wy)	Diaph D1 X	0.000223	6E-05	3.742	54	12.5	25.2	11.8
Story3	Serv 10 (G-0.7Wx-0.3Wy)	Diaph D1 Y	0.000642	0.000248	2.584	24	17.8	19.6	11.8
Story3	Serv 11 (G-0.5Wx-0.5Wy)	Diaph D1 X	0.000342	0.000142	2.403	54	12.5	25.2	11.8
Story3	Serv 11 (G-0.5Wx-0.5Wy)	Diaph D1 Y	0.000724	0.000289	2.502	24	17.8	19.6	11.8
Story3	Serv 12 (G-0.3Wx-0.7Wy)	Diaph D1 X	0.000466	0.000229	2.035	54	12.5	25.2	11.8
Story3	Serv 12 (G-0.3Wx-0.7Wy)	Diaph D1 Y	0.000805	0.000329	2.445	24	17.8	19.6	11.8
Story3	Serv 13 (G+0.7Wx-0.3Wy)	Diaph D1 X	0.000887	0.000495	1.794	54	12.5	25.2	11.8
Story3	Serv 13 (G+0.7Wx-0.3Wy)	Diaph D1 Y	0.000845	0.000294	2.869	24	17.8	19.6	11.8
Story3	Serv 14 (G+0.5Wx-0.5Wy)	Diaph D1 X	0.000823	0.000457	1.8	54	12.5	25.2	11.8
Story3	Serv 14 (G+0.5Wx-0.5Wy)	Diaph D1 Y	0.000871	0.000341	2.555	24	17.8	19.6	11.8

L926

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	Serv 15 (G+0.3Wx-0.7Wy)	Diaph D1 X	0.000749	0.000415	1.805	54	12.5	25.2	11.8
Story3	Serv 15 (G+0.3Wx-0.7Wy)	Diaph D1 Y	0.000891	0.000362	2.464	24	17.8	19.6	11.8
Story3	Serv 16 (G-0.7Wx+0.3Wy)	Diaph D1 X	0.000181	3.3E-05	5.429	13	1.7	13.5	11.8
Story3	Serv 16 (G-0.7Wx+0.3Wy)	Diaph D1 Y	0.000487	0.000162	3.007	24	17.8	19.6	11.8
Story3	Serv 17 (G-0.5Wx+0.5Wy)	Diaph D1 X	0.000209	6.7E-05	3.128	54	12.5	25.2	11.8
Story3	Serv 17 (G-0.5Wx+0.5Wy)	Diaph D1 Y	0.000461	0.000142	3.24	24	17.8	19.6	11.8
Story3	Serv 18 (G-0.3Wx+0.7Wy)	Diaph D1 X	0.000283	0.000125	2.264	54	12.5	25.2	11.8
Story3	Serv 18 (G-0.3Wx+0.7Wy)	Diaph D1 Y	0.000441	0.000126	3.512	24	17.8	19.6	11.8
Story3	Ult 01 (1.35G)	Diaph D1 X	0.000696	0.000379	1.839	54	12.5	25.2	11.8
Story3	Ult 01 (1.35G)	Diaph D1 Y	0.000899	0.000329	2.734	24	17.8	19.6	11.8
Story3	Ult 02 (1.2G+1.5Q)	Diaph D1 X	0.000815	0.00042	1.938	54	12.5	25.2	11.8
Story3	Ult 02 (1.2G+1.5Q)	Diaph D1 Y	0.001151	0.000433	2.661	24	17.8	19.6	11.8
Story3	Ult 03 (1.2G+Wx+0.4Q)	Diaph D1 X	0.001378	0.000766	1.799	54	12.5	25.2	11.8
Story3	Ult 03 (1.2G+Wx+0.4Q)	Diaph D1 Y	0.00111	0.000301	3.69	3	17.8	15.3	11.8
Story3	Ult 04 (1.2G-Wx+0.4Q)	Diaph D1 X	0.000281	3.7E-05	7.639	16	1.7	15.3	11.8
Story3	Ult 04 (1.2G-Wx+0.4Q)	Diaph D1 Y	0.000677	0.000248	2.735	24	17.8	19.6	11.8
Story3	Ult 05 (1.2G+Wy+0.4Q)	Diaph D1 X	0.000476	0.000248	1.919	54	12.5	25.2	11.8
Story3	Ult 05 (1.2G+Wy+0.4Q)	Diaph D1 Y	0.000507	0.000113	4.471	24	17.8	19.6	11.8
Story3	Ult 06 (1.2G-Wy+0.4Q)	Diaph D1 X	0.000867	0.00047	1.844	54	12.5	25.2	11.8
Story3	Ult 06 (1.2G-Wy+0.4Q)	Diaph D1 Y	0.00128	0.000546	2.343	24	17.8	19.6	11.8
Story3	Ult 07 (0.9G+Wx)	Diaph D1 X	0.001171	0.00064	1.83	54	12.5	25.2	11.8
Story3	Ult 07 (0.9G+Wx)	Diaph D1 Y	0.000817	0.000169	4.821	3	17.8	15.3	11.8
Story3	Ult 08 (0.9G-Wx)	Diaph D1 X	0.000287	8.5E-05	3.399	16	1.7	15.3	11.8
Story3	Ult 08 (0.9G-Wx)	Diaph D1 Y	0.000384	0.000134	2.863	24	17.8	19.6	11.8

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	Ult 09 (0.9G+Wy)	Diaph D1 X	0.000269	0.000141	1.9	54	12.5	25.2	11.8
Story3	Ult 10 (0.9G-Wy)	Diaph D1 X	0.00066	0.000346	1.91	54	12.5	25.2	11.8
Story3	Ult 10 (0.9G-Wy)	Diaph D1 Y	0.000986	0.000436	2.264	24	17.8	19.6	11.8
Story3	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph D1 X	0.0009	0.000514	1.752	54	12.5	25.2	11.8
Story3	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph D1 Y	0.000635	0.000121	5.239	3	17.8	15.3	11.8
Story3	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph D1 X	0.00072	0.00043	1.674	54	12.5	25.2	11.8
Story3	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph D1 Y	0.000514	8.9E-05	5.769	3	17.8	15.3	11.8
Story3	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph D1 X	0.000539	0.00033	1.635	54	12.5	25.2	11.8
Story3	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph D1 Y	0.000394	5.7E-05	6.889	24	17.8	19.6	11.8
Story3	Ult 14 (0.9G-0.7Wx-0.3Wy)	Diaph D1 Y	0.000564	0.000227	2.49	24	17.8	19.6	11.8
Story3	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph D1 X	0.000209	4.9E-05	4.234	54	12.5	25.2	11.8
Story3	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph D1 Y	0.000685	0.000286	2.391	24	17.8	19.6	11.8
Story3	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph D1 X	0.000389	0.000175	2.224	54	12.5	25.2	11.8
Story3	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph D1 Y	0.000805	0.000346	2.327	24	17.8	19.6	11.8
Story3	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph D1 X	0.001018	0.000552	1.845	54	12.5	25.2	11.8
Story3	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph D1 Y	0.000867	0.00027	3.208	3	17.8	15.3	11.8
Story3	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph D1 X	0.000915	0.000493	1.858	54	12.5	25.2	11.8
Story3	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph D1 Y	0.000901	0.000338	2.667	24	17.8	19.6	11.8
Story3	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph D1 X	0.000813	0.000434	1.874	54	12.5	25.2	11.8
Story3	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph D1 Y	0.000935	0.000395	2.366	24	17.8	19.6	11.8
Story3	Ult 20 (0.9G-0.7Wx+0.3Wy)	Diaph D1 X	0.000197	3.1E-05	6.295	16	1.7	15.3	11.8
Story3	Ult 20 (0.9G-0.7Wx+0.3Wy)	Diaph D1 Y	0.000332	9E-05	3.673	24	17.8	19.6	11.8
Story3	Ult 21 (0.9G-0.5Wx+0.5Wy)	Diaph D1 X	0.000151	7E-06	21.491	7	17.8	3	11.8
Story3	Ult 21 (0.9G-0.5Wx+0.5Wy)	Diaph D1 Y	0.000298	6.1E-05	4.85	24	17.8	19.6	11.8
Story3	Ult 22 (0.9G-0.3Wx+0.7Wy)	Diaph D1 X	0.000167	4.5E-05	3.685	7	17.8	3	11.8

1257

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	Ult 22 (0.9G-0.3Wx+0.7Wy)	Diaph D1 Y	0.000264	3.2E-05	8.133	24	17.8	19.6	11.8
Story3	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Diaph D1 X	0.001107	0.00064	1.73	54	12.5	25.2	11.8
Story3	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Diaph D1 Y	0.000928	0.000253	3.674	24	17.8	19.6	11.8
Story3	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph D1 X	0.000927	0.000556	1.667	54	12.5	25.2	11.8
Story3	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph D1 Y	0.000808	0.000221	3.658	24	17.8	19.6	11.8
Story3	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph D1 X	0.000746	0.000436	1.71	54	12.5	25.2	11.8
Story3	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph D1 Y	0.000687	0.000189	3.637	24	17.8	19.6	11.8
Story3	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph D1 X	0.000244	3.4E-05	7.075	13	1.7	13.5	11.8
Story3	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph D1 Y	0.000858	0.000337	2.544	24	17.8	19.6	11.8
Story3	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph D1 X	0.000416	0.000156	2.668	54	12.5	25.2	11.8
Story3	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph D1 Y	0.000979	0.000397	2.465	24	17.8	19.6	11.8
Story3	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph D1 X	0.000596	0.000281	2.118	54	12.5	25.2	11.8
Story3	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph D1 Y	0.001099	0.000457	2.406	24	17.8	19.6	11.8
Story3	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph D1 X	0.001225	0.000678	1.807	54	12.5	25.2	11.8
Story3	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph D1 Y	0.00116	0.000402	2.887	24	17.8	19.6	11.8
Story3	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph D1 X	0.001122	0.000619	1.814	54	12.5	25.2	11.8
Story3	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph D1 Y	0.001194	0.00047	2.544	24	17.8	19.6	11.8
Story3	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph D1 X	0.00102	0.00056	1.822	54	12.5	25.2	11.8
Story3	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph D1 Y	0.001229	0.000506	2.43	24	17.8	19.6	11.8
Story3	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Diaph D1 Y	0.000626	0.000208	3.015	24	17.8	19.6	11.8
Story3	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph D1 X	0.000243	5.6E-05	4.332	13	1.7	13.5	11.8
Story3	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph D1 Y	0.000592	0.000181	3.272	24	17.8	19.6	11.8
Story3	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph D1 X	0.000322	0.000126	2.558	54	12.5	25.2	11.8
Story3	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph D1 Y	0.000558	0.000154	3.625	24	17.8	19.6	11.8
Story3	Ult 35 (G+EQX+0.3Q) Max	Diaph D1 X	0.00224	0.001283	1.746	54	12.5	25.2	11.8

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	Ult 35 (G+EQX+0.3Q) Min	Diaph D1 X	0.001267	0.000639	1.983	54	12.5	25.2	11.8
Story3	Ult 35 (G+EQX+0.3Q) Min	Diaph D1 Y	0.001632	0.000718	2.274	3	17.8	15.3	11.8
Story3	Ult 36 (G-EQX+0.3Q) Max	Diaph D1 X	0.000536	0.000139	3.87	16	1.7	15.3	11.8
Story3	Ult 36 (G-EQX+0.3Q) Max	Diaph D1 Y	0.000349	7.5E-05	4.671	6	17.8	13.5	11.8
Story3	Ult 36 (G-EQX+0.3Q) Min	Diaph D1 X	0.001133	0.000509	2.227	95	6.8	25.2	11.8
Story3	Ult 36 (G-EQX+0.3Q) Min	Diaph D1 Y	0.000672	0.000281	2.392	22	1.7	19.6	11.8
Story3	Ult 37 (G+EQY+0.3Q) Max	Diaph D1 X	0.000538	0.000267	2.014	54	12.5	25.2	11.8
Story3	Ult 37 (G+EQY+0.3Q) Max	Diaph D1 Y	0.000703	0.000512	1.373	16	1.7	15.3	11.8
Story3	Ult 37 (G+EQY+0.3Q) Min	Diaph D1 X	0.000232	5.9E-05	3.964	7	17.8	3	11.8
Story3	Ult 37 (G+EQY+0.3Q) Min	Diaph D1 Y	0.000359	9.5E-05	3.769	44	17.8	6.8	11.8
Story3	Ult 38 (G-EQY+0.3Q) Max	Diaph D1 X	0.00122	0.000637	1.913	54	12.5	25.2	11.8
Story3	Ult 38 (G-EQY+0.3Q) Max	Diaph D1 Y	0.001305	0.000588	2.217	24	17.8	19.6	11.8
Story3	Ult 38 (G-EQY+0.3Q) Min	Diaph D1 X	0.000572	0.000202	2.833	54	12.5	25.2	11.8
Story3	Ult 38 (G-EQY+0.3Q) Min	Diaph D1 Y	0.001815	0.000907	2.002	24	17.8	19.6	11.8
Story3	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 X	0.002234	0.001281	1.744	54	12.5	25.2	11.8
Story3	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 Y	0.001039	0.00025	4.158	16	1.7	15.3	11.8
Story3	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 X	0.001068	0.000549	1.944	54	12.5	25.2	11.8
Story3	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 Y	0.001462	0.000607	2.408	3	17.8	15.3	11.8
Story3	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 X	0.001389	0.000824	1.684	54	12.5	25.2	11.8
Story3	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 Y	0.000779	0.00026	3.002	16	1.7	15.3	11.8
Story3	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 X	0.000579	0.000339	1.709	54	12.5	25.2	11.8
Story3	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 Y	0.0009	0.000335	2.689	24	17.8	19.6	11.8
Story3	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 X	0.001043	0.000619	1.684	54	12.5	25.2	11.8
Story3	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 Y	0.000931	0.000618	1.507	16	1.7	15.3	11.8

8257

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 X	0.000256	0.000176	1.455	426	4.5	10.725	11.8
Story3	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 Y	0.000437	5.9E-05	7.377	24	17.8	19.6	11.8
Story3	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 X	0.000505	0.000107	4.71	16	1.7	15.3	11.8
Story3	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 Y	0.000337	3.9E-05	8.549	97	6.8	18	11.8
Story3	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 X	0.001128	0.000505	2.234	95	6.8	25.2	11.8
Story3	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 Y	0.000934	0.000442	2.113	24	17.8	19.6	11.8
Story3	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 X	0.000531	0.000167	3.174	54	12.5	25.2	11.8
Story3	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 Y	0.000574	0.000199	2.877	54	12.5	25.2	11.8
Story3	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 Y	0.001213	0.000597	2.033	24	17.8	19.6	11.8
Story3	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 X	0.001006	0.000488	2.06	54	12.5	25.2	11.8
Story3	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 Y	0.001036	0.00045	2.304	24	17.8	19.6	11.8
Story3	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 Y	0.001777	0.000912	1.949	24	17.8	19.6	11.8
Story3	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 X	0.002439	0.001381	1.766	54	12.5	25.2	11.8
Story3	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 X	0.001273	0.000598	2.127	54	12.5	25.2	11.8
Story3	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 Y	0.001957	0.000926	2.114	3	17.8	15.3	11.8
Story3	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 X	0.00173	0.000965	1.793	54	12.5	25.2	11.8
Story3	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 Y	0.001084	0.000347	3.125	24	17.8	19.6	11.8
Story3	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 X	0.00092	0.000421	2.187	54	12.5	25.2	11.8
Story3	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 Y	0.001723	0.000821	2.1	3	17.8	15.3	11.8
Story3	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 X	0.001725	0.000924	1.868	54	12.5	25.2	11.8
Story3	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 Y	0.001342	0.000582	2.305	24	17.8	19.6	11.8
Story3	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 X	0.000786	0.000292	2.688	54	12.5	25.2	11.8
Story3	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 Y	0.002084	0.001046	1.993	3	17.8	15.3	11.8
Story3	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 X	0.000549	0.000106	5.19	16	1.7	15.3	11.8

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 Y	0.000515	0.000247	2.087	6	17.8	13.5	11.8
Story3	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 X	0.001332	0.000624	2.135	95	6.8	25.2	11.8
Story3	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 Y	0.00062	0.000227	2.738	22	1.7	19.6	11.8
Story3	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 X	0.000345	3.8E-05	9.183	18	16.4	1	11.8
Story3	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 Y	0.00048	0.000292	1.641	6	17.8	13.5	11.8
Story3	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 X	0.000624	0.000246	2.536	95	6.8	25.2	11.8
Story3	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 Y	0.000389	8.8E-05	4.441	24	17.8	19.6	11.8
Story3	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 X	0.000477	0.00015	3.175	18	16.4	1	11.8
Story3	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 Y	0.000698	0.000509	1.371	6	17.8	13.5	11.8
Story3	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 X	0.00062	0.000225	2.758	95	6.8	25.2	11.8
Story3	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 Y	0.000333	0.000101	3.291	44	17.8	6.8	11.8
Story3	ENVELOPE Max	Diaph D1 X	0.002439	0.001384	1.763	54	12.5	25.2	11.8
Story3	ENVELOPE Max	Diaph D1 Y	0.001039	0.000683	1.522	16	1.7	15.3	11.8
Story3	ENVELOPE Min	Diaph D1 X	0.001332	0.000624	2.135	95	6.8	25.2	11.8
Story3	ENVELOPE Min	Diaph D1 Y	0.002084	0.001065	1.957	3	17.8	15.3	11.8
Story3	DStlD1	Diaph D1 X	0.000516	0.000281	1.839	54	12.5	25.2	11.8
Story3	DStlD1	Diaph D1 Y	0.000666	0.000244	2.734	24	17.8	19.6	11.8
Story3	DStlD2	Diaph D1 X	0.000646	0.000336	1.922	54	12.5	25.2	11.8
Story3	DStlD2	Diaph D1 Y	0.000901	0.000337	2.672	24	17.8	19.6	11.8
Story3	DCmpD1	Diaph D1 X	0.000516	0.000281	1.839	54	12.5	25.2	11.8
Story3	DCmpD1	Diaph D1 Y	0.000666	0.000244	2.734	24	17.8	19.6	11.8
Story3	DCmpD2	Diaph D1 X	0.000646	0.000336	1.922	54	12.5	25.2	11.8
Story3	DCmpD2	Diaph D1 Y	0.000901	0.000337	2.672	24	17.8	19.6	11.8
Story3	DCmpS1	Diaph D1 X	0.000696	0.000379	1.839	54	12.5	25.2	11.8

L529

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story3	DCmpS1	Diaph D1 Y	0.000899	0.000329	2.734	24	17.8	19.6	11.8
Story3	DCmpS2	Diaph D1 X	0.000892	0.000462	1.929	54	12.5	25.2	11.8
Story3	DCmpS2	Diaph D1 Y	0.001251	0.000469	2.667	24	17.8	19.6	11.8
Story3	DCmpC1	Diaph D1 X	0.000659	0.00039	1.691	54	12.5	25.2	11.8
Story3	DCmpC1	Diaph D1 Y	0.000709	0.000241	2.935	24	17.8	19.6	11.8
Story2	Dead	Diaph D1 X	0.000131	3.5E-05	3.721	9	11.2	12.8	8.6
Story2	Dead	Diaph D1 Y	0.000199	5.9E-05	3.366	65	0	28	8.6
Story2	Live	Diaph D1 X	4.6E-05	1.1E-05	4.284	9	11.2	12.8	8.6
Story2	Live	Diaph D1 Y	7.5E-05	2.4E-05	3.046	65	0	28	8.6
Story2	SDead	Diaph D1 X	2.8E-05	1.3E-05	2.198	9	11.2	12.8	8.6
Story2	SDead	Diaph D1 Y	8.2E-05	3.4E-05	2.429	67	19.6	18	8.6
Story2	Wind x	Diaph D1 X	9.6E-05	5.8E-05	1.66	47	12.5	15.3	8.6
Story2	Wind x	Diaph D1 Y	7.9E-05	3.5E-05	2.289	67	19.6	18	8.6
Story2	Wind y	Diaph D1 X	1.9E-05	1E-05	1.967	358	7.2	29.4	8.6
Story2	Wind y	Diaph D1 Y	0.000132	6.8E-05	1.943	67	19.6	18	8.6
Story2	EQ X 1	Diaph D1 X	0.000677	0.000365	1.854	358	7.2	29.4	8.6
Story2	EQ X 2	Diaph D1 X	0.000877	0.000465	1.884	358	7.2	29.4	8.6
Story2	EQ X 3	Diaph D1 X	0.00062	0.000336	1.845	47	12.5	15.3	8.6
Story2	EQ Y 1	Diaph D1 Y	0.000553	0.000285	1.94	4	16.4	15.3	8.6
Story2	EQ Y 2	Diaph D1 X	0.000183	7.4E-05	2.458	358	7.2	29.4	8.6
Story2	EQ Y 2	Diaph D1 Y	0.000677	0.000345	1.96	83	19.6	21.8	8.6
Story2	EQ Y 3	Diaph D1 Y	0.000614	0.000317	1.937	80	0	21.8	8.6
Story2	Serv 01 (G)	Diaph D1 X	0.000159	5.1E-05	3.089	9	11.2	12.8	8.6
Story2	Serv 01 (G)	Diaph D1 Y	0.000274	8.9E-05	3.069	65	0	28	8.6
Story2	Serv 02 (G+0.7Q)	Diaph D1 X	0.000191	5.9E-05	3.243	9	11.2	12.8	8.6
Story2	Serv 02 (G+0.7Q)	Diaph D1 Y	0.000326	0.000106	3.065	65	0	28	8.6
Story2	Serv 03 (G+Wx)	Diaph D1 X	0.000197	9.9E-05	1.996	9	11.2	12.8	8.6
Story2	Serv 03 (G+Wx)	Diaph D1 Y	0.000229	6.4E-05	3.582	65	0	28	8.6

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story2	Serv 04 (G-Wx)	Diaph D1 Y	0.000319	0.000115	2.783	65	0	28	8.6
Story2	Serv 05 (G+Wy)	Diaph D1 X	0.000152	4.1E-05	3.662	9	11.2	12.8	8.6
Story2	Serv 05 (G+Wy)	Diaph D1 Y	0.000204	4.9E-05	4.202	65	0	28	8.6
Story2	Serv 06 (G-Wy)	Diaph D1 X	0.000166	6.1E-05	2.701	9	11.2	12.8	8.6
Story2	Serv 06 (G-Wy)	Diaph D1 Y	0.000344	0.00013	2.646	65	0	28	8.6
Story2	Serv 07 (G+0.7Wx+0.3Wy)	Diaph D1 X	0.000183	8.2E-05	2.248	9	11.2	12.8	8.6
Story2	Serv 07 (G+0.7Wx+0.3Wy)	Diaph D1 Y	0.000221	5.9E-05	3.733	65	0	28	8.6
Story2	Serv 08 (G+0.5Wx+0.5Wy)	Diaph D1 X	0.000175	7E-05	2.482	9	11.2	12.8	8.6
Story2	Serv 08 (G+0.5Wx+0.5Wy)	Diaph D1 Y	0.000216	5.6E-05	3.868	65	0	28	8.6
Story2	Serv 09 (G+0.3Wx+0.7Wy)	Diaph D1 X	0.000165	5.9E-05	2.824	9	11.2	12.8	8.6
Story2	Serv 09 (G+0.3Wx+0.7Wy)	Diaph D1 Y	0.000211	5.3E-05	3.979	65	0	28	8.6
Story2	Serv 10 (G-0.7Wx-0.3Wy)	Diaph D1 X	0.000134	2.1E-05	6.33	9	11.2	12.8	8.6
Story2	Serv 10 (G-0.7Wx-0.3Wy)	Diaph D1 Y	0.000326	0.000119	2.739	65	0	28	8.6
Story2	Serv 11 (G-0.5Wx-0.5Wy)	Diaph D1 X	0.000143	3.2E-05	4.406	9	11.2	12.8	8.6
Story2	Serv 11 (G-0.5Wx-0.5Wy)	Diaph D1 Y	0.000332	0.000123	2.706	65	0	28	8.6
Story2	Serv 12 (G-0.3Wx-0.7Wy)	Diaph D1 X	0.000152	4.4E-05	3.44	9	11.2	12.8	8.6
Story2	Serv 12 (G-0.3Wx-0.7Wy)	Diaph D1 Y	0.000336	0.000125	2.683	65	0	28	8.6
Story2	Serv 13 (G+0.7Wx-0.3Wy)	Diaph D1 X	0.000188	8.8E-05	2.143	9	11.2	12.8	8.6
Story2	Serv 13 (G+0.7Wx-0.3Wy)	Diaph D1 Y	0.000263	8.4E-05	3.147	65	0	28	8.6
Story2	Serv 14 (G+0.5Wx-0.5Wy)	Diaph D1 X	0.000182	8E-05	2.258	9	11.2	12.8	8.6
Story2	Serv 14 (G+0.5Wx-0.5Wy)	Diaph D1 Y	0.000287	9.7E-05	2.953	65	0	28	8.6
Story2	Serv 15 (G+0.3Wx-0.7Wy)	Diaph D1 X	0.000175	7.2E-05	2.414	9	11.2	12.8	8.6
Story2	Serv 15 (G+0.3Wx-0.7Wy)	Diaph D1 Y	0.00031	0.00011	2.808	65	0	28	8.6
Story2	Serv 16 (G-0.7Wx+0.3Wy)	Diaph D1 X	0.00013	1.5E-05	8.521	9	11.2	12.8	8.6
Story2	Serv 16 (G-0.7Wx+0.3Wy)	Diaph D1 Y	0.000285	9.5E-05	3	65	0	28	8.6

L530

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story2	Serv 17 (G-0.5Wx+0.5Wy)	Diaph D1 X	0.000136	2.2E-05	6.079	9	11.2	12.8	8.6
Story2	Serv 17 (G-0.5Wx+0.5Wy)	Diaph D1 Y	0.000261	8.1E-05	3.208	65	0	28	8.6
Story2	Serv 18 (G-0.3Wx+0.7Wy)	Diaph D1 X	0.000142	3E-05	4.702	9	11.2	12.8	8.6
Story2	Serv 18 (G-0.3Wx+0.7Wy)	Diaph D1 Y	0.000238	6.8E-05	3.491	65	0	28	8.6
Story2	Ult 01 (1.35G)	Diaph D1 X	0.000214	6.9E-05	3.089	9	11.2	12.8	8.6
Story2	Ult 01 (1.35G)	Diaph D1 Y	0.00037	0.00012	3.069	65	0	28	8.6
Story2	Ult 02 (1.2G+1.5Q)	Diaph D1 X	0.00026	7.8E-05	3.338	9	11.2	12.8	8.6
Story2	Ult 02 (1.2G+1.5Q)	Diaph D1 Y	0.000441	0.000144	3.063	65	0	28	8.6
Story2	Ult 03 (1.2G+Wx+0.4Q)	Diaph D1 X	0.000266	0.000137	1.948	9	11.2	12.8	8.6
Story2	Ult 03 (1.2G+Wx+0.4Q)	Diaph D1 Y	0.000291	7.9E-05	3.684	65	0	28	8.6
Story2	Ult 04 (1.2G-Wx+0.4Q)	Diaph D1 Y	0.000426	0.000155	2.752	65	0	28	8.6
Story2	Ult 05 (1.2G+Wy+0.4Q)	Diaph D1 X	0.000199	5.1E-05	3.883	9	11.2	12.8	8.6
Story2	Ult 05 (1.2G+Wy+0.4Q)	Diaph D1 Y	0.000254	5.6E-05	4.528	65	0	28	8.6
Story2	Ult 06 (1.2G-Wy+0.4Q)	Diaph D1 X	0.000219	8.1E-05	2.714	9	11.2	12.8	8.6
Story2	Ult 06 (1.2G-Wy+0.4Q)	Diaph D1 Y	0.000463	0.000178	2.606	65	0	28	8.6
Story2	Ult 07 (0.9G+Wx)	Diaph D1 X	0.0002	0.000117	1.711	9	11.2	12.8	8.6
Story2	Ult 07 (0.9G+Wx)	Diaph D1 Y	0.000179	4.2E-05	4.219	65	0	28	8.6
Story2	Ult 08 (0.9G-Wx)	Diaph D1 X	0.000134	2.4E-05	5.522	358	7.2	29.4	8.6
Story2	Ult 08 (0.9G-Wx)	Diaph D1 Y	0.000314	0.000118	2.655	65	0	28	8.6
Story2	Ult 09 (0.9G+Wy)	Diaph D1 X	0.000133	3.1E-05	4.218	9	11.2	12.8	8.6
Story2	Ult 09 (0.9G+Wy)	Diaph D1 Y	0.000142	2E-05	7.271	65	0	28	8.6
Story2	Ult 10 (0.9G-Wy)	Diaph D1 X	0.000153	6.1E-05	2.507	9	11.2	12.8	8.6
Story2	Ult 10 (0.9G-Wy)	Diaph D1 Y	0.000351	0.000141	2.488	65	0	28	8.6
Story2	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph D1 X	0.00018	9.1E-05	1.97	9	11.2	12.8	8.6
Story2	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph D1 Y	0.000168	3.6E-05	4.721	65	0	28	8.6
Story2	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph D1 X	0.000166	7.4E-05	2.242	9	11.2	12.8	8.6

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story2	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph D1 Y	0.000161	3.1E-05	5.18	65	0	28	8.6
Story2	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph D1 X	0.000153	5.7E-05	2.678	9	11.2	12.8	8.6
Story2	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph D1 Y	0.000153	2.6E-05	5.798	65	0	28	8.6
Story2	Ult 14 (0.9G-0.7Wx-0.3Wy)	Diaph D1 Y	0.000325	0.000125	2.599	65	0	28	8.6
Story2	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph D1 X	0.000119	1.8E-05	6.51	9	11.2	12.8	8.6
Story2	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph D1 Y	0.000332	0.00013	2.564	65	0	28	8.6
Story2	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph D1 X	0.000133	3.5E-05	3.751	9	11.2	12.8	8.6
Story2	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph D1 Y	0.00034	0.000134	2.532	65	0	28	8.6
Story2	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph D1 X	0.000186	0.0001	1.857	9	11.2	12.8	8.6
Story2	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph D1 Y	0.000231	7.2E-05	3.202	65	0	28	8.6
Story2	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph D1 X	0.000176	8.9E-05	1.984	9	11.2	12.8	8.6
Story2	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph D1 Y	0.000265	9.2E-05	2.888	65	0	28	8.6
Story2	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph D1 X	0.000167	7.8E-05	2.148	9	11.2	12.8	8.6
Story2	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph D1 Y	0.0003	0.000112	2.685	65	0	28	8.6
Story2	Ult 20 (0.9G-0.7Wx+0.3Wy)	Diaph D1 Y	0.000262	8.9E-05	2.961	65	0	28	8.6
Story2	Ult 21 (0.9G-0.5Wx+0.5Wy)	Diaph D1 Y	0.000228	6.9E-05	3.31	65	0	28	8.6
Story2	Ult 22 (0.9G-0.3Wx+0.7Wy)	Diaph D1 X	0.000119	1.5E-05	8.065	9	11.2	12.8	8.6
Story2	Ult 22 (0.9G-0.3Wx+0.7Wy)	Diaph D1 Y	0.000194	4.9E-05	3.94	65	0	28	8.6
Story2	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Diaph D1 X	0.000246	0.000111	2.216	9	11.2	12.8	8.6
Story2	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Diaph D1 Y	0.00028	7.2E-05	3.881	65	0	28	8.6
Story2	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph D1 X	0.000232	9.4E-05	2.476	9	11.2	12.8	8.6
Story2	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph D1 Y	0.000273	6.8E-05	4.034	65	0	28	8.6
Story2	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph D1 X	0.000219	7.7E-05	2.851	9	11.2	12.8	8.6
Story2	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph D1 Y	0.000265	6.3E-05	4.21	65	0	28	8.6
Story2	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph D1 X	0.000172	2.1E-05	8.192	9	11.2	12.8	8.6

L531

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story2	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph D1 Y	0.000437	0.000162	2.704	65	0	28	8.6
Story2	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph D1 X	0.000186	3.8E-05	4.872	9	11.2	12.8	8.6
Story2	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph D1 Y	0.000444	0.000166	2.674	65	0	28	8.6
Story2	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph D1 X	0.000199	5.5E-05	3.608	9	11.2	12.8	8.6
Story2	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph D1 Y	0.000452	0.000171	2.646	65	0	28	8.6
Story2	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph D1 X	0.000252	0.00012	2.103	9	11.2	12.8	8.6
Story2	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph D1 Y	0.000343	0.000109	3.155	65	0	28	8.6
Story2	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph D1 X	0.000243	0.000109	2.233	9	11.2	12.8	8.6
Story2	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph D1 Y	0.000377	0.000128	2.938	65	0	28	8.6
Story2	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph D1 X	0.000233	9.8E-05	2.392	9	11.2	12.8	8.6
Story2	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph D1 Y	0.000412	0.000148	2.779	65	0	28	8.6
Story2	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Diaph D1 Y	0.000374	0.000125	2.99	65	0	28	8.6
Story2	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph D1 X	0.000175	2.3E-05	7.53	9	11.2	12.8	8.6
Story2	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph D1 Y	0.00034	0.000105	3.224	65	0	28	8.6
Story2	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph D1 X	0.000185	3.4E-05	5.362	9	11.2	12.8	8.6
Story2	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph D1 Y	0.000306	8.6E-05	3.566	65	0	28	8.6
Story2	Ult 35 (G+EQX+0.3Q) Max	Diaph D1 X	0.000815	0.000443	1.837	359	12.1	29.4	8.6
Story2	Ult 35 (G+EQX+0.3Q) Min	Diaph D1 X	0.000558	0.000313	1.782	78	3.6	18	8.6
Story2	Ult 35 (G+EQX+0.3Q) Min	Diaph D1 Y	0.000506	0.000192	2.631	67	19.6	18	8.6
Story2	Ult 36 (G-EQX+0.3Q) Max	Diaph D1 X	0.000585	0.000262	2.236	67	19.6	18	8.6
Story2	Ult 36 (G-EQX+0.3Q) Max	Diaph D1 Y	0.000219	5.4E-05	4.026	98	6.8	15.3	8.6
Story2	Ult 36 (G-EQX+0.3Q) Min	Diaph D1 X	0.00094	0.000455	2.067	358	7.2	29.4	8.6
Story2	Ult 36 (G-EQX+0.3Q) Min	Diaph D1 Y	0.000532	0.000224	2.369	61	0	18	8.6
Story2	Ult 37 (G+EQY+0.3Q) Max	Diaph D1 X	0.000185	7.4E-05	2.495	9	11.2	12.8	8.6

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story2	Ult 37 (G+EQY+0.3Q) Max	Diaph D1 Y	0.000481	0.000259	1.86	83	19.6	21.8	8.6
Story2	Ult 37 (G+EQY+0.3Q) Min	Diaph D1 X	0.000246	4.1E-05	5.991	358	7.2	29.4	8.6
Story2	Ult 37 (G+EQY+0.3Q) Min	Diaph D1 Y	0.000276	0.000151	1.821	47	12.5	15.3	8.6
Story2	Ult 38 (G-EQY+0.3Q) Max	Diaph D1 X	0.000181	9.3E-05	1.956	9	11.2	12.8	8.6
Story2	Ult 38 (G-EQY+0.3Q) Max	Diaph D1 Y	0.000746	0.00035	2.132	358	7.2	29.4	8.6
Story2	Ult 38 (G-EQY+0.3Q) Min	Diaph D1 Y	0.000901	0.000427	2.107	80	0	21.8	8.6
Story2	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 X	0.000844	0.000456	1.849	359	12.1	29.4	8.6
Story2	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 Y	0.000143	5.2E-05	2.766	81	11.2	12.675	8.6
Story2	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 X	0.000552	0.000308	1.792	78	3.6	18	8.6
Story2	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 Y	0.000382	0.000121	3.156	67	19.6	18	8.6
Story2	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 X	0.000425	0.000232	1.833	359	12.1	29.4	8.6
Story2	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 Y	0.000185	9.6E-05	1.928	83	19.6	21.8	8.6
Story2	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 X	0.000267	0.000151	1.766	61	0	18	8.6
Story2	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 X	0.000297	0.00016	1.861	359	12.1	29.4	8.6
Story2	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 Y	0.000506	0.00027	1.876	83	19.6	21.8	8.6
Story2	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 X	0.000197	4.7E-05	4.187	9	11.2	12.8	8.6
Story2	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 Y	0.000242	0.000129	1.881	359	12.1	29.4	8.6
Story2	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 X	0.000577	0.000256	2.252	67	19.6	18	8.6
Story2	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 Y	0.000368	0.00015	2.449	98	6.8	15.3	8.6
Story2	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 X	0.000968	0.00047	2.057	358	7.2	29.4	8.6
Story2	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 Y	0.000716	0.000326	2.196	61	0	18	8.6
Story2	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 X	0.00029	8.4E-05	3.441	67	19.6	18	8.6
Story2	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 Y	0.000483	0.00021	2.302	98	6.8	15.3	8.6
Story2	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 X	0.000547	0.000226	2.423	359	12.1	29.4	8.6

L532

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story2	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 Y	0.000716	0.000327	2.187	61	0	18	8.6
Story2	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 Y	0.000738	0.000348	2.122	358	7.2	29.4	8.6
Story2	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 X	0.00042	0.000151	2.779	359	12.1	29.4	8.6
Story2	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 Y	0.000974	0.000466	2.09	61	0	18	8.6
Story2	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 X	0.000868	0.000472	1.839	358	7.2	29.4	8.6
Story2	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 Y	0.000359	0.000127	2.826	359	12.1	29.4	8.6
Story2	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 X	0.00056	0.000316	1.774	78	3.6	18	8.6
Story2	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 Y	0.000709	0.000303	2.337	67	19.6	18	8.6
Story2	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 X	0.000466	0.000259	1.804	358	7.2	29.4	8.6
Story2	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 Y	0.000475	0.000197	2.418	358	7.2	29.4	8.6
Story2	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 X	0.00028	0.000164	1.711	61	0	18	8.6
Story2	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 Y	0.00069	0.000305	2.264	67	19.6	18	8.6
Story2	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 X	0.000382	0.000214	1.785	358	7.2	29.4	8.6
Story2	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 Y	0.000733	0.000342	2.147	358	7.2	29.4	8.6
Story2	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 X	0.000194	9E-05	2.158	9	11.2	12.8	8.6
Story2	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 Y	0.000967	0.000459	2.109	67	19.6	18	8.6
Story2	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 X	0.000589	0.000262	2.25	67	19.6	18	8.6
Story2	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 Y	0.000313	0.00013	2.409	83	19.6	21.8	8.6
Story2	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 X	0.000995	0.000484	2.058	358	7.2	29.4	8.6
Story2	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 Y	0.000416	0.000157	2.645	61	0	18	8.6
Story2	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 X	0.000311	9.4E-05	3.316	67	19.6	18	8.6
Story2	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 Y	0.000296	0.000162	1.824	83	19.6	21.8	8.6
Story2	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 X	0.000593	0.000248	2.392	358	7.2	29.4	8.6
Story2	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 Y	0.000225	5.1E-05	4.449	65	0	28	8.6

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story2	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 Y	0.000573	0.000307	1.869	83	19.6	21.8	8.6
Story2	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 X	0.000509	0.000194	2.625	358	7.2	29.4	8.6
Story2	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 Y	0.000271	0.00014	1.943	47	12.5	15.3	8.6
Story2	ENVELOPE Max	Diaph D1 X	0.000868	0.000472	1.839	358	7.2	29.4	8.6
Story2	ENVELOPE Max	Diaph D1 Y	0.000573	0.000307	1.866	83	19.6	21.8	8.6
Story2	ENVELOPE Min	Diaph D1 X	0.000995	0.000484	2.056	358	7.2	29.4	8.6
Story2	ENVELOPE Min	Diaph D1 Y	0.000974	0.000466	2.09	61	0	18	8.6
Story2	DStlD1	Diaph D1 X	0.000159	5.1E-05	3.089	9	11.2	12.8	8.6
Story2	DStlD1	Diaph D1 Y	0.000274	8.9E-05	3.069	65	0	28	8.6
Story2	DStlD2	Diaph D1 X	0.000205	6.2E-05	3.297	9	11.2	12.8	8.6
Story2	DStlD2	Diaph D1 Y	0.000348	0.000114	3.064	65	0	28	8.6
Story2	DCmpD1	Diaph D1 X	0.000159	5.1E-05	3.089	9	11.2	12.8	8.6
Story2	DCmpD1	Diaph D1 Y	0.000274	8.9E-05	3.069	65	0	28	8.6
Story2	DCmpD2	Diaph D1 X	0.000205	6.2E-05	3.297	9	11.2	12.8	8.6
Story2	DCmpD2	Diaph D1 Y	0.000348	0.000114	3.064	65	0	28	8.6
Story2	DCmpS1	Diaph D1 X	0.000214	6.9E-05	3.089	9	11.2	12.8	8.6
Story2	DCmpS1	Diaph D1 Y	0.00037	0.00012	3.069	65	0	28	8.6
Story2	DCmpS2	Diaph D1 X	0.000284	8.6E-05	3.316	9	11.2	12.8	8.6
Story2	DCmpS2	Diaph D1 Y	0.000482	0.000157	3.064	65	0	28	8.6
Story2	DCmpC1	Diaph D1 X	0.000196	5.3E-05	3.721	9	11.2	12.8	8.6
Story2	DCmpC1	Diaph D1 Y	0.000299	8.9E-05	3.366	65	0	28	8.6
Story1	Dead	Diaph D1 X	1.4E-05	6E-06	2.557	209	19.525	3	5.4
Story1	Live	Diaph D1 X	5E-06	2E-06	2.534	209	19.525	3	5.4
Story1	Live	Diaph D1 Y	4E-06	1E-06	3.45	109	19	28	5.4
Story1	SDead	Diaph D1 X	2E-06	1E-06	2.629	209	19.525	3	5.4
Story1	SDead	Diaph D1 Y	2E-06	1E-06	3.3	109	19	28	5.4
Story1	Wind x	Diaph D1 X	4.3E-05	2.7E-05	1.594	107	0.8	28	5.4
Story1	Wind y	Diaph D1 X	1E-05	3E-06	3.564	109	19	28	5.4
Story1	Wind y	Diaph D1 Y	1.9E-05	1.1E-05	1.673	109	19	28	5.4

1555

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story1	EQ X 1	Diaph D1 X	0.000163	9.6E-05	1.69	109	19	28	5.4
Story1	EQ X 1	Diaph D1 Y	7.3E-05	1.2E-05	6.17	109	19	28	5.4
Story1	EQ X 2	Diaph D1 X	0.00021	0.000114	1.833	109	19	28	5.4
Story1	EQ X 2	Diaph D1 Y	0.000105	1.6E-05	6.424	109	19	28	5.4
Story1	EQ X 3	Diaph D1 X	0.000116	7.7E-05	1.512	107	0.8	28	5.4
Story1	EQ Y 1	Diaph D1 X	3.4E-05	8E-06	4.159	109	19	28	5.4
Story1	EQ Y 1	Diaph D1 Y	7.2E-05	4.4E-05	1.631	109	19	28	5.4
Story1	EQ Y 2	Diaph D1 X	6.6E-05	2.1E-05	3.22	109	19	28	5.4
Story1	EQ Y 2	Diaph D1 Y	9.4E-05	5.3E-05	1.772	109	19	28	5.4
Story1	EQ Y 3	Diaph D1 Y	5.5E-05	3.8E-05	1.455	107	0.8	28	5.4
Story1	Serv 01 (G)	Diaph D1 X	1.7E-05	7E-06	2.551	209	19.525	3	5.4
Story1	Serv 01 (G)	Diaph D1 Y	9E-06	1E-06	12.723	113	19	20.6	5.4
Story1	Serv 02 (G+0.7Q)	Diaph D1 X	2E-05	8E-06	2.549	209	19.525	3	5.4
Story1	Serv 02 (G+0.7Q)	Diaph D1 Y	1.2E-05	1E-06	7.884	113	19	20.6	5.4
Story1	Serv 03 (G+Wx)	Diaph D1 X	3.9E-05	2.2E-05	1.799	107	0.8	28	5.4
Story1	Serv 04 (G-Wx)	Diaph D1 X	2E-05	6E-06	3.425	109	19	28	5.4
Story1	Serv 05 (G+Wy)	Diaph D1 X	1.8E-05	8E-06	2.422	209	19.525	3	5.4
Story1	Serv 05 (G+Wy)	Diaph D1 Y	1.1E-05	5E-06	2.058	107	0.8	28	5.4
Story1	Serv 06 (G-Wy)	Diaph D1 X	1.7E-05	6E-06	2.659	108	6.8	28	5.4
Story1	Serv 06 (G-Wy)	Diaph D1 Y	2.1E-05	8E-06	2.588	109	19	28	5.4
Story1	Serv 07 (G+0.7Wx+0.3Wy)	Diaph D1 X	2.9E-05	1.5E-05	1.862	107	0.8	28	5.4
Story1	Serv 08 (G+0.5Wx+0.5Wy)	Diaph D1 X	2.2E-05	1.1E-05	1.942	209	19.525	3	5.4
Story1	Serv 08 (G+0.5Wx+0.5Wy)	Diaph D1 Y	1.3E-05	3E-06	4.594	107	0.8	28	5.4
Story1	Serv 09 (G+0.3Wx+0.7Wy)	Diaph D1 X	2E-05	1E-05	2.094	209	19.525	3	5.4
Story1	Serv 09 (G+0.3Wx+0.7Wy)	Diaph D1 Y	1.2E-05	5E-06	2.694	107	0.8	28	5.4
Story1	Serv 10 (G-0.7Wx-0.3Wy)	Diaph D1 X	1E-05	1E-06	20.581	209	19.525	3	5.4
Story1	Serv 10 (G-0.7Wx-0.3Wy)	Diaph D1 Y	8E-06	2E-06	4.437	293	7.7	9.25	5.4
Story1	Serv 11 (G-0.5Wx-0.5Wy)	Diaph D1 X	1.2E-05	2E-06	6.103	209	19.525	3	5.4
Story1	Serv 11 (G-0.5Wx-0.5Wy)	Diaph D1 Y	1.1E-05	3E-06	3.383	112	15.4	20.6	5.4
Story1	Serv 12 (G-0.3Wx-0.7Wy)	Diaph D1 X	1.3E-05	4E-06	3.817	209	19.525	3	5.4
Story1	Serv 12 (G-0.3Wx-0.7Wy)	Diaph D1 Y	1.5E-05	5E-06	2.894	109	19	28	5.4
Story1	Serv 13 (G+0.7Wx-0.3Wy)	Diaph D1 X	3.2E-05	1.7E-05	1.893	107	0.8	28	5.4
Story1	Serv 13 (G+0.7Wx-0.3Wy)	Diaph D1 Y	1.9E-05	4E-06	4.802	113	19	20.6	5.4
Story1	Serv 14 (G+0.5Wx-0.5Wy)	Diaph D1 X	2.8E-05	1.4E-05	1.988	107	0.8	28	5.4
Story1	Serv 14 (G+0.5Wx-0.5Wy)	Diaph D1 Y	2E-05	6E-06	3.383	113	19	20.6	5.4
Story1	Serv 15 (G+0.3Wx-0.7Wy)	Diaph D1 X	2.3E-05	1.1E-05	2.148	107	0.8	28	5.4
Story1	Serv 15 (G+0.3Wx-0.7Wy)	Diaph D1 Y	2.1E-05	7E-06	2.981	113	19	20.6	5.4
Story1	Serv 16 (G-0.7Wx+0.3Wy)	Diaph D1 X	1.3E-05	1E-06	12.738	109	19	28	5.4
Story1	Serv 16 (G-0.7Wx+0.3Wy)	Diaph D1 Y	7E-06	1E-06	5.226	76	19.6	9.4	5.4
Story1	Serv 17 (G-0.5Wx+0.5Wy)	Diaph D1 X	1.3E-05	2E-06	6.611	209	19.525	3	5.4
Story1	Serv 17 (G-0.5Wx+0.5Wy)	Diaph D1 Y	8E-06	2E-06	3.254	76	19.6	9.4	5.4
Story1	Serv 18 (G-0.3Wx+0.7Wy)	Diaph D1 X	1.5E-05	5E-06	3.2	209	19.525	3	5.4
Story1	Serv 18 (G-0.3Wx+0.7Wy)	Diaph D1 Y	8E-06	3E-06	2.581	76	19.6	9.4	5.4
Story1	Ult 01 (1.35G)	Diaph D1 X	2.3E-05	9E-06	2.551	209	19.525	3	5.4

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story1	Ult 01 (1.35G)	Diaph D1 Y	1.2E-05	1E-06	12.723	113	19	20.6	5.4
Story1	Ult 02 (1.2G+1.5Q)	Diaph D1 X	2.7E-05	1.1E-05	2.547	209	19.525	3	5.4
Story1	Ult 02 (1.2G+1.5Q)	Diaph D1 Y	1.6E-05	2E-06	6.599	113	19	20.6	5.4
Story1	Ult 03 (1.2G+Wx+0.4Q)	Diaph D1 X	5.7E-05	3.2E-05	1.775	107	0.8	28	5.4
Story1	Ult 04 (1.2G-Wx+0.4Q)	Diaph D1 X	3.1E-05	1.1E-05	2.856	109	19	28	5.4
Story1	Ult 05 (1.2G+Wy+0.4Q)	Diaph D1 X	2.4E-05	1E-05	2.405	209	19.525	3	5.4
Story1	Ult 05 (1.2G+Wy+0.4Q)	Diaph D1 Y	1.5E-05	8E-06	1.947	107	0.8	28	5.4
Story1	Ult 06 (1.2G-Wy+0.4Q)	Diaph D1 X	2.3E-05	9E-06	2.619	108	6.8	28	5.4
Story1	Ult 06 (1.2G-Wy+0.4Q)	Diaph D1 Y	3.1E-05	1.3E-05	2.453	109	19	28	5.4
Story1	Ult 07 (0.9G+Wx)	Diaph D1 X	5.2E-05	3E-05	1.715	107	0.8	28	5.4
Story1	Ult 08 (0.9G-Wx)	Diaph D1 X	3.5E-05	1.6E-05	2.139	109	19	28	5.4
Story1	Ult 08 (0.9G-Wx)	Diaph D1 Y	1.1E-05	2E-06	6.472	107	0.8	28	5.4
Story1	Ult 09 (0.9G+Wy)	Diaph D1 X	1.7E-05	7E-06	2.472	209	19.525	3	5.4
Story1	Ult 09 (0.9G+Wy)	Diaph D1 Y	1.4E-05	9E-06	1.649	76	19.6	9.4	5.4
Story1	Ult 10 (0.9G-Wy)	Diaph D1 X	1.9E-05	7E-06	2.54	108	6.8	28	5.4
Story1	Ult 10 (0.9G-Wy)	Diaph D1 Y	2.7E-05	1.2E-05	2.234	109	19	28	5.4
Story1	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph D1 X	3.6E-05	2.1E-05	1.746	107	0.8	28	5.4
Story1	Ult 11 (0.9G+0.7Wx+0.3Wy)	Diaph D1 Y	1.8E-05	3E-06	6.544	107	0.8	28	5.4
Story1	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph D1 X	2.6E-05	1.5E-05	1.789	107	0.8	28	5.4
Story1	Ult 12 (0.9G+0.5Wx+0.5Wy)	Diaph D1 Y	1.7E-05	5E-06	3.148	107	0.8	28	5.4
Story1	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph D1 X	2E-05	1.1E-05	1.924	209	19.525	3	5.4
Story1	Ult 13 (0.9G+0.3Wx+0.7Wy)	Diaph D1 Y	1.5E-05	8E-06	1.946	107	0.8	28	5.4
Story1	Ult 14 (0.9G-0.7Wx-0.3Wy)	Diaph D1 X	1.9E-05	7E-06	2.839	109	19	28	5.4
Story1	Ult 14 (0.9G-0.7Wx-0.3Wy)	Diaph D1 Y	8E-06	3E-06	2.527	107	0.8	28	5.4
Story1	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph D1 X	1E-05	1E-06	10.415	296	6.5	9.4	5.4
Story1	Ult 15 (0.9G-0.5Wx-0.5Wy)	Diaph D1 Y	1.1E-05	4E-06	2.462	112	15.4	20.6	5.4
Story1	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph D1 X	1E-05	1E-06	7.667	209	19.525	3	5.4
Story1	Ult 16 (0.9G-0.3Wx-0.7Wy)	Diaph D1 Y	1.7E-05	7E-06	2.326	109	19	28	5.4
Story1	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph D1 X	4.2E-05	2.4E-05	1.793	107	0.8	28	5.4
Story1	Ult 17 (0.9G+0.7Wx-0.3Wy)	Diaph D1 Y	2.4E-05	5E-06	4.705	113	19	20.6	5.4
Story1	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph D1 X	3.6E-05	1.9E-05	1.877	107	0.8	28	5.4
Story1	Ult 18 (0.9G+0.5Wx-0.5Wy)	Diaph D1 Y	2.5E-05	8E-06	3.155	113	19	20.6	5.4
Story1	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph D1 X	2.9E-05	1.4E-05	2.015	107	0.8	28	5.4
Story1	Ult 19 (0.9G+0.3Wx-0.7Wy)	Diaph D1 Y	2.5E-05	1E-05	2.57	109	19	28	5.4
Story1	Ult 20 (0.9G-0.7Wx+0.3Wy)	Diaph D1 X	2.5E-05	9E-06	2.734	109	19	28	5.4
Story1	Ult 20 (0.9G-0.7Wx+0.3Wy)	Diaph D1 Y	1E-05	3E-06	3.349	76	19.6	9.4	5.4
Story1	Ult 21 (0.9G-0.5Wx+0.5Wy)	Diaph D1 X	1.9E-05	4E-06	4.192	109	19	28	5.4
Story1	Ult 21 (0.9G-0.5Wx+0.5Wy)	Diaph D1 Y	1.1E-05	5E-06	2.185	76	19.6	9.4	5.4
Story1	Ult 22 (0.9G-0.3Wx+0.7Wy)	Diaph D1 Y	1.2E-05	6E-06	1.897	76	19.6	9.4	5.4
Story1	Ult 23 (1.2G+0.7Wx+0.3Wy+0.4Q)	Diaph D1 X	4.1E-05	2.2E-05	1.83	107	0.8	28	5.4
Story1	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph D1 X	3E-05	1.6E-05	1.902	107	0.8	28	5.4
Story1	Ult 24 (1.2G+0.5Wx+0.5Wy+0.4Q)	Diaph D1 Y	1.9E-05	4E-06	4.446	107	0.8	28	5.4
Story1	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph D1 X	2.7E-05	1.3E-05	2.052	209	19.525	3	5.4
Story1	Ult 25 (1.2G+0.3Wx+0.7Wy+0.4Q)	Diaph D1 Y	1.7E-05	7E-06	2.548	107	0.8	28	5.4
Story1	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph D1 X	1.5E-05	1E-06	12.511	109	19	28	5.4
Story1	Ult 26 (1.2G-0.7Wx-0.3Wy+0.4Q)	Diaph D1 Y	1.1E-05	3E-06	3.577	293	7.7	9.25	5.4
Story1	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph D1 X	1.5E-05	2E-06	8.128	209	19.525	3	5.4

L534

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story1	Ult 27 (1.2G-0.5Wx-0.5Wy+0.4Q)	Diaph D1 Y	1.5E-05	5E-06	3.019	112	15.4	20.6	5.4
Story1	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph D1 X	1.7E-05	4E-06	4.197	209	19.525	3	5.4
Story1	Ult 28 (1.2G-0.3Wx-0.7Wy+0.4Q)	Diaph D1 Y	2.1E-05	8E-06	2.669	109	19	28	5.4
Story1	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph D1 X	4.7E-05	2.5E-05	1.865	107	0.8	28	5.4
Story1	Ult 29 (1.2G+0.7Wx-0.3Wy+0.4Q)	Diaph D1 Y	2.8E-05	6E-06	4.56	113	19	20.6	5.4
Story1	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph D1 X	4E-05	2E-05	1.959	107	0.8	28	5.4
Story1	Ult 30 (1.2G+0.5Wx-0.5Wy+0.4Q)	Diaph D1 Y	2.9E-05	9E-06	3.244	113	19	20.6	5.4
Story1	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph D1 X	3.3E-05	1.6E-05	2.108	107	0.8	28	5.4
Story1	Ult 31 (1.2G+0.3Wx-0.7Wy+0.4Q)	Diaph D1 Y	3E-05	1.1E-05	2.812	109	19	28	5.4
Story1	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Diaph D1 X	2.1E-05	4E-06	5.697	109	19	28	5.4
Story1	Ult 32 (1.2G-0.7Wx+0.3Wy+0.4Q)	Diaph D1 Y	9E-06	2E-06	4.491	76	19.6	9.4	5.4
Story1	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph D1 X	1.7E-05	1E-06	16.293	209	19.525	3	5.4
Story1	Ult 33 (1.2G-0.5Wx+0.5Wy+0.4Q)	Diaph D1 Y	1.1E-05	4E-06	3.005	76	19.6	9.4	5.4
Story1	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph D1 X	2E-05	6E-06	3.415	209	19.525	3	5.4
Story1	Ult 34 (1.2G-0.3Wx+0.7Wy+0.4Q)	Diaph D1 Y	1.2E-05	5E-06	2.394	76	19.6	9.4	5.4
Story1	Ult 35 (G+EQX+0.3Q) Max	Diaph D1 X	0.000221	0.000128	1.726	107	0.8	28	5.4
Story1	Ult 35 (G+EQX+0.3Q) Max	Diaph D1 Y	7.8E-05	1.4E-05	5.614	107	0.8	28	5.4
Story1	Ult 35 (G+EQX+0.3Q) Min	Diaph D1 X	0.000127	7.6E-05	1.67	107	0.8	28	5.4
Story1	Ult 35 (G+EQX+0.3Q) Min	Diaph D1 Y	0.000115	4.2E-05	2.761	109	19	28	5.4
Story1	Ult 36 (G-EQX+0.3Q) Max	Diaph D1 X	0.000106	5.6E-05	1.885	109	19	28	5.4
Story1	Ult 36 (G-EQX+0.3Q) Max	Diaph D1 Y	9.5E-05	3.7E-05	2.537	109	19	28	5.4
Story1	Ult 36 (G-EQX+0.3Q) Min	Diaph D1 X	0.0002	0.000114	1.757	109	19	28	5.4
Story1	Ult 36 (G-EQX+0.3Q) Min	Diaph D1 Y	6.7E-05	1.8E-05	3.676	107	0.8	28	5.4
Story1	Ult 37 (G+EQY+0.3Q) Max	Diaph D1 X	3.6E-05	1.4E-05	2.626	378	15.1167	1	5.4
Story1	Ult 37 (G+EQY+0.3Q) Max	Diaph D1 Y	8.4E-05	5.5E-05	1.528	109	19	28	5.4
Story1	Ult 37 (G+EQY+0.3Q) Min	Diaph D1 X	5.7E-05	1.7E-05	3.334	109	19	28	5.4
Story1	Ult 37 (G+EQY+0.3Q) Min	Diaph D1 Y	4.4E-05	3.1E-05	1.424	76	19.6	9.4	5.4
Story1	Ult 38 (G-EQY+0.3Q) Max	Diaph D1 X	7.6E-05	3.6E-05	2.134	109	19	28	5.4
Story1	Ult 38 (G-EQY+0.3Q) Max	Diaph D1 Y	6E-05	3.3E-05	1.834	109	19	28	5.4
Story1	Ult 38 (G-EQY+0.3Q) Min	Diaph D1 Y	0.000104	5.9E-05	1.757	109	19	28	5.4
Story1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 X	0.000221	0.000128	1.724	107	0.8	28	5.4
Story1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 Y	9.5E-05	3.6E-05	2.612	107	0.8	28	5.4
Story1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 X	0.000108	6.8E-05	1.587	107	0.8	28	5.4
Story1	Ult 39 (G+1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 Y	0.0001	3.1E-05	3.256	109	19	28	5.4
Story1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 X	0.000117	6.7E-05	1.747	107	0.8	28	5.4
Story1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 Y	6.9E-05	3.8E-05	1.828	107	0.8	28	5.4

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 X	3.8E-05	2.6E-05	1.466	107	0.8	28	5.4
Story1	Ult 40 (G+0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 Y	3.8E-05	4E-06	10.133	113	19	20.6	5.4
Story1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 X	7.6E-05	4.1E-05	1.861	107	0.8	28	5.4
Story1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 Y	8.2E-05	5.4E-05	1.536	107	0.8	28	5.4
Story1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 X	3.2E-05	5E-06	6.465	183	18.4	3	5.4
Story1	Ult 41 (G+0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 Y	4.2E-05	2.5E-05	1.693	108	6.8	28	5.4
Story1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 X	8.6E-05	4.7E-05	1.822	109	19	28	5.4
Story1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 Y	8E-05	2.7E-05	3.017	109	19	28	5.4
Story1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 X	0.000199	0.000116	1.715	109	19	28	5.4
Story1	Ult 42 (G-1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 Y	8.3E-05	4E-05	2.051	107	0.8	28	5.4
Story1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 X	2.4E-05	1.1E-05	2.111	153	4.5	10.535	5.4
Story1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 Y	2.5E-05	4E-06	6.611	108	6.8	28	5.4
Story1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 X	9.4E-05	5.4E-05	1.759	107	0.8	28	5.4
Story1	Ult 43 (G-0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 Y	5.8E-05	3.5E-05	1.64	107	0.8	28	5.4
Story1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 X	4.1E-05	1.3E-05	3.3	109	19	28	5.4
Story1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 Y	4.6E-05	2.7E-05	1.719	108	6.8	28	5.4
Story1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 X	5.3E-05	3.1E-05	1.714	107	0.8	28	5.4
Story1	Ult 44 (G-0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 Y	9.2E-05	5.6E-05	1.646	109	19	28	5.4
Story1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Max	Diaph D1 X	0.000239	0.000137	1.744	107	0.8	28	5.4
Story1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 X	0.000127	7.2E-05	1.757	107	0.8	28	5.4
Story1	Ult 45 (G+1.0EQX-0.3EQY+0.3Q) Min	Diaph D1 Y	0.000143	6.4E-05	2.239	109	19	28	5.4
Story1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 X	0.000148	8.2E-05	1.809	109	19	28	5.4
Story1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Max	Diaph D1 Y	5.5E-05	1.2E-05	4.477	109	19	28	5.4
Story1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 X	6.9E-05	3.6E-05	1.918	108	6.8	28	5.4

5935

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story1	Ult 46 (G+0.5EQX-0.5EQY+0.3Q) Min	Diaph D1 Y	0.00011	5.5E-05	2.005	109	19	28	5.4
Story1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 X	0.000139	7.3E-05	1.901	109	19	28	5.4
Story1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Max	Diaph D1 Y	7.2E-05	3.3E-05	2.153	109	19	28	5.4
Story1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 X	4.7E-05	1.7E-05	2.807	109	19	28	5.4
Story1	Ult 47 (G+0.3EQX-1.0EQY+0.3Q) Min	Diaph D1 Y	0.000136	7.4E-05	1.833	109	19	28	5.4
Story1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 X	0.000107	5.3E-05	1.999	109	19	28	5.4
Story1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Max	Diaph D1 Y	0.000123	6E-05	2.064	109	19	28	5.4
Story1	Ult 48 (G-1.0EQX+0.3EQY+0.3Q) Min	Diaph D1 X	0.00022	0.000123	1.79	109	19	28	5.4
Story1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 X	4.9E-05	1.7E-05	2.866	109	19	28	5.4
Story1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Max	Diaph D1 Y	9E-05	5.2E-05	1.731	109	19	28	5.4
Story1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 X	0.000128	6.6E-05	1.957	109	19	28	5.4
Story1	Ult 49 (G-0.5EQX+0.5EQY+0.3Q) Min	Diaph D1 Y	3.5E-05	8E-06	4.364	109	19	28	5.4
Story1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Max	Diaph D1 Y	0.000116	7E-05	1.645	109	19	28	5.4
Story1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 X	0.00012	5.5E-05	2.16	109	19	28	5.4
Story1	Ult 50 (G-0.3EQX+1.0EQY+0.3Q) Min	Diaph D1 Y	5.2E-05	2.9E-05	1.783	109	19	28	5.4
Story1	ENVELOPE Max	Diaph D1 X	0.000239	0.000137	1.742	107	0.8	28	5.4
Story1	ENVELOPE Max	Diaph D1 Y	0.000123	7.7E-05	1.605	109	19	28	5.4
Story1	ENVELOPE Min	Diaph D1 X	0.00022	0.000126	1.739	109	19	28	5.4
Story1	ENVELOPE Min	Diaph D1 Y	0.000143	8.2E-05	1.757	109	19	28	5.4
Story1	DStlD1	Diaph D1 X	1.7E-05	7E-06	2.551	209	19.525	3	5.4
Story1	DStlD1	Diaph D1 Y	9E-06	1E-06	12.723	113	19	20.6	5.4
Story1	DStlD2	Diaph D1 X	2.2E-05	9E-06	2.548	209	19.525	3	5.4
Story1	DStlD2	Diaph D1 Y	1.3E-05	2E-06	7.076	113	19	20.6	5.4
Story1	DCmpD1	Diaph D1 X	1.7E-05	7E-06	2.551	209	19.525	3	5.4
Story1	DCmpD1	Diaph D1 Y	9E-06	1E-06	12.723	113	19	20.6	5.4
Story1	DCmpD2	Diaph D1 X	2.2E-05	9E-06	2.548	209	19.525	3	5.4
Story1	DCmpD2	Diaph D1 Y	1.3E-05	2E-06	7.076	113	19	20.6	5.4
Story1	DCmpS1	Diaph D1 X	2.3E-05	9E-06	2.551	209	19.525	3	5.4
Story1	DCmpS1	Diaph D1 Y	1.2E-05	1E-06	12.723	113	19	20.6	5.4
Story1	DCmpS2	Diaph D1 X	3E-05	1.2E-05	2.547	209	19.525	3	5.4

Table 3.4 - Diaphragm Max/Avg Drifts (continued)

Story	Load Case/Combo	Item	Max Drift	Avg Drift	Ratio	Label	Max Loc X m	Max Loc Y m	Max Loc Z m
Story1	DCmpS2	Diaph D1 Y	1.8E-05	3E-06	6.847	113	19	20.6	5.4
Story1	DCmpC1	Diaph D1 X	2.2E-05	9E-06	2.557	209	19.525	3	5.4

3.2 Modal Results

Table 3.5 - Modal Periods and Frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigenvalue rad²/sec²
Modal	1	0.406	2.463	15.4751	239.4783
Modal	2	0.306	3.267	20.5272	421.3667
Modal	3	0.265	3.77	23.6849	560.9761
Modal	4	0.236	4.237	26.6249	708.8865
Modal	5	0.179	5.58	35.0577	1229.0396
Modal	6	0.15	6.658	41.8313	1749.8613
Modal	7	0.147	6.823	42.8718	1837.9948
Modal	8	0.14	7.126	44.7764	2004.9286
Modal	9	0.138	7.241	45.4979	2070.0622
Modal	10	0.131	7.628	47.9256	2296.865
Modal	11	0.115	8.672	54.4871	2968.8465
Modal	12	0.111	9.025	56.707	3215.6871
Modal	13	0.098	10.197	64.0727	4105.3084
Modal	14	0.093	10.809	67.9125	4612.104
Modal	15	0.08	12.552	78.8636	6219.464
Modal	16	0.071	14.182	89.1056	7939.8088
Modal	17	0.064	15.65	98.3299	9668.7657
Modal	18	0.049	20.405	128.2089	16437.5221
Modal	19	0.027	37.181	233.615	54575.9469
Modal	20	0.024	41.669	261.8111	68545.0489

Table 3.6 - Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	0.406	0.1479	0.0157	0	0.1479	0.0157	0
Modal	2	0.306	0.0148	0.2657	0	0.1627	0.2814	0
Modal	3	0.265	0.1698	0.0029	0	0.3325	0.2842	0
Modal	4	0.236	0.0321	3.888E-06	0	0.3646	0.2843	0
Modal	5	0.179	0.0418	0.0414	0	0.4064	0.3256	0
Modal	6	0.15	0	0.0939	0	0.4064	0.4195	0
Modal	7	0.147	0.1443	0.0396	0	0.5507	0.4591	0
Modal	8	0.14	0.1144	0.0211	0	0.6651	0.4802	0
Modal	9	0.138	0.003	0.0013	0	0.6681	0.4815	0
Modal	10	0.131	0.0371	0.0181	0	0.7052	0.4996	0
Modal	11	0.115	0.0275	0.0548	0	0.7326	0.5544	0
Modal	12	0.111	0.016	0.0106	0	0.7486	0.565	0
Modal	13	0.098	0.0101	0.0061	0	0.7587	0.5711	0
Modal	14	0.093	1.168E-05	0.075	0	0.7587	0.6461	0
Modal	15	0.08	0.0321	0.2599	0	0.7908	0.9059	0

1548

Table 3.6 - Modal Participating Mass Ratios (Part 1 of 2, continued)

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	16	0.071	0.1022	0.0062	0	0.893	0.9121	0
Modal	17	0.064	0.0763	0.0204	0	[illegible]	[illegible]	0
Modal	18	0.049	0.0011	0.0182	0	0.9704	0.9507	0
Modal	19	0.027	0.0031	0.0258	0	0.9735	0.9765	0
Modal	20	0.024	0.014	0.0052	0	0.9876	0.9817	0

Table 3.6 - Modal Participating Mass Ratios (Part 2 of 2)

Case	Mode	RX	RY	RZ	Sum RX	Sum RY	Sum RZ
Modal	1	0.0186	0.1239	0.1652	0.0186	0.1239	0.1652
Modal	2	0.228	0.0097	0.0024	0.2465	0.1336	0.1676
Modal	3	0.0003	0.0015	0.1115	0.2468	0.1351	0.2791
Modal	4	0.0001	0.0867	0.1156	0.2469	0.2218	0.3947
Modal	5	0.1321	0.0717	0.0371	0.3791	0.2935	0.4318
Modal	6	0.0175	0.0037	0.0218	0.3966	0.2972	0.4535
Modal	7	0.052	0.0345	0.0003	0.4486	0.3317	0.4538
Modal	8	0.0099	0.0096	0.021	0.4585	0.3413	0.4749
Modal	9	0.0015	0.0977	0.0031	0.46	0.4389	0.478
Modal	10	0.0921	0.0402	0.1831	0.5521	0.4792	0.6611
Modal	11	0.0107	0.0161	0.0496	0.5627	0.4953	0.7107
Modal	12	0.0247	0.0813	0.0187	0.5874	0.5765	0.7294
Modal	13	0.0151	0.0733	0.0002	0.6025	0.6498	0.7296
Modal	14	0.0325	0.0129	0.0061	0.635	0.6627	0.7357
Modal	15	0.0844	0.0066	0.0098	0.7194	0.6693	0.7455
Modal	16	0.0001	0.0631	0.0554	0.7195	0.7324	[illegible]
Modal	17	0.0215	0.0681	0.0698	0.741	0.8006	0.8707
Modal	18	0.0186	0.0156	0.063	0.7596	0.8161	0.9337
Modal	19	0.0032	0.0212	0.0075	0.7628	0.8374	0.9413
Modal	20	0.0028	0.0354	0.0008	0.7655	0.8728	0.9421

L537