

Tom Chia Design Ltd
7 Roseville Cottages, Summerfield Lane, Frensham, Surrey. GU10 3AN

Site: 10 Aveley Lane
Job: Ground floor rear extension & Alterations to Roof
Job number: WF-106

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SuperBeam 4.56h 440397

WF-106.SBW

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Beam: 'A' Purlin in new roof

Span: 6.4 m.

	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U	T o.w .	0.5	0		L	1.60	1.60
U	T Roof	1.65x1.7	0		L	8.98	8.98
						10.58	10.58

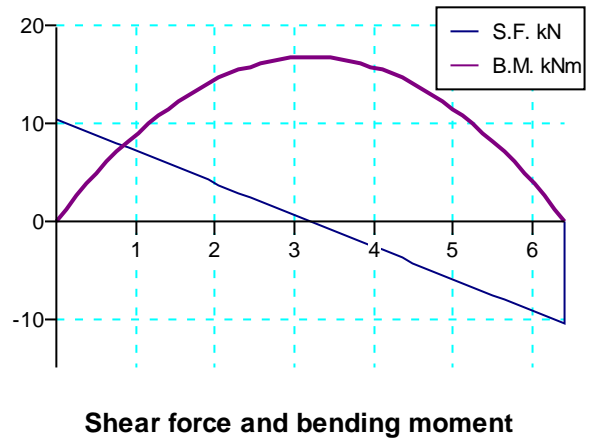
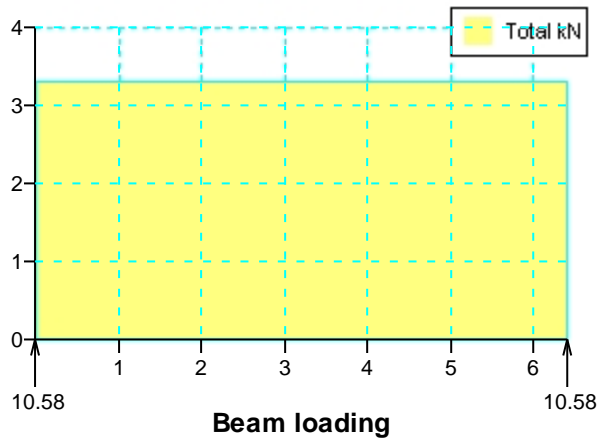
Total load: 21.15 kN

Load types: U:UDL T: Total (positions in m. from R1)

Maximum B.M. = 16.9 kNm at 3.20 m. from R1

Maximum S.F. = 10.6 kN at R1

Total deflection = $72.2 \times 10^8/EI$ at 3.20 m. from R1 (*E in N/mm², I in cm⁴*)



Steel calculation to BS449 Part 2 using S275 (Grade 43) steel
SECTION SIZE: 2No 200 x 75 x 23 PFC Grade 43

D=200.0 mm B=75.0 mm t=6.0 mm T=12.5 mm $I_x=1,960 \text{ cm}^4$ $r_y=2.39 \text{ cm}$ $Z_x=196 \text{ cm}^3$

$L_E/r_y = 6.40 \times 100 / 2.39 = 268$ $D/T = 16.0$

Permissible bending stress, $p_{bc} = 75.8 \text{ N/mm}^2$ (Table 3a)

Actual bending stress, $f_{bc} = 16.92 \times 1000 / 2 \times 196.0 = 43.2 \text{ N/mm}^2$ OK

Maximum shear in w eb, $f_s = 10.58 \times 1000 / (2 \times 6.0 \times 200.0) = 4.4 \text{ N/mm}^2$ OK

Web buckling and crushing have not been checked

Total deflection = $72.2 \times 1e8 / (2 \times 205,000 \times 1,960) = 9.0 \text{ mm}$ (L/712) OK

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2 = 0.324$ at 3.20 m. (≤ 1.25 OK)

Bearing details

200x75x23 PFC stiff bearing length, $b_1 = t + 0.8r + T = 28.1 \text{ mm}$; O/A b_1 taken as 56.2 mm

Factor reactions by 1.55 (user selected value)

Masonry: 100mm 7.3N/mm² solid block (SF>2.0), class (iii) mortar, normal const/normal mfr

Local design strength (factored) = $6.4/3.5 = 1.83 \text{ N/mm}^2$ (BS5628-1:2005 Table 2d/2e)

R1: 150 x 100 mm padstone

Factored reaction = $10.58 \times 1.55 = 16.39 \text{ kN}$

Factored stress under padstone = $1.55 \times 10.58 \times 1000 / 150 \times 100 = 1.09 \text{ N/mm}^2$

R2 as R1

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Beam: 'B' between beams 'C'

Span: 4.8 m.

	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U T	o.w .	0.95	0		L	2.28	2.28
U T	Floor	2.0x1.8	0		L	8.64	8.64
						10.92	10.92

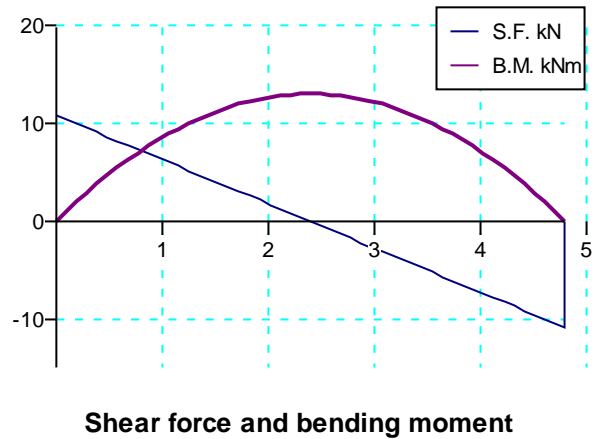
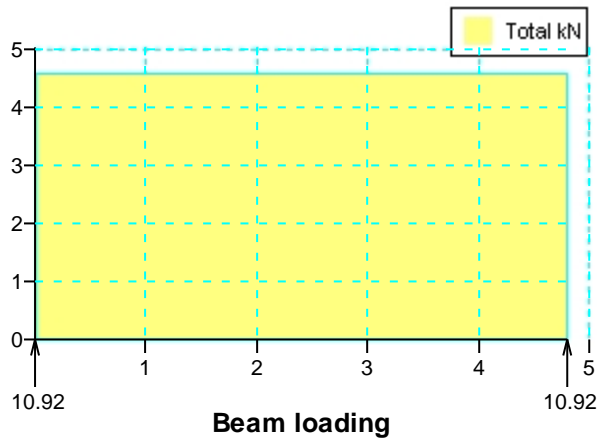
Total load: 21.84 kN

Load types: U:UDL T: Total (positions in m. from R1)

Maximum B.M. = 13.1 kNm at 2.40 m. from R1

Maximum S.F. = 10.9 kN at R1

Total deflection = $31.4 \times 10^{-8}/EI$ at 2.40 m. from R1 (*E in N/mm², I in cm⁴*)



Steel calculation to BS449 Part 2 using S275 (Grade 43) steel

SECTION SIZE: 160 x 80 x 10 HF RHS Grade 43 (33.7kg/m)

$I_x = 1,280 \text{ cm}^4$ $r_y = 3.10 \text{ cm}$ $Z_y = 161 \text{ cm}^3$ $A = 42.9 \text{ cm}^2$

$L_E/r_y = 4.80 \times 100 / 3.10 = 155$ $D/T = 16.0$

Permissible bending stress, $p_{bc} = 180 \text{ N/mm}^2$ (Table 2)

Actual bending stress, $f_{bc} = 13.10 \times 1000 / 161.0 = 81.4 \text{ N/mm}^2$ OK

Shear area = $0.5 \times \text{CSA} = 42.9 \times 100 \times 0.5 = 2,145 \text{ mm}^2$ (clause 23)

Maximum shear, $f_s = 10.92 \times 1000 / 2,145 = 5.1 \text{ N/mm}^2$ OK

Web buckling and crushing have not been checked

Total deflection = $31.4 \times 1e8 / (205,000 \times 1,280) = 12.0 \text{ mm}$ (L/401) OK

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2 = 0.204$ at 2.40 m. (≤ 1.25 OK)

Bearing details

160x80x10 RHS stiff bearing length, b_1 taken as $B - 3t = 50 \text{ mm}$

Factor reactions by 1.55 (user selected value)

Masonry: 100mm 7.3N/mm² solid block (SF>2.0), class (iii) mortar, normal const/normal mfr

Local design strength (factored) = $6.4/3.5 = 1.83 \text{ N/mm}^2$ (BS5628-1:2005 Table 2d/2e)

R1: 100 x 100 mm padstone

Factored reaction = $10.92 \times 1.55 = 16.93 \text{ kN}$

Factored stress under padstone = $1.55 \times 10.92 \times 1000 / 100 \times 100 = 1.69 \text{ N/mm}^2$

R2 as R1

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Beam: 'C' under stud wall

Span: 6.4 m.

	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U T	o.w .	0.65	0		L	2.08	2.08
U T	Roof	1.65x1.7	0		L	8.98	8.98
U T	Stud Wall	0.4x1.8	0		L	2.30	2.30
U T	Ceiling	0.4x1.0	0		L	1.28	1.28
U T	Floor	2.0x0.6	0		L	3.84	3.84
						<u>18.48</u>	<u>18.48</u>

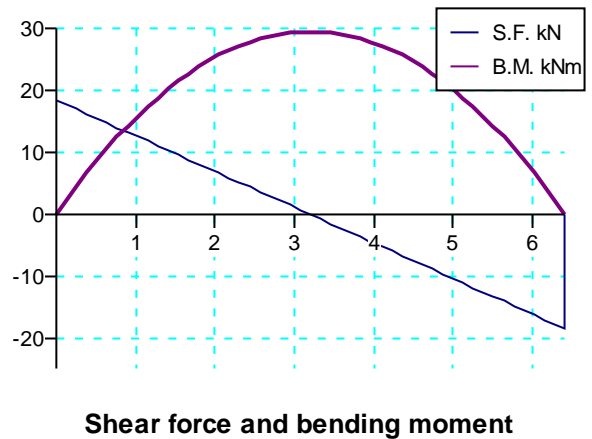
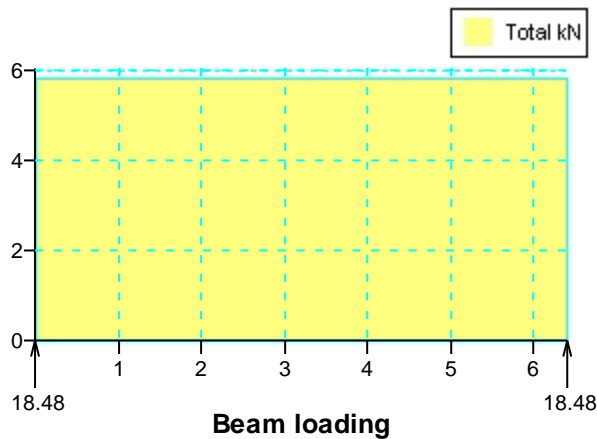
Total load: 36.96 kN

Load types: U:UDL T: Total (positions in m. from R1)

Maximum B.M. = 29.6 kNm at 3.20 m. from R1

Maximum S.F. = 18.5 kN at R1

Total deflection = $126.1 \times 10^{-8}/EI$ at 3.20 m. from R1 (E in N/mm^2 , I in cm^4)



Steel calculation to BS449 Part 2 using S275 (Grade 43) steel

SECTION SIZE : 2No 200 x 75 x 23 PFC Grade 43

$D=200.0$ mm $B=75.0$ mm $t=6.0$ mm $T=12.5$ mm $I_x=1,960$ cm⁴ $r_y=2.39$ cm $Z_x=196$ cm³

$L_e/r_y = 6.40 \times 100 / 2.39 = 268$ $D/T = 16.0$

Permissible bending stress, $p_{bc} = 75.8$ N/mm² (Table 3a)

Actual bending stress, $f_{bc} = 29.57 \times 1000 / 2 \times 196.0 = 75.4$ N/mm² OK

Maximum shear in web, $f_s = 18.48 \times 1000 / (2 \times 6.0 \times 200.0) = 7.7$ N/mm² OK

Web buckling and crushing have not been checked

Total deflection = $126 \times 1e8 / (2 \times 205,000 \times 1,960) = 15.7$ mm (L/408) OK

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2 = 0.989$ at 3.20 m. (≤ 1.25 OK)

Bearing details

200x75x23 PFC stiff bearing length, $b_1 = t + 0.8r + T = 28.1$ mm; O/A b_1 taken as 56.2 mm

Factor reactions by 1.55 (user selected value)

Masonry: 100mm 7.3N/mm² solid block (SF>2.0), class (iii) mortar, normal const/normal mfr

Local design strength (factored) = $6.4/3.5 = 1.83$ N/mm² (BS5628-1:2005 Table 2d/2e)

R1: 175 x 100 mm padstone

Factored reaction = $18.48 \times 1.55 = 28.64$ kN

Factored stress under padstone = $1.55 \times 18.48 \times 1000 / 175 \times 100 = 1.64$ N/mm²

R2 as R1

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Beam: 'C1' under walls to Bedroom 2

Span: 3.0 m.

	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U T	o.w .	0.65	0		L	0.97	0.97
U T	Roof	1.65x3.0	0		L	7.42	7.42
						8.40	8.40

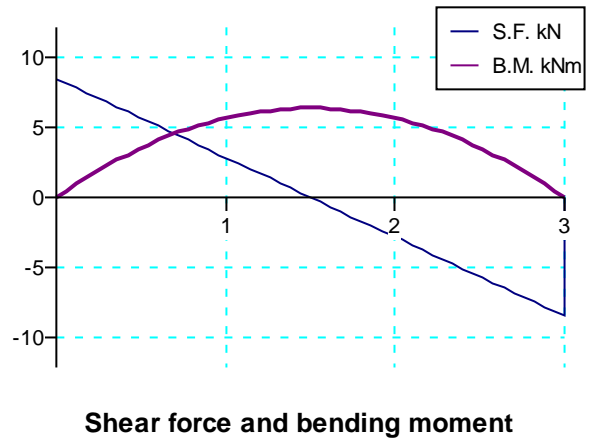
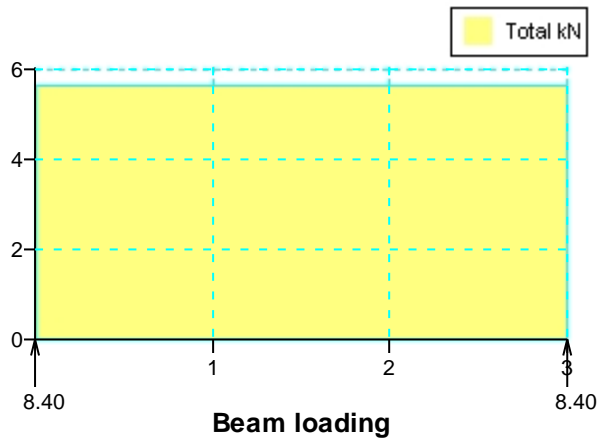
Total load: 16.80 kN

Load types: U:UDL T: Total (positions in m. from R1)

Maximum B.M. = 6.30 kNm at 1.50 m. from R1

Maximum S.F. = 8.40 kN at R1

Total deflection = $5.91 \times 10^8 / EI$ at 1.50 m. from R1 (*E in N/mm², I in cm⁴*)



Steel calculation to BS449 Part 2 using S275 (Grade 43) steel
SECTION SIZE: 180 x 90 x 26 PFC Grade 43

D=180.0 mm B=90.0 mm t=6.5 mm T=12.5 mm $I_x=1,820 \text{ cm}^4$ $r_y=2.89 \text{ cm}$ $Z_x=202 \text{ cm}^3$

$L_E/r_y = 3.00 \times 100 / 2.89 = 104$ $D/T = 14.4$

Permissible bending stress, $p_{bc} = 144.5 \text{ N/mm}^2$ (Table 3a)

Actual bending stress, $f_{bc} = 6.300 \times 1000 / 202.0 = 31.2 \text{ N/mm}^2$ OK

Maximum shear in w eb, $f_s = 8.400 \times 1000 / (6.5 \times 180.0) = 7.2 \text{ N/mm}^2$ OK

Web buckling and crushing have not been checked

Total deflection = $5.91 \times 1e8 / (205,000 \times 1,820) = 1.6 \text{ mm}$ (L/1895) OK

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2 = 0.047$ at 1.50 m. (≤ 1.25 OK)

Bearing details

180x90x26 PFC stiff bearing length, $b_1 = t + 0.8r + T = 28.6 \text{ mm}$

Factor reactions by 1.55 (user selected value)

Masonry: 100mm 7.3N/mm² solid block (SF>2.0), class (iii) mortar, normal const/normal mfr

Local design strength (factored) = $6.4/3.5 = 1.83 \text{ N/mm}^2$ (BS5628-1:2005 Table 2d/2e)

R1: 90 x 100 mm padstone

Factored reaction = $8.40 \times 1.55 = 13.02 \text{ kN}$

Factored stress under padstone = $1.55 \times 8.40 \times 1000 / 90 \times 100 = 1.45 \text{ N/mm}^2$

R2 as R1

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Beam: 'D' over Living Room

Span: 5.8 m.

Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U T o.w.	0.65	0		L	1.88	1.88
U T Floor	2.0x3.0	0		L	17.40	17.40
P T Bm: 'C1' under w all : R1	8.40 [B/F]	2.2			5.21	3.19
					24.50	22.47

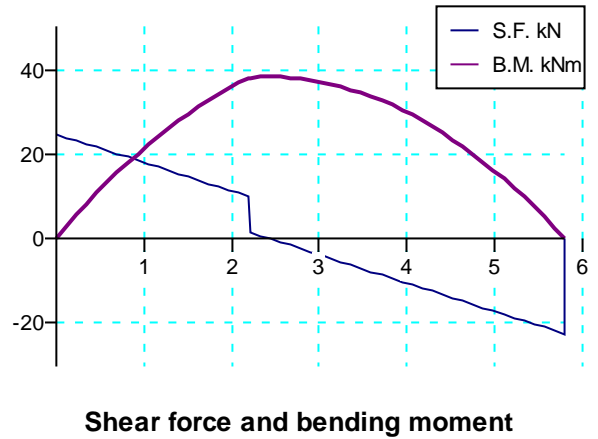
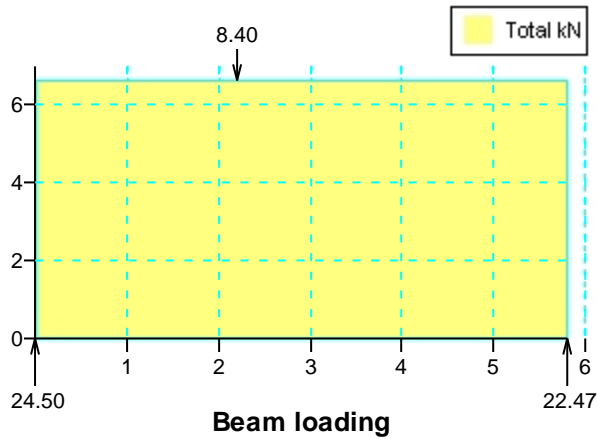
Total load: 46.97 kN

Load types: U:UDL P:PL T: Total (positions in m. from R1)

Maximum B.M. = 38.0 kNm at 2.42 m. from R1

Maximum S.F. = 24.5 kN at R1

Total deflection = $129.4 \times 10^8 / EI$ at 2.85 m. from R1 (*E in N/mm², I in cm⁴*)



Steel calculation to BS449 Part 2 using S275 (Grade 43) steel

SECTION SIZE : 2No 200 x 90 x 30 PFC Grade 43

D=200.0 mm B=90.0 mm t=7.0 mm T=14.0 mm $I_x=2,520 \text{ cm}^4$ $r_y=2.88 \text{ cm}$ $Z_x=252 \text{ cm}^3$

$L_E/r_y = 5.80 \times 100 / 2.88 = 201$ D/T = 14.3

Permissible bending stress, $p_{bc} = 98 \text{ N/mm}^2$ (Table 3a)

Actual bending stress, $f_{bc} = 37.97 \times 1000 / 2 \times 252.0 = 75.3 \text{ N/mm}^2$ OK

Maximum shear in web, $f_s = 24.50 \times 1000 / (2 \times 7.0 \times 200.0) = 8.7 \text{ N/mm}^2$ OK

Web buckling and crushing have not been checked

Total deflection = $129 \times 1e8 / (2 \times 205,000 \times 2,520) = 12.5 \text{ mm}$ (L/463) OK

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2 = 0.591$ at 2.44 m. (≤ 1.25 OK)

Bearing details

200x90x30 PFC stiff bearing length, $b_1 = t + 0.8r + T = 30.6 \text{ mm}$; O/A b_1 taken as 61.2 mm

Factor reactions by 1.55 (user selected value)

Masonry: 100mm 7.3N/mm² solid block (SF>2.0), class (iii) mortar, normal const/normal mfr

Local design strength (factored) = $6.4/3.5 = 1.83 \text{ N/mm}^2$ (BS5628-1:2005 Table 2d/2e)

R1: 225 x 100 mm padstone

Factored reaction = $24.50 \times 1.55 = 37.97 \text{ kN}$

Factored stress under padstone = $1.55 \times 24.50 \times 1000 / 225 \times 100 = 1.69 \text{ N/mm}^2$

R2: 200 x 100 mm padstone

Factored reaction = $22.47 \times 1.55 = 34.83 \text{ kN}$

Factored stress under padstone = $1.55 \times 22.47 \times 1000 / 200 \times 100 = 1.74 \text{ N/mm}^2$

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Beam: 'E' over Dining Area/ Living Room

Span: 4.8 m.

Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U T o.w.	0.65	0		L	1.56	1.56
P T Bm: 'D' over Living : R1	24.50 [B/F]	1.6			16.33	8.17
P T Beam: 'B' betw een : R1	10.92 [B/F]	2.1			6.14	4.78
P T Bm: 'C' under stud : R1	18.48 [B/F]	3.3			5.78	12.70
					<u>29.81</u>	<u>27.21</u>

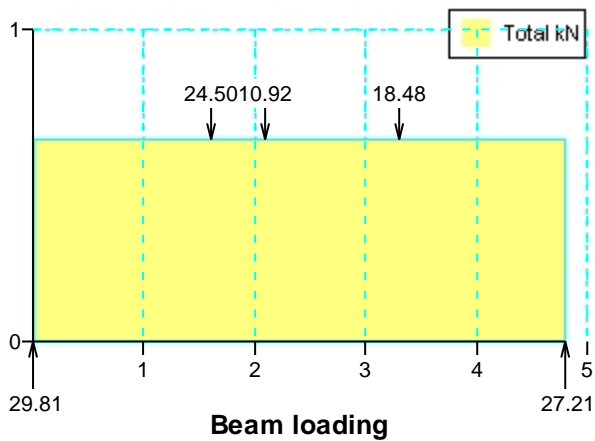
Total load: 57.02 kN

Load types: U:UDL P:PL T: Total (positions in m. from R1)

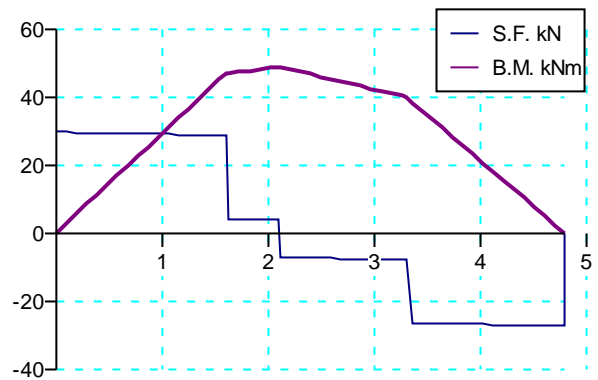
Maximum B.M. = 48.9 kNm at 2.10 m. from R1

Maximum S.F. = 29.8 kN at R1

Total deflection = $111.9 \times 10^8 / EI$ at 2.36 m. from R1 (*E in N/mm², I in cm⁴*)



Beam loading



Shear force and bending moment

Steel calculation to BS449 Part 2 using S275 (Grade 43) steel

SECTION SIZE : 254 x 146 x 43 UB Grade 43

D=259.6 mm B=147.3 mm t=7.2 mm T=12.7 mm $I_x=6,540 \text{ cm}^4$ $r_y=3.52 \text{ cm}$ $Z_x=504 \text{ cm}^3$

$L_e/r_y = 4.80 \times 100 / 3.52 = 136$ D/T = 20.4

Permissible bending stress, $p_{bc} = 108.3 \text{ N/mm}^2$ (Table 3a)

Actual bending stress, $f_{bc} = 48.92 \times 1000 / 504.0 = 97.1 \text{ N/mm}^2$ OK

Maximum shear in w eb, $f_s = 29.81 \times 1000 / (7.2 \times 259.6) = 15.9 \text{ N/mm}^2$ OK

Check unstiffened w eb capacities w ith loads of 29.81 kN and 27.21 kN

Bearing: $p_b = 210 \text{ N/mm}^2$ (Table 9); C1 = 53.2 kN; C2 = 1.51 kN/mm

Buckling: $p_c = 141 \text{ N/mm}^2$ (Table 17a); C1 = 132 kN; C2 = 1.02 kN/mm

R1: Unstiffened w eb bearing capacity, $P_w = 53.2 \text{ kN}$: no minimum stiff bearing length required

R2: Unstiffened w eb bearing capacity, $P_w = 53.2 \text{ kN}$: no minimum stiff bearing length required

Total deflection = $112 \times 1e8 / (205,000 \times 6,540) = 8.3 \text{ mm}$ (L/575) OK

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2 = 0.801$ at 2.11 m. (≤ 1.25 OK)

Bearing details

254x146x43 UB stiff bearing length, $b_1 = t + 1.6r + 2T = 44.8 \text{ mm}$

Factor reactions by 1.55 (user selected value)

Masonry: 100mm 7.3N/mm² solid block (SF>2.0), class (iii) mortar, normal const/normal mfr

Local design strength (factored) = $6.4 / 3.5 = 1.83 \text{ N/mm}^2$ (BS5628-1:2005 Table 2d/2e)

R1: 300 x 100 mm padstone

Factored reaction = $29.81 \times 1.55 = 46.21 \text{ kN}$

Factored stress under padstone = $1.55 \times 29.81 \times 1000 / 300 \times 100 = 1.54 \text{ N/mm}^2$

R2: 250 x 100 mm padstone

Factored reaction = $27.21 \times 1.55 = 42.17 \text{ kN}$

Factored stress under padstone = $1.55 \times 27.21 \times 1000 / 250 \times 100 = 1.69 \text{ N/mm}^2$

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Beam: 'F' over folding doors

Span: 3.6 m.

Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U T o.w.	0.65	0		L	1.17	1.17
U T Floor	2.0x1.6	0		L	5.76	5.76
P T Bm: 'E' over Dining : R2	27.21 [B/F]	2.0			<u>12.09</u>	<u>15.12</u>
					19.02	22.05

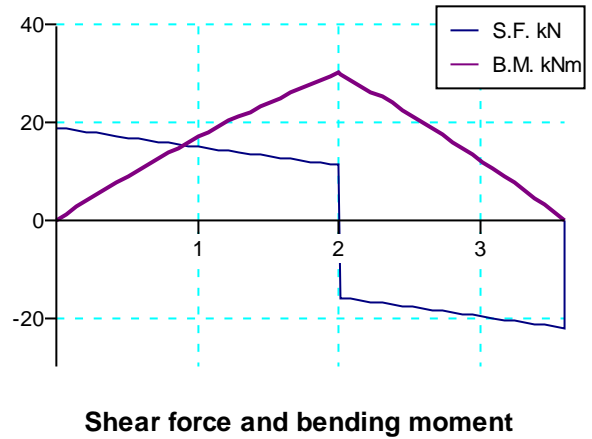
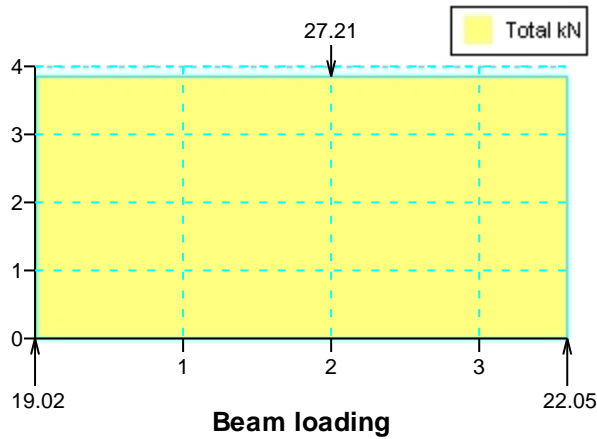
Total load: 41.07 kN

Load types: U:UDL P:PL T: Total (positions in m. from R1)

Maximum B.M. = 30.3 kNm at 2.00 m. from R1

Maximum S.F. = -22.0 kN at R2

Total deflection = $34.4 \times 10^8 / EI$ at 1.86 m. from R1 (**E in N/mm², I in cm⁴**)



Steel calculation to BS449 Part 2 using S275 (Grade 43) steel

SECTION SIZE : 2No 150 x 90 x 24 PFC Grade 43

D=150.0 mm B=90.0 mm t=6.5 mm T=12.0 mm $I_x=1,160 \text{ cm}^4$ $r_y=2.89 \text{ cm}$ $Z_x=155 \text{ cm}^3$

$L_E/r_y = 3.60 \times 100 / 2.89 = 125$ D/T = 12.5

Permissible bending stress, $p_{bc} = 139.2 \text{ N/mm}^2$ (Table 3a)

Actual bending stress, $f_{bc} = 30.35 \times 1000 / 2 \times 155.0 = 97.9 \text{ N/mm}^2$ OK

Maximum shear in web, $f_s = 22.05 \times 1000 / (2 \times 6.5 \times 150.0) = 11.3 \text{ N/mm}^2$ OK

Web buckling and crushing have not been checked

Total deflection = $34.4 \times 1e8 / (2 \times 205,000 \times 1,160) = 7.2 \text{ mm}$ (L/497) OK

Combined bending and shear check (14.c): $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2 = 0.492$ at 2.02 m. (≤ 1.25 OK)

Bearing details

150x90x24 PFC stiff bearing length, $b_1 = t + 0.8r + T = 28.1 \text{ mm}$; O/A b_1 taken as 56.2 mm

Factor reactions by 1.55 (user selected value)

Masonry: 100mm 7.3N/mm² solid block (SF>2.0), class (iii) mortar, normal const/normal mfr

Local design strength (factored) = $6.4 / 3.5 = 1.83 \text{ N/mm}^2$ (BS5628-1:2005 Table 2d/2e)

R1: 180 x 250 mm padstone

Factored reaction = $19.02 \times 1.55 = 29.49 \text{ kN}$

Factored stress under padstone = $1.55 \times 19.02 \times 1000 / 180 \times 250 = 0.66 \text{ N/mm}^2$

R2: 200 x 100 mm padstone

Factored reaction = $22.05 \times 1.55 = 34.17 \text{ kN}$

Factored stress under padstone = $1.55 \times 22.05 \times 1000 / 200 \times 100 = 1.71 \text{ N/mm}^2$

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7 Roseville Cottages, Summerfield Lane, Frensham, Surrey. GU10 3AN

Site: 10 Aveley Lane
Job: Ground floor rear extension & Alterations to Roof
Job number: WF-106

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SuperBeam 4.56h 440397

WF-106.SBW

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Steel column calculation to BS449 Part 2 using S275 (Grade 43) steel

Location: Post 'G' between folding doors

Length: 2.1 m.

Pos	Load	Total kN
A	Beam 'F'	42.00
Total load		42.00

SECTION SIZE: 100 x 50 x 5 HF RHS Grade 43 (10.8kg/m)

Gross area, $A_g = 13.7 \text{ cm}^2$ $D = 100.0 \text{ mm}$ $T = 5.0 \text{ mm}$ $t = 5.0 \text{ mm}$

$r_x = 3.48 \text{ cm}$ $r_y = 1.99 \text{ cm}$ $Z_x = 33.0 \text{ cm}^3$ $Z_y = 21.6 \text{ cm}^3$

Major axis: $L_{Ex} = 1.0L = 2.10 \text{ m}$. Slenderness, $\lambda_y = 2.10 \times 100/3.48 = 60.3$

Minor axis: $L_{Ey} = 1.0L = 2.10 \text{ m}$. Slenderness, $\lambda_y = 2.10 \times 100/1.99 = 106 \leftarrow$

Compressive strength, $p_c = 75.9 \text{ N/mm}^2$ (Table 17a)

Member is axially loaded only:

Axial load = 42.00 kN

Compressive resistance = $13.7 \times 100 \times 75.9/1000 = 104.0 \text{ kN OK}$

Baseplate calculation (considering axial load only)

Factor load by 1.60 (user selected value): factored load on base = 67.2kN

Concrete strength, $f_{cu} = 20 \text{ N/mm}^2$

Minimum area required = $F_c/0.6f_{cu} = 67.2 \times 1000/(0.6 \times 20) = 5,600 \text{ mm}^2$

K (min reqd proj) = 7.50mm Minimum base plate size = 116 x 66mm

Minimum thickness = $K\sqrt{3 \times 0.6.f_{cu}/p_{yp}} = 2.71 \text{ mm}$ ($p_{yp} = 275 \text{ N/mm}^2$)

Use 175 x 175 x 5mm base plate

Use 250x200mm wide top plate as bearing for beams F