

STRUCTURAL CALCULATIONS

Job Number: 19/177-1

Client: TRUE STEEL FRAMES

For: COSCIA

Site Address: No. 4 REDWOOD STREET, ROSTREVOR (DW1)

Design: A.N.

Date: OCT'19

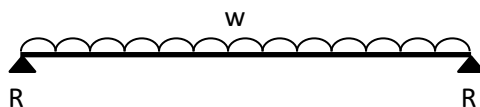
Revision: A (14/10/2019)

Australian Standards applicable to attached calculations

- Dead and live loads and load combinations to **AS 1170.0/1**
- Wind Loads to **AS 1170.2 & AS 4055**
- Steelwork to **AS 4100 & AS 4600**

BEAM B1

L = 4.5 m



Design Loads

			<u>DL (kN/m)</u>		<u>LL (kN/m)</u>
Beam S/Weight			0.10		
Wall (L.Weight)	2.70 m	0.60 kPa	1.62		
Roof (Sheet)	3.60 m	0.40 kPa	1.44	0.25 kPa	0.90
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

Design Load Combinations

	<u>w</u>	<u>R</u>
[S] DL	3.16	7.11
[S] LL	0.90	2.03
[U] 1.2DL+1.5LL	5.14	11.57

TRY: 2 / TSF4510

Le = 0.60 m

Check Bending

M* _{mid} =	13.02 kNm	M _{oa} =	381.92
φM _{sx} =	40.04 kNm :: OK	α _s =	0.97
φM _{bx} =	38.91 kNm :: OK	α _m =	1.00

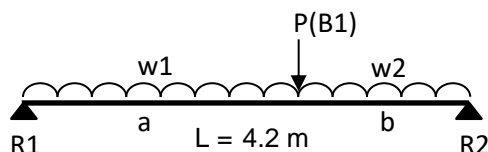
Check Deflection

I _x =	19.40 x 10 ⁶ mm ⁴
Δ _{DL} =	4.35 mm (L / 1035)
Δ _{DL+LL} =	5.59 mm (L / 805)

Adopt: 2 / TSF4510

BEAM B2

a = 2.5 m
b = 1.7 m



Design Loads

UDL - w1			DL (kN/m)		LL (kN/m)
Beam S/Weight			0.10		
Wall (L.Weight)	0.00 m	0.60 kPa	0.00		
Roof (Sheet)	0.00 m	0.40 kPa	0.00	0.25 kPa	0.00
Domestic Floor	2.15 m	1.00 kPa	2.15	1.50 kPa	3.23

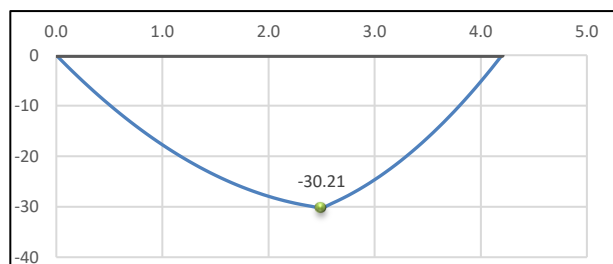
UDL - w2			DL (kN/m)		LL (kN/m)
Wall (L.Weight)	2.70 m	0.60 kPa	1.62		
Roof (Sheet)	0.00 m	0.40 kPa	0.00	0.25 kPa	0.00
Balcony Floor	2.15 m	1.00 kPa	2.15	2.00 kPa	4.30

Design Load Combinations

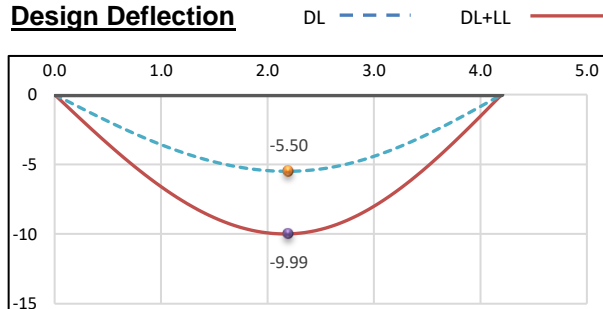
	w1	w2	P	R1	R2
[S] DL	2.25	3.87	6.75	8.0	10.9
[S] LL	3.23	4.30	1.94	7.9	9.4
[U] 1.2DL+1.5LL	7.54	11.09	11.00	21.5	27.2

TRY: 2 / TSF4510 Le = 0.6 m

Design Bending Moment



Design Deflection



Checks

M* =	30.21 kNm	M _{oa} =	381.92
φM _{sx} =	40.04 kNm :: OK	α _s =	0.97
φM _{bx} =	38.91 kNm :: OK	α _m =	1.00

I _x =	19.40 x 10 ⁶ mm ⁴
Δ _{DL} =	5.50 mm (L / 764)
Δ _{DL+LL} =	9.99 mm (L / 420)

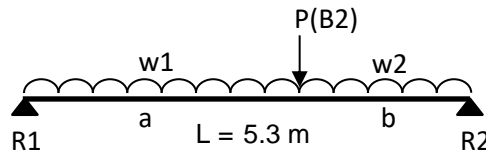
Adopt: 2 / TSF4510

Provide boxed top and bottom chords, I_x = 38 x 10⁶ mm⁴

Alternatively, use 2/C30024 (boxed)

BEAM B3

a = 4.3 m
b = 1.0 m



Design Loads

UDL - w1			DL (kN/m)		LL (kN/m)
Beam S/Weight			0.10		
Wall (L.Weight)	0.00 m	0.60 kPa	0.00		
Roof (Sheet)	0.00 m	0.40 kPa	0.00	0.25 kPa	0.00
Domestic Floor	0.60 m	1.00 kPa	0.60	1.50 kPa	0.90

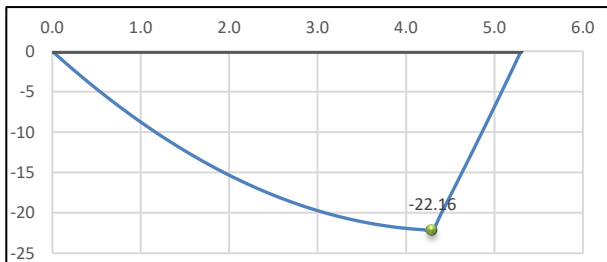
UDL - w2			DL (kN/m)		LL (kN/m)
Wall (L.Weight)	0.00 m	0.60 kPa	0.00		
Roof (Sheet)	0.00 m	0.40 kPa	0.00	0.25 kPa	0.00
Domestic Floor	0.60 m	1.00 kPa	0.60	1.50 kPa	0.90

Design Load Combinations

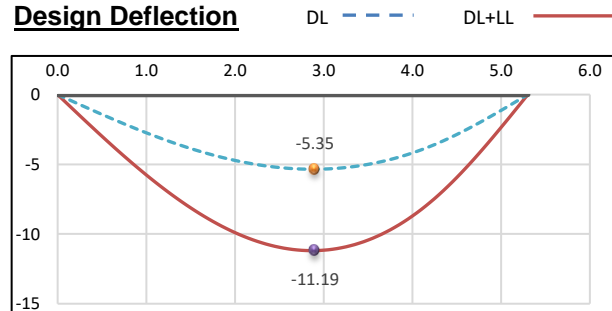
	w1	w2	P	R1	R2
[S] DL	0.70	0.70	8.01	3.4	8.4
[S] LL	0.90	0.90	7.93	3.9	8.8
[U] 1.2DL+1.5LL	2.19	2.19	21.51	9.9	23.3

TRY: 2 / TSF4510 Le = 1.5 m

Design Bending Moment



Design Deflection



Checks

M* =	22.16 kNm	M _{oa} =	103.67
φM _{sx} =	40.04 kNm :: OK	α _s =	0.81
φM _{bx} =	32.56 kNm :: OK	α _m =	1.00
I _x =	19.40 x 10 ⁶ mm ⁴		
Δ _{DL} =	5.35 mm (L / 991)		
Δ _{DL+LL} =	11.19 mm (L / 474)		

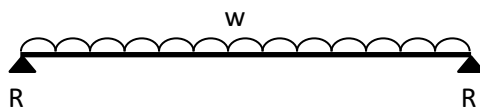
Adopt: 2 / TSF4510

Provide boxed top and bottom chords, I_x = 38 x 10⁶ mm⁴

Alternatively, use 2/C30024 (boxed)

BEAM B4

L = 4.1 m



Design Loads

			<u>DL (kN/m)</u>		<u>LL (kN/m)</u>
Beam S/Weight			0.08		
Wall (L.Weight)	2.70 m	0.60 kPa	1.62		
Roof (Sheet)	4.15 m	0.40 kPa	1.66	0.25 kPa	1.04
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

Design Load Combinations

	<u>W</u>	<u>R</u>
[S] DL	3.36	6.89
[S] LL	1.04	2.13
[U] 1.2DL+1.5LL	5.59	11.46

TRY: 2 / TSF4575

Le = 1.50 m

Check Bending

M* _{mid} =	11.74 kNm	M _{oa} =	61.51
φM _{sx} =	28.27 kNm :: OK	α _s =	0.78
φM _{bx} =	21.97 kNm :: OK	α _m =	1.00

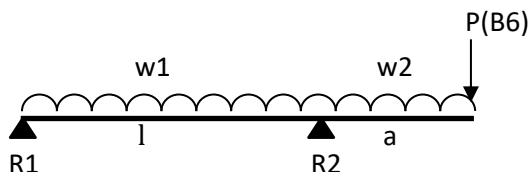
Check Deflection

I _x =	14.00 x 10 ⁶ mm ⁴
Δ _{DL} =	4.41 mm (L / 929)
Δ _{DL+LL} =	5.78 mm (L / 710)

Adopt: 2 / TSF4575

BEAM B5

$l =$ 1.8 m
 $a =$ 0.8 m
 $L =$ 2.6 m



Design Loads

UDL - w1			DL (kN/m)		LL (kN/m)
Beam S/Weight			0.08		
Wall (L.Weight)	2.70 m	0.60 kPa	1.62		
Roof (Sheet)	1.20 m	0.40 kPa	0.48	0.25 kPa	0.30
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

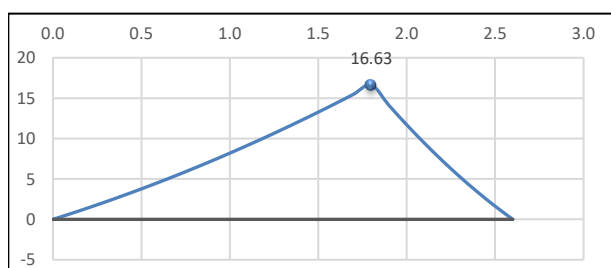
UDL - w2			DL (kN/m)		LL (kN/m)
Wall (L.Weight)	2.70 m	0.60 kPa	1.62		
Roof (Sheet)	1.20 m	0.40 kPa	0.48	0.25 kPa	0.30
Domestic Floor	2.80 m	1.00 kPa	2.80	1.50 kPa	4.20

Design Load Combinations

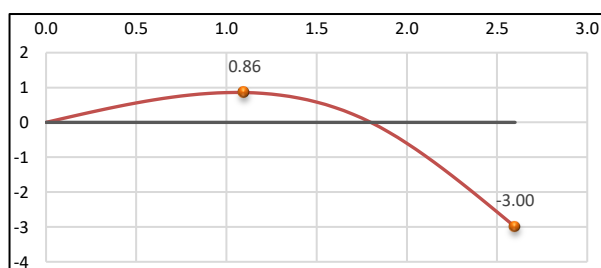
	w1		w2		P	R1	R2
[S]	DL	2.18	DL+LL	9.48	12.40	-5.2	29.1
[U]	1.2DL	2.62	1.2DL+1.5LL	12.73	15.70	-6.9	37.5

TRY: 2 / TSF4575 Le = 0.6 m

Design Bending Moment



Design Deflection



Design Bending Moments & Deflection

$M^* =$ 0.00 kNm
 $-M^* =$ -16.63 kNm
 $\phi M_{sx} =$ 28.27 kNm :: OK
 $\phi M_{bx} =$ 27.39 kNm :: OK

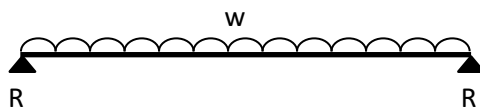
$M_{oa} =$ 258.14
 $\alpha_s =$ 0.97
 $\alpha_m =$ 1.00

$I_x =$ $14.00 \times 10^6 \text{ mm}^4$
 $\Delta_l =$ 0.86 mm (l / 2093)
 $\Delta_a =$ 3 mm (a / 267)

Adopt: 2 / TSF4575

BEAM B6

L = 5.6 m



Design Loads

			<u>DL (kN/m)</u>		<u>LL (kN/m)</u>
Beam S/Weight			0.10		
Wall (L.Weight)	2.70 m	0.60 kPa	1.62		
Roof (Sheet)	4.15 m	0.40 kPa	1.66	0.25 kPa	1.04
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

Design Load Combinations

	<u>w</u>	<u>R</u>
[S] DL	3.38	9.46
[S] LL	1.04	2.91
[U] 1.2DL+1.5LL	5.61	15.71

TRY: 2 / TSF6010

Le = 1.50 m

Check Bending

M* _{mid} =	22.00 kNm	M _{oa} =	112.33
φM _{sx} =	59.38 kNm :: OK	α _s =	0.74
φM _{bx} =	44.23 kNm :: OK	α _m =	1.00

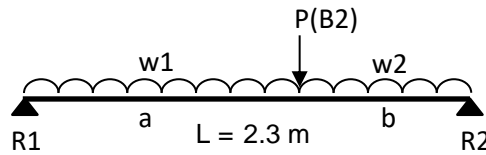
Check Deflection

I _x =	38.54 x 10 ⁶ mm ⁴	
Δ _{DL} =	5.62 mm	(L / 997)
Δ _{DL+LL} =	7.34 mm	(L / 763)

Adopt: 2 / TSF6010

LINTEL L1

a = 1.3 m
b = 1.0 m



Design Loads

UDL - w1			DL (kN/m)		LL (kN/m)
Beam S/Weight			0.10		
Wall (L.Weight)	0.00 m	0.60 kPa	0.00		
Roof (Sheet)	0.00 m	0.40 kPa	0.00	0.25 kPa	0.00
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

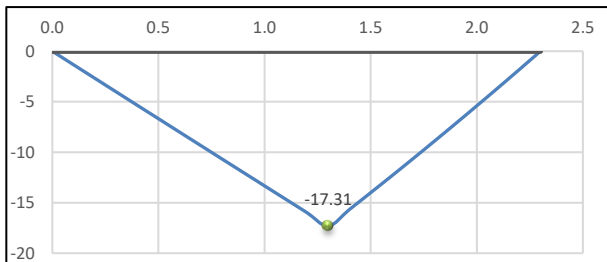
UDL - w2			DL (kN/m)		LL (kN/m)
Wall (L.Weight)	2.70 m	0.60 kPa	1.62		
Roof (Sheet)	0.00 m	0.40 kPa	0.00	0.25 kPa	0.00
Balcony Floor	0.00 m	1.00 kPa	0.00	2.00 kPa	0.00

Design Load Combinations

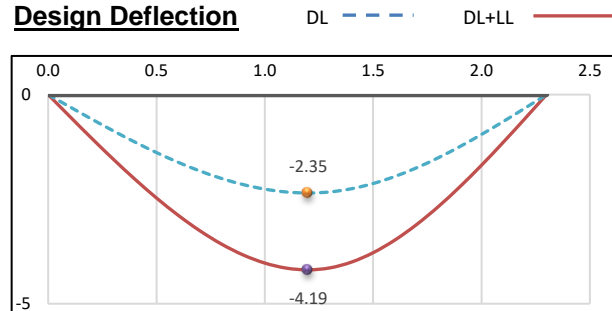
	w1	w2	P	R1	R2
[S] DL	0.10	1.72	11.90	5.6	8.1
[S] LL	0.00	0.00	10.15	4.4	5.7
[U] 1.2DL+1.5LL	0.12	2.06	29.51	13.4	18.3

TRY: 2 / TSF3010 Le = 2.3 m

Design Bending Moment



Design Deflection



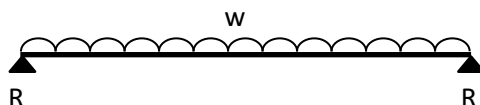
Checks

M* =	17.31 kNm	M _{oa} =	61.19
φM _{sx} =	21.40 kNm :: OK	α _s =	0.83
φM _{bx} =	17.80 kNm :: OK	α _m =	1.00
I _x =	6.85 x 10 ⁶ mm ⁴		
Δ _{DL} =	2.35 mm (L / 979)		
Δ _{DL+LL} =	4.19 mm (L / 549)		

Adopt: 2 / TSF3010 Or 2/C20015 (boxed)

BEAM RB1

L = 4.4 m



Design Loads

			<u>DL (kN/m)</u>		<u>LL (kN/m)</u>
Beam S/Weight			0.10		
Wall (L.Weight)	0.00 m	0.60 kPa	0.00		
Roof (Sheet)	1.40 m	0.40 kPa	0.56	0.25 kPa	0.35
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

Design Load Combinations

	<u>W</u>	<u>R</u>
[S] DL	0.66	1.45
[S] LL	0.35	0.77
[U] 1.2DL+1.5LL	1.32	2.90

TRY: 150x50x3.0 RHS Le = 1.20 m

Check Bending

M* _{mid} =	3.19 kNm	M _{oa} =	294.15
φM _{sx} =	16.20 kNm :: OK	α _s =	1.00
φM _{bx} =	16.20 kNm :: OK	α _m =	1.00

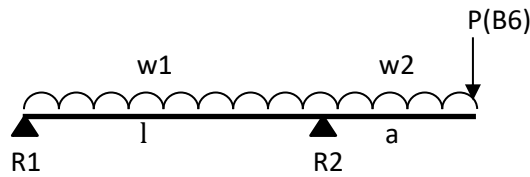
Check Deflection

I _x =	2.99 x 10 ⁶ mm ⁴
Δ _{DL} =	5.39 mm (L / 817)
Δ _{DL+LL} =	8.24 mm (L / 534)

Adopt: 150x50x3.0 RHS Or 2/C15015 (boxed)

BEAM RB2

$l =$ 3.0 m
 $a =$ 1.5 m
 $L =$ 4.5 m



Design Loads

UDL - w1			DL (kN/m)		LL (kN/m)
Beam S/Weight			0.08		
Wall (L.Weight)	0.00 m	0.60 kPa	0.00		
Roof (Sheet)	1.00 m	0.40 kPa	0.40	0.25 kPa	0.25
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

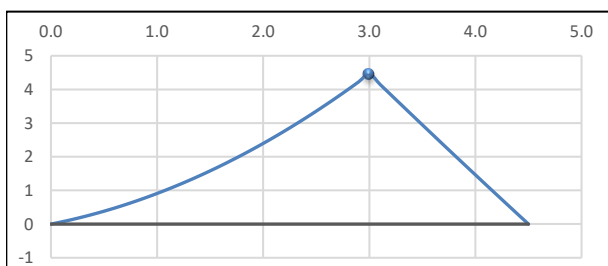
UDL - w2			DL (kN/m)		LL (kN/m)
Wall (L.Weight)	0.00 m	0.60 kPa	0.00		
Roof (Sheet)	0.00 m	0.40 kPa	0.00	0.25 kPa	0.00
Domestic Floor	0.00 m	1.00 kPa	0.00	1.50 kPa	0.00

Design Load Combinations

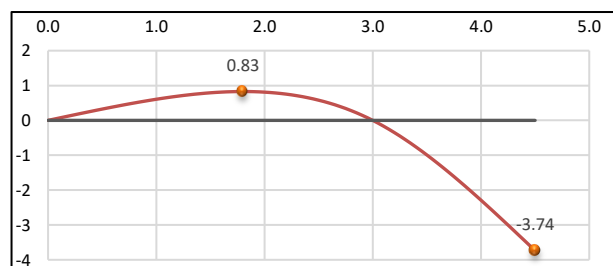
	w1		w2		P	R1	R2
[S]	DL	0.48	DL+LL	0.08	2.50	-0.6	4.6
[U]	1.2DL	0.58	1.2DL+1.5LL	0.10	2.90	-0.6	5.4

TRY: 2 / TSF4075 Le = 1.2 m

Design Bending Moment



Design Deflection



Design Bending Moments & Deflection

$M^* =$ 0.00 kNm
 $-M^* =$ -4.46 kNm
 $\phi M_{sx} =$ 23.80 kNm :: OK
 $\phi M_{bx} =$ 20.46 kNm :: OK

$M_{oa} =$ 79.95
 $\alpha_s =$ 0.86
 $\alpha_m =$ 1.00

$I_x =$ $10.45 \times 10^6 \text{ mm}^4$
 $\Delta l =$ 0.83 mm (l / 3614)
 $\Delta a =$ 3.74 mm (a / 401)

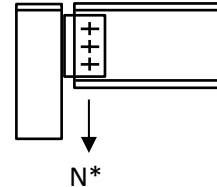
Adopt: 2 / TSF4075 Or 2/C20015 (boxed)

COLUMN C1

Height = 3.0 m

Loads

$N^* = 37.50$ kN (refer to B5)
 $N_e^* = 37.50$ kN
 $M_e^* = 1.69$ kNm (e = 0.045 m)



TRY: 89x89x2.0 SHS

Properties

$\phi N_s = 172.0$ kN (for $l_e = 3.0$ m)
 $\phi N_{cy} = 117.0$ kN
 $\phi M_{sx} = 5.31$ kNm
 $\phi M_{bx} = 5.3$ kNm

Check section capacity

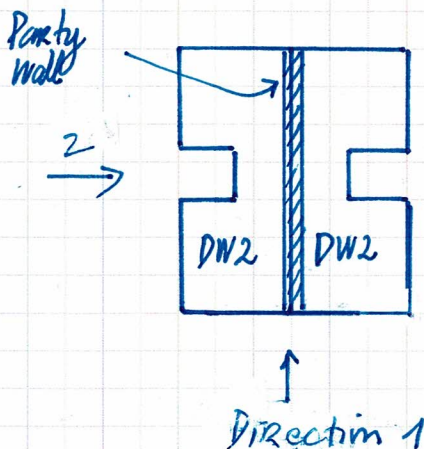
$$\frac{M_e^*}{\phi M_s} + \frac{N^*}{\phi N_s} = 0.54 < 1.0, \text{ therefore OK}$$

Check member capacity

$$\frac{M_e^*}{\phi M_b} + \frac{N^*}{\phi N_c} = 0.64 < 1.0, \text{ therefore OK}$$

Adopt: 89x89x2.0 SHS

Ground Floor Bracing.



1) Bracing for wind load in direction 1
Refer to TSF details.

2) Bracing for wind load in direction 2

As party wall runs full length of both dwellings 1 & 2 (shaftlines in between), two dwellings assumed to act as one for stability under

wind load in direction 2.

Wind speed N1

Roof pitch $18^\circ \Rightarrow p = 0.52 \text{ kPa ult. (AS 4055)}$
(net) (Table S.2-S.13)

Racking force:

contributing area = 100 m^2

$$\Rightarrow F_R = 100 \times 0.52 = 52 \text{ kN ult.}$$

i) Hardie-Brace (5mm thick, 5.4 kN/m)

$1.5 \text{ m}, 1.2 \text{ m}, 0.9 \text{ m} \rightarrow 3.7 \text{ m total}$
 $\rightarrow 3.7 \times 5.4 = 20 \text{ kN ult.}$

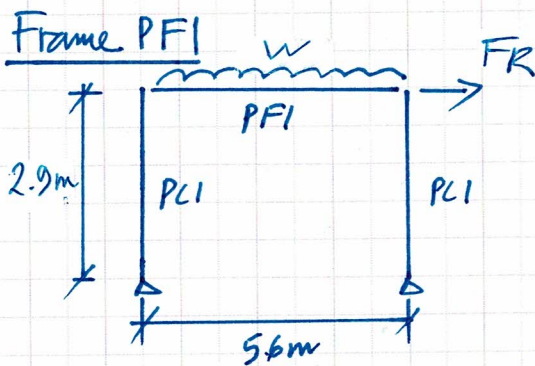
2 dwellings $\Rightarrow \text{Remaining} = 12 \text{ kN ult.}$

ii) Portal frame

Total capacity: 14 kN (Refer to Portal Frame Calculations)

\therefore Bracing achieved 54 kN required

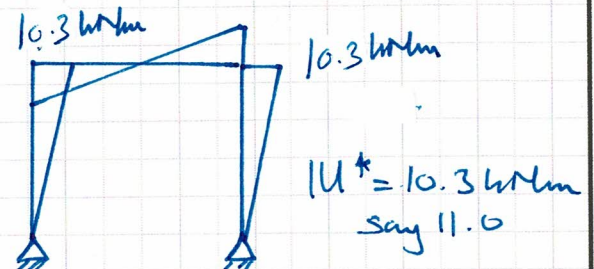
Portal Frames.



$$W_{DL} = 1.5 \times 0.6 + 0.4 = 1.3 \text{ kN/m} \quad (\text{wall})$$

$$W_{DL}^* = 1.6 \text{ kN/m}$$

Also design frame to resist a racking force of $14/2 = 7 \text{ kN}$



i> PC1: check member cap.

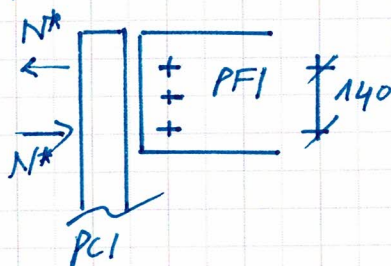
$$\frac{M^*}{\phi M_s} + \frac{N^*}{\phi N_{cy}} = \frac{11.0}{17.9} + \frac{4.5}{95.7} = 0.66 < 1.0$$

(L = 6.0)

using $89 \times 89 \times 6.0 \text{ SHS}$.

ii> PFI: $\phi M_{bx} = 47 \text{ kNm}$ (L = 5.6m) $\therefore \text{Ok.}$
using 250 PFC

iii> Connection



$$N^* = 11/0.14 = 78.5 \text{ kN}$$

$$\Rightarrow \text{use } 3 \text{ M20 } 8.8/\text{S}$$

250 PFC web thickness : 8mm
edge distance to bolt : 40mm

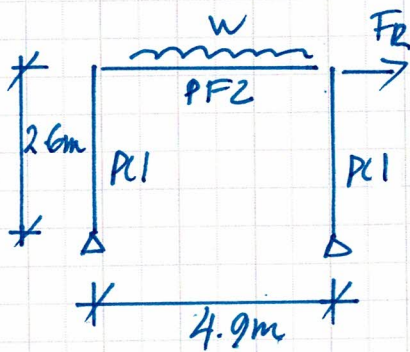
$$\Rightarrow \text{tear out cap of web} = 127 \text{ kN}$$

\therefore Adopt PC1: $89 \times 89 \times 6.0 \text{ SHS}$ 10mm base pl.
2 M16 chemset anchors
125mm embedment.

PFI: 250 PFC, 3M20 8.8/S.
10mm cleat pl.

Portal Frames (cont.)

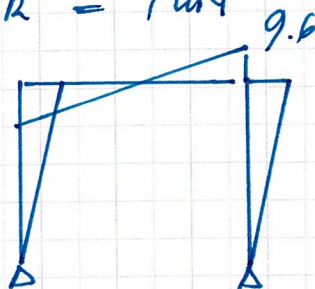
Frame PF2



(wall)
 $W_{DL} = 0.6 \times 2.4 + 0.4 = 1.9 \text{ kN/m}$

$W_{DL}^* = 2.3 \text{ kN/m}$

$FR^* = 7 \text{ kN}$



$M^* = 9.6 \text{ kNm}$

\Rightarrow less critical than
Frame PF1

\therefore Adopt RC1: 89x6.0 SHS, 10mm base plate.
2 M16 chemset anchors
125 mm embedment

PF2: 250 PFC, 10mm cleat, 3 M20 8.8/S
+ 200x10mm bottom plate.
(support brack)