STRUCTURAL CALCULATIONS

FOR

SINGLE STOREY REAR & SIDE EXTENSION

AT

SITE POST CODE: N19 4QP

ON

24th APRIL 2026

BY

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REFERENCE:

CALCULATIONS ARE PREPARED IN ACCORDANCE WITH THE FOLLOWING CODES OF PRACTICE:

BS 5268 [TIMBER SC3 GRADE]
CODE OF PRACTICE FOR USE OF TIMBER

BS 648 [WEIGHT OF BUILDING MATERIAL]
CODE OF PRACTICE FOR BUILDING MATERIAL

BS 5950 PART 1 – 2000
STRUCTURAL USE OF STEELWORK IN BUILDING

BS 5628 PART 1 – 1992
CODE OF PRACTICE FOR USE OF MASONRY

BS 6399 PART 1 – 1996
LOADING FOR BUILDINGS
[DEAD AND IMPOSED LOADS]

BS 6399 PART 3 - 1988 LOADING FOR BUILDINGS
[IMPOSED ROOF LOAD]

SPAN TABLES FOR SOLID TIMBER MEMBERS IN FLOORS, CEILINGS AND ROOFS FOR DWELLINGS --TRADA 2004

LOAD CALCULATIONS:

FLAT ROOF

	DEAD LOAD (kN/m^2)	**LIVE LOAD (kN/m^2)**
PLASTER BOARD	0.12	SNOW & REPAIR ACCESS = 0.75 kN/m^2
JOIST	0.18	-
FELT	0.15	-
CHIPPINGS	0.24	-
BOARDING	0.12	-
TOTAL	**0.81 kN/m^2**	**0.75 kN/m^2**

PITCHED ROOF

	DEAD LOAD (kN/m^2)	**LIVE LOAD (kN/m^2)**
RAFTERS	0.12	SNOW & REPAIR ACCESS = 0.75 kN /m2
BATTENS	0.04	-
FELT	0.05	-
TILES	0.68	-
	0.89 (On Slope)	-
	0.89 / Cos 45 Degrees	-
TOTAL	**= 1.26 (On Plan)**	**0.75 kN/m^2**

FLOOR

	DEAD LOAD (kN/m^2)	**LIVE LOAD (kN/m^2)**
CEILING	0.15	IMPOSED = 1.50 kN /m2
JOIST	0.15	-
BOARDING	0.20	-
TOTAL	**0.50 kN/m^2**	**1.50 kN/m^2**

CEILING

	DEAD LOAD (kN/m^2)	LIVE LOAD (kN/m^2)
CEILING	0.25	-
TOTAL	**0.25 kN/m^2**	-

BRICK WORK

	DEAD LOAD (kN/m^3)	LIVE LOAD (kN/m^3)
BRICKS	22.00	-
TOTAL	**22.00 kN/m^3**	-

BLOCK WORK

	DEAD LOAD (kN/m^3)	LIVE LOAD (kN/m^3)
BLOCKS	14.00	-
TOTAL	**14.00 kN/m^3**	-

INTERNAL STUDDING

	DEAD LOAD (kN/m^2)	LIVE LOAD (kN/m^2)
PLASTER BOARD	0.04	-
STUD	0.68	-
TOTAL	**0.72 kN/m^2**	-

EXTERNAL STUDDING

	DEAD LOAD (kN/m^2)	**LIVE LOAD (kN/m^2)**
PLASTER BOARD	0.12	-
TILING	0.68	-
FELT	0.05	-
BATTENS	0.04	-
STUD	0.12	-
	----------------	----------------
TOTAL	**1.01 kN/m^2**	-
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GENERAL AND SAFETY NOTES:

1. All dimensions, setting out and levels are to be verified on site with the architect prior to the commencement of any site work.

2. Building control approval must be obtained prior to the commencement of building works.

3.The contractor shall be responsible for and must take all necessary precautions to ensure the stability of the existing structure and earthworks on adjoining sites during the course of the contract.

4.Materials and constructions are to be in accordance with the relevant British Standards and Codes of Practice.

5.Any services or drainage which pass through the foundation are to be encased in a flexible sleeve.

6.The dimensions of all steel sections required should be measured on site by the client (or their representative contractor or steelwork fabricator). All Steel Beams to have minimum of 1/2hr Fire Resistance via ‘Nullifire’ Paint or 19mm Gyproc Plank tied with 1.6mm wire binding@100mm c/c and finished in Carlite Bonding 16mm thick.

7. It is the responsibility of the Client / Contractor to notify the designer of any discrepancies.

8. Note that all steel (Sizes & Quantity) shown on the drawings are should be checked prior to ordering any material.

9. Structural Drawings provided here are based on architectural drawings and site survey therefore are indicative only and are NOT TO SCALE.

10. All existing foundations and lintels to be exposed and to be checked for adequacy by Builder / Building Control Officer and or replaced if necessary.

11. Depth of all footings is to be approved by the local building inspector. Minimum of 1 m deep, advise engineer if footings are located within 30m of large trees or hedges. Also notify if water is struck, tree roots are found or clay soil appears very dry and brittle.

LOAD CALCULATIONS FOR ROOF BEAM (RB):

CLEAR SPAN OF THE ROOF BEAM (RB) = 2800mm

SLOPE = 15 Degrees Max.

LOADING:

DEAD LOAD ON ROOF BEAM (RB):

PITCHED ROOF = 0.92 kN/m^2 x SPAN OF ROOF IN MTS.

= 0.92 kN/m^2 x 2.5

= 2.38 kN/m

THEREFORE TOTAL DEAD LOAD ON RB = 2.38 kN/m.

LIVE LOAD ON ROOF BEAM (RB):

PITCHED ROOF = 0.75 kN/m^2 x SPAN OF ROOF IN MTS.

= 0.75 kN/m^2 x 2.5

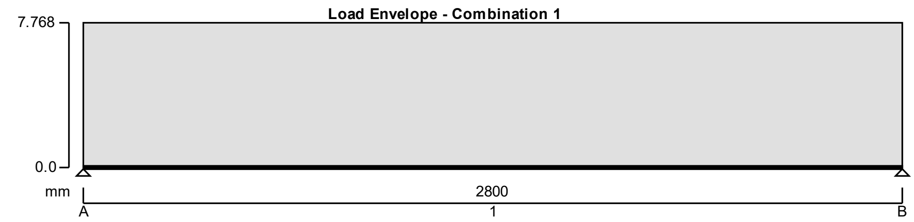
= 1.88 kN/m

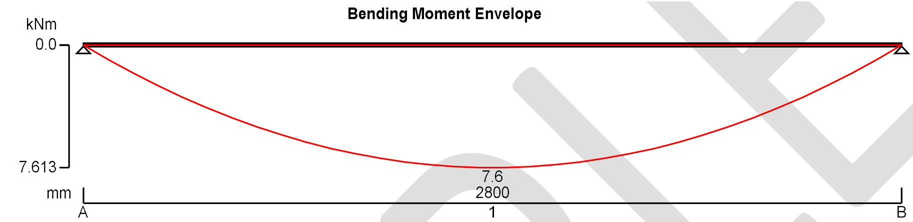
THEREFORE TOTAL LIVE LOAD ON RB = 1.88 kN/m

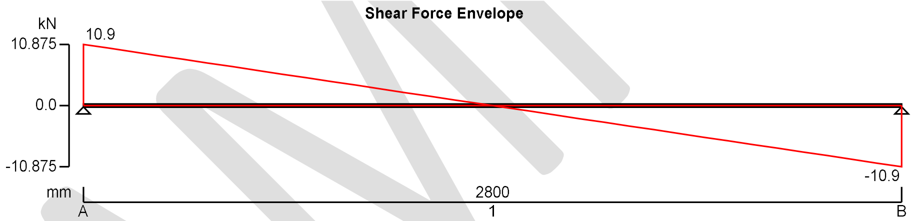
STRUCTURAL REPORT FOR ROOF BEAM (RB):

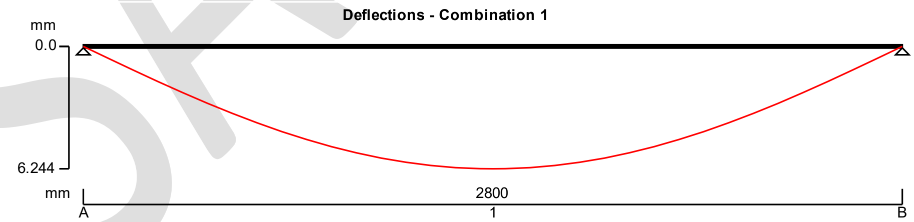
FLITCH BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.4.00









Applied loading

Beam loads

	Dead full UDL 1.000 kN/m	
	Dead full UDL 2.400 kN/m	
	Live full UDL 1.880 kN/m	

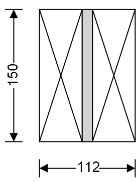
Load combinations

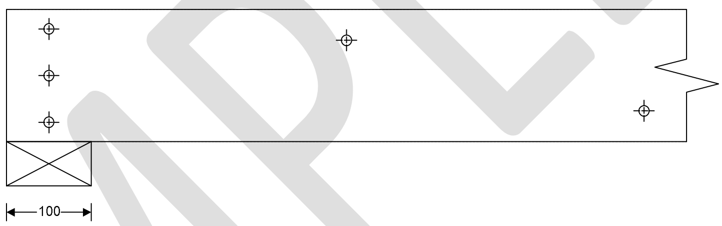
Load combination 1	Support A	Dead × 1.40
		Live × 1.60
		Other × 1.00

	Span 1	Dead × 1.40
		Live × 1.60
		Other × 1.00
	Support B	Dead × 1.40
		Live × 1.60
		Other × 1.00

Analysis results

Maximum moment	M_{max} = **7.613** kNm	M_{min} = **0.000** kNm
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **7.613** kNm	
Maximum shear	F_{max} = **10.875** kN	F_{min} = **-10.875** kN
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **10.875** kN	
Total load on beam	W_{tot} = **21.750** kN	
Reactions at support A	R_{A_max} = **10.875** kN	R_{A_min} = **10.875** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **4.760** kN	
Unfactored live load reaction at support A	R_{A_Live} = **2.632** kN	
Reactions at support B	R_{B_max} = **10.875** kN	R_{B_min} = **10.875** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **4.760** kN	
Unfactored live load reaction at support B	R_{B_Live} = **2.632** kN	





Timber section details

Breadth of timber sections	b = **50** mm
Depth of timber sections	h = **150** mm
Number of timber sections in beam	N = **2**
Timber strength class	**C24**

Steel section details

Breadth of steel plate	b_s = **12** mm
Depth of steel plate	h_s = **150** mm
Number of steel plates in beam	N_s = **1**
Steel stress	p_y = **165** N/mm^2
Bolt diameter	ϕ_b = **12** mm

Beam details

Length of bearing	L_b = **100** mm
Service class of timber	**1**
Load duration	**Long term**

Section properties

Cross sectional area of beam	$A = N \times b \times h$ = **15000** mm^2
Timber section modulus	$Z_{xt} = N \times b \times h^2 / 6$ = **375000** mm^3
Steel section modulus	$Z_{xs} = N_s \times b_s \times h_s^2 / 6$ = **45000** mm^3
Second moment of area of timber	$I_{xt} = N \times b \times h^3 / 12$ = **28125000** mm^4
Second moment of area of steel	$I_{xs} = N_s \times b_s \times h_s^3 / 12$ = **3375000** mm^4

Load proportions

Instant deflection under permanent actions	u_{instG} = **2.733** mm

Instant deflection under principal variable action	u_{instQ1} = **1.511** mm
	k_{def} = **0.6**
	ψ_2 = **0.3**
Final minimum modulus of elasticity	

$E_{min,fin} = E_{min} \times (u_{instG} + u_{instQ1}) / (u_{instG} + u_{instQ1} + k_{def} \times (u_{instG} + \psi_2 \times u_{instQ1}))$ = **4964** N/mm^2

Proportion of applied load in timber	$k_t = E_{mean} \times I_{xt} / (E_{mean} \times I_{xt} + E_{S5950} \times I_{xs})$ = **0.305**
Proportion of applied load in steel	$k_s = 1.1 \times E_{S5950} \times I_{xs} / (E_{min,fin} \times I_{xt} + E_{S5950} \times I_{xs})$ = **0.915**

Modification factors

Service class for bending parallel to grain	K_{2m} = **1.00**
Service class for tension parallel to grain	K_{2t} = **1.00**
Service class for compression	K_{2c} = **1.00**
Service class for shear parallel to grain	K_{2s} = **1.00**
Service class for modulus of elasticity	K_{2e} = **1.00**
Duration of loading	K_3 = **1.00**
Bearing stress	K_4 = **1.00**
Depth of section	$K_7 = (300\text{ mm} / h)^{0.11}$ = **1.08**
Load sharing	K_8 = **1.00**
Composite E value	K_9 = **1.00**

Check lateral stability of beam

Ends held in position	
Permissible depth-to-breadth ratio	**3.00**
Actual depth-to-breadth ratio	$h / (N \times b + N_s \times b_s)$ = **1.34**

PASS - Lateral support is adequate

Check bearing stress

Permissible bearing stress (no wane)	$\sigma_{c\_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_4 \times K_8$ = **2.400** N/mm^2
Applied bearing stress	$\sigma_{c\_a} = R_{A\_max} / (N \times b \times L_b)$ = **1.088** N/mm^2

PASS - Compressive stress within permissible limits at bearing

Check beam in bending

Permissible bending stress	$\sigma_{m\_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8$ = **8.094** N/mm^2
Applied timber bending stress	$\sigma_{m\_a} = k_t \times M / Z_{xt}$ = **6.193** N/mm^2

PASS - Timber bending stress within permissible limits

Applied steel bending stress	$\sigma_{m\_a\_s} = k_s \times M / Z_{xs}$ = **154.842** N/mm^2

PASS - Steel bending stress within permissible limits

Check beam in shear

Permissible shear stress	$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8$ = **0.710** N/mm^2
Applied shear stress	$\tau_a = 3 \times k_t \times F / (2 \times A)$ = **0.332** N/mm^2

PASS - Shear stress within permissible limits

Check deflection

Modulus of elasticity for deflection	$E = E_{mean} \times K_{2e}$ = **10800** N/mm^2
Permissible deflection	$\delta_{adm} = \min(14\text{ mm}, 0.003 \times L_{s1})$ = **8.400** mm
Bending deflection	δ_{b_s1} = **6.244** mm
Shear deflection	δ_{v_s1} = **0.902** mm
Total deflection	$\delta_a = \delta_{b\_s1} + \delta_{v\_s1}$ = **7.147** mm

PASS - Deflection is within permissible limits

Flitch plate bolting requirements

Total load on beam	W_{tot} = **21.750** kN
Total load taken by steel	$W_s = k_s \times W_{tot}$ = **19.908** kN
Basic bolt shear load - Table 71	v_{90} = **1.873** kN

Number of interfaces	$N_{int} = (N + N_s) – 1 =$ **2**
Number of bolts required at supports	$N_{be} = \max(k_s \times R_{A\_max} / (N_{int} \times v_{90}), 2) =$ **2.657**
Limiting bolt spacing	$S_{limit} = \min(2.5 \times h, 600\text{ mm}) =$ **375** mm
Maximum bolt spacing	$S_{max} =$ **350** mm
Minimum number of bolts along length of beam	$N_{bl} = W_s / (N_{int} \times v_{90}) =$ **5.314**

- Provide a minimum of 3 No.12 mm diameter bolts at each support
- Provide 12 mm diameter bolts at maximum 350 mm centres staggered 40 mm alternately above and below the centre line

Minimum bolt spacings

Minimum end spacing	$S_{end} = 4 \times \phi_b =$ **48** mm
Minimum edge spacing	$S_{edge} = 1.5 \times \phi_b =$ **18** mm
Minimum bolt spacing	$S_{bolt} = 4 \times \phi_b =$ **48** mm
Minimum washer diameter	$\phi_w = 3 \times \phi_b =$ **36** mm
Minimum washer thickness	$t_w = 0.25 \times \phi_b =$ **3** mm

LOAD CALCULATIONS FOR STEEL BEAM 1:

CLEAR SPAN OF THE STEEL BEAM 1 = 1400mm

LOADING:

DEAD LOAD ON STEEL BEAM 1:

TIMBER FLOOR = 0.50 kN/m^2 x SPAN OF FLOOR IN MTS.

= 0.50 kN/m^2 x 1.5m

= 0.75 kN/m

BRICK WORK = 22 kN/m^3 x THICKNES OF WALL x HEIGHT OF WALL IN MTS.
(100mm)

= 22 kN/m^3 x 0.100m x 3.5m

= 7.70 kN/m

THEREFORE TOTAL DEAD LOAD ON SB1 = 0.75 + 7.70 = 8.45 kN/m.

LIVE LOAD ON STEEL BEAM 1:

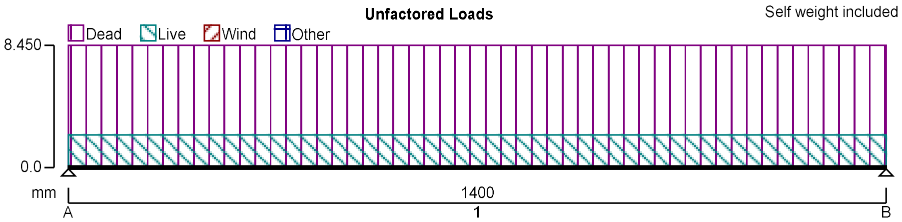
TIMBER FLOOR = 1.5 kN/m^2 x SPAN OF FLOOR IN MTS.

= 1.5 kN/m^2 x 1.5m

= 2.25 kN/m

THEREFORE TOTAL LIVE LOAD ON SB1 = 2.25 kN/m

STRUCTURAL REPORT FOR STEEL BEAM 1:



BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **1**

Material Properties:

Modulus of elasticity = **205** kN/mm^2 Material density = **7860** kg/m^3

Support Conditions:

Support A Vertically **"Restrained"** Rotationally **"Free"**

Support B Vertically **"Restrained"** Rotationally **"Free"**

Span Definitions:

Span 1 Length = **1400** mm Cross-sectional area = **2925** mm^2 Moment of inertia = **12.5×10^6** mm^4

LOADING DETAILS

Beam Loads:

Load 1 Self weight Dead load = **1.000**

Load 2 UDL Dead load **8.5** kN/m

Load 3 UDL Live load **2.3** kN/m

LOAD COMBINATIONS

Load combination 1

Span 1 1.4×Dead + 1.6×Live + 1×Other

BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

Support A Max react = **-11.0** kN Min react = **-11.0** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

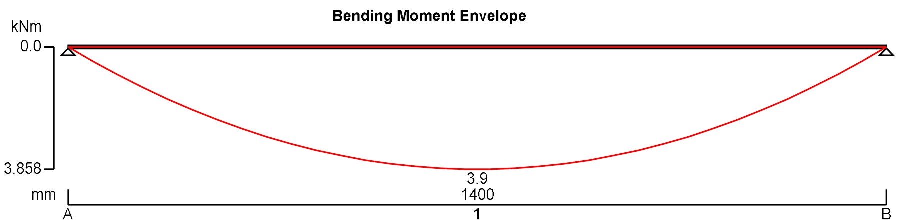
Support B Max react = **-11.0** kN Min react = **-11.0** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

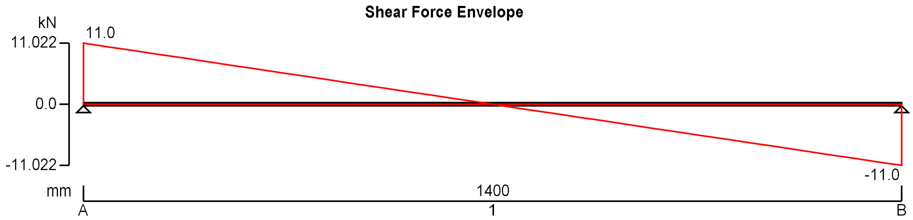
Beam Max/Min results - Combination Summary

Maximum shear = **11.0** kN Minimum shearF_{min} = **-11.0** kN

Maximum moment = **3.9** kNm Minimum moment = **0.0** kNm

Maximum deflection = **0.3** mm Minimum deflection = **0.0** mm





DESIGN SPAN 1

Member design checks for a simply-supported steel beam to BS 5950 (with LTB)

Summary of results

Material	Grade = **"S355"**	p_y = **355** N/mm^2	
Section	**"UC 152x152x23"**	Classification	**"Semi-Compact"**

Check	*Load*	*Capacity*	*Notes*	*Result*
Deflection	δ_{y_max} = **0.0** mm	δ_{lim} = **3.9** mm	**Span / 360 or 4.0 mm**	**Pass**
Shear	F_{vy} = **11.0** kN	P_{vy} = **188.3** kN	**Low shear**	**Pass**
Moment	M_x = **3.9** kNm	M_{cx} = **58.2** kNm	**Low shear**	**Pass**
LTB	M_{LT} = **3.9** kNm	M_b / m_{LT} = **53.3** kNm	L_{E_LT} = **2.0** m m_{LT} = **1.00**	**Pass**

LOAD CALCULATIONS FOR STEEL BEAM 2 & 3:

CLEAR SPAN OF THE STEEL BEAM 2 & 3 = 3100mm

LOADING:

DEAD LOAD ON STEEL BEAM 2 & 3:

TIMBER FLOOR = 0.50 kN/m^2 x SPAN OF FLOOR IN MTS.

= 0.50 kN/m^2 x 0.4m

= 0.20 kN/m

STUD WORK = 0.5 kN/m^2 x HEIGHT OF STUD PARTITION IN MTS.
(100mm)

= 0.5 kN/m^2 x 2.3m

= 1.15 kN/m

THEREFORE TOTAL DEAD LOAD ON SB2= 0.20 + 1.15 = 1.35 kN/m.

POINT LOAD FROM LOFT BEAM, LB1 = 11.00 kN@0.150m from L.H.S

PARTIAL UDL FROM 00mm to 300mm

BRICK WORK = 22 kN/m^3 x THICKNES OF WALL x HEIGHT OF WALL IN MTS.
(100mm)

= 22 kN/m^3 x 0.100m x 3.5m

= 7.70 kN/m

LIVE LOAD ON STEEL BEAM 2 & 3:

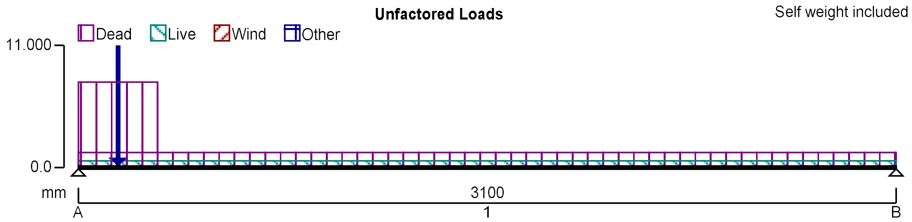
TIMBER FLOOR = 1.5 kN/m^2 x SPAN OF FLOOR IN MTS.

= 1.5 kN/m^2 x 0.4m

= 0.60 kN/m

THEREFORE TOTAL LIVE LOAD ON SB2 = 0.60 kN/m

STRUCTURAL REPORT FOR STEEL BEAM 2 & 3:



BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **1**

Material Properties:

Modulus of elasticity = **205** kN/mm^2 Material density = **7860** kg/m^3

Support Conditions:

Support A Vertically **"Restrained"** Rotationally **"Free"**

Support B Vertically **"Restrained"** Rotationally **"Free"**

Span Definitions:

Span 1 Length = **3100** mm Cross-sectional area = **2925** mm^2 Moment of inertia = **12.5**×**10^6** mm^4

LOADING DETAILS

Beam Loads:

Load 1 Self weight Dead load = **1.000**

Load 2 UDL Dead load **1.4** kN/m

Load 3 UDL Live load **0.6** kN/m

Load 4 Point Other load **11.0** kN at **0.150** m

Load 5 Partial UDL Dead load **7.7** kN/m from **0.000** m to **0.300** m

LOAD COMBINATIONS

Load combination 1

Span 1 1.4×Dead + 1.6×Live + 1×Other

BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

Support A Max react = **-18.5** kN Min react = **-18.5** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

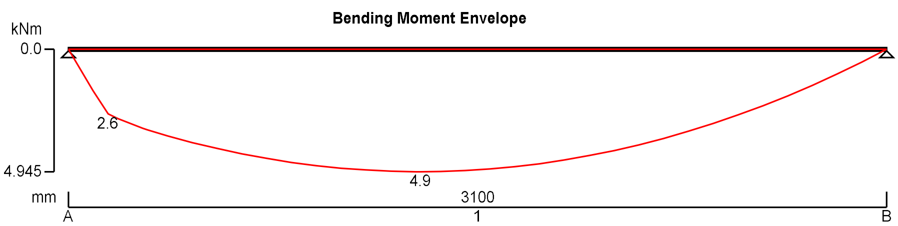
Support B Max react = **-5.6** kN Min react = **-5.6** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

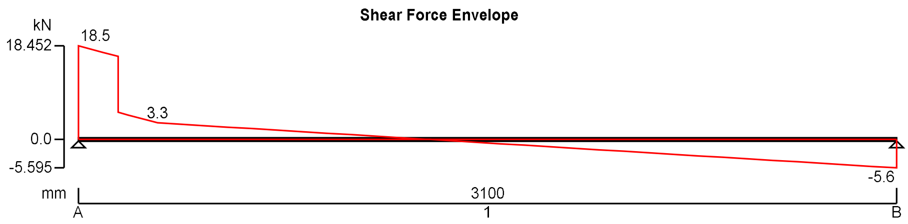
Beam Max/Min results - Combination Summary

Maximum shear = **18.5** kN Minimum shearF_{min} = **-5.6** kN

Maximum moment = **4.9** kNm Minimum moment = **0.0** kNm

Maximum deflection = **2.0** mm Minimum deflection = **0.0** mm





DESIGN SPAN 1

Member design checks for a simply-supported steel beam to BS 5950 (with LTB)

Summary of results

Material	Grade = **"S355"**	p_y = **355** N/mm^2	
Section	**"UC 152x152x23"**	Classification	**"Semi-Compact"**

Check	*Load*	*Capacity*	*Notes*	*Result*
Deflection	δ_{y_max} = **0.3** mm	δ_{lim} = **8.6** mm	**Span / 360 or 9.0 mm**	**Pass**
Shear	F_{vy} = **18.5** kN	P_{vy} = **188.3** kN	**Low shear**	**Pass**
Moment	M_x = **4.9** kNm	M_{cx} = **58.2** kNm	**Low shear**	**Pass**
LTB	M_{LT} = **4.9** kNm	M_b / m_{LT} = **35.9** kNm	L_{E_LT} = **4.1** m m_{LT} = **1.00**	**Pass**

LOAD CALCULATIONS FOR STEEL BEAM 4:

CLEAR SPAN OF THE STEEL BEAM 4 = 5230mm

LOADING:

DEAD LOAD ON STEEL BEAM 4:

PITCHED ROOF = 1.26 kN/m^2 x SPAN OF ROOF IN MTS.

= 1.26 kN/m^2 x 1.5

= 1.89 kN/m

TIMBER FLOOR = 0.50 kN/m^2 x SPAN OF FLOOR IN MTS

= 0.50 kN/m^2 x 1.5m

= 1.50 kN/m

BRICK WORK = 22 kN/m^3 x THICKNES OF WALL x HEIGHT OF WALL IN MTS.
(225mm)

= 22 kN/m^3 x 0.225m x 2.60m

= 12.87 kN/m

PITCHED ROOF = 1.26 kN/m^2 x SPAN OF ROOF IN MTS.

= 1.26 kN/m^2 x 1.00

= 1.26 kN/m

THEREFORE TOTAL DEAD LOAD ON SB4=1.89+1.50 +12.87+1.26= 17.52kN/m

<u>LIVE LOAD ON STEEL BEAM 4:</u>

PITCHED ROOF = 0.75 kN/m^2 x SPAN OF ROOF IN MTS.

= 0.75 kN/m^2 x 1.5m

= 1.13 kN/m

TIMBER FLOOR = 1.5 kN/m^2 x SPAN OF FLOOR IN MTS.

= 1.5 kN/m^2 x 1.5m

= 2.25 kN/m

PITCHED ROOF = 0.75 kN/m^2 x SPAN OF ROOF IN MTS.

= 0.75 kN/m^2 x 1.00m

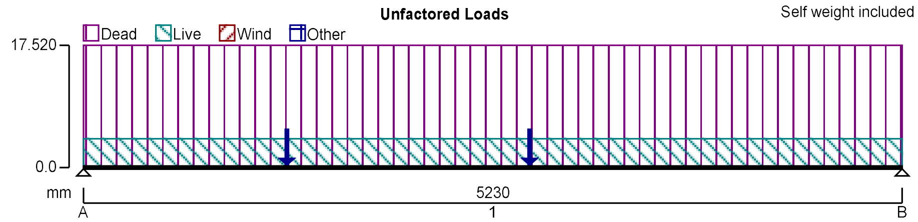
= 0.75 kN/m

<u>THEREFORE TOTAL LIVE LOAD ON SB4 = 1.13 + 2.25 + 0.75 = 4.13 kN/m</u>

<u>POINT LOAD FROM STEEL BEAM 2 = 5.60 kN@1.30m from L.H.S</u>

<u>POINT LOAD FROM STEEL BEAM 3 = 5.60 kN@2.85m from L.H.S</u>

STRUCTURAL REPORT FOR STEEL BEAM 4:



BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **1**

Material Properties:

Modulus of elasticity = **205** kN/mm^2 Material density = **7860** kg/m^3

Support Conditions:

Support A Vertically **"Restrained"** Rotationally **"Free"**

Support B Vertically **"Restrained"** Rotationally **"Free"**

Span Definitions:

Span 1 Length = **5230** mm Cross-sectional area = **9043** mm^2 Moment of inertia = **76.2×10^6** mm^4

LOADING DETAILS

Beam Loads:

Load 1 Self weight Dead load = **1.000**

Load 2 UDL Dead load **17.5** kN/m

Load 3 UDL Live load **4.1** kN/m

Load 4 Point Other load **5.6** kN at **1.300** m

Load 5 Point Other load **5.6** kN at **2.850** m

LOAD COMBINATIONS

Load combination 1

Span 1 1.4×Dead + 1.6×Live + 1×Wind + 1×Other

BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

Support A Max react = **-90.7** kN Min react = **-90.7** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

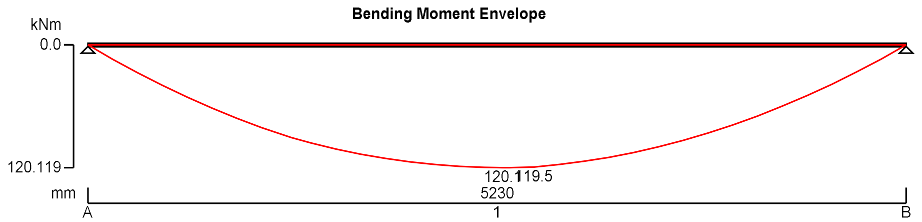
Support B Max react = **-88.4** kN Min react = **-88.4** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

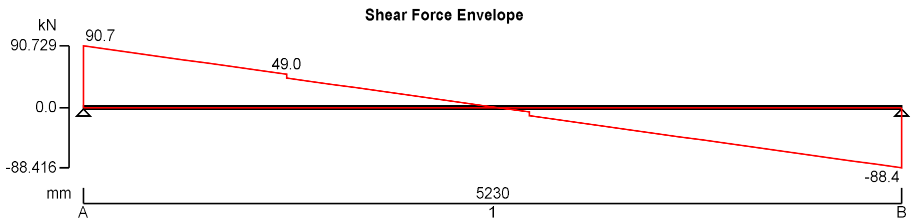
Beam Max/Min results - Combination Summary

Maximum shear = **90.7** kN   Minimum shearF_{min} = **-88.4** kN

Maximum moment = **120.1** kNm   Minimum moment = **0.0** kNm

Maximum deflection = **21.8** mm   Minimum deflection = **0.0** mm





DESIGN SPAN 1

Member design checks for a simply-supported steel beam to BS 5950 (with LTB)

Summary of results

Material	Grade = **"S355"**	p_y = **345** N/mm^2	
Section	**"UC 203x203x71"**	Classification	**"Plastic"**

Check	*Load*	*Capacity*	*Notes*	*Result*
Deflection	δ_{y_max} = **2.6** mm	δ_{lim} = **14.5** mm	**Span / 360 or 15.0 mm**	**Pass**
Shear	F_{vy} = **90.7** kN	P_{vy} = **446.7** kN	**Low shear**	**Pass**
Moment	M_x = **120.1** kNm	M_{cx} = **275.6** kNm	**Low shear**	**Pass**
LTB	M_{LT} = **120.1** kNm	M_b / m_{LT} = **179.8** kNm	L_{E_LT} = **6.8** m m_{LT} = **1.00**	**Pass**

LOAD CALCULATIONS FOR STEEL BEAM 5 & 6:

CLEAR SPAN OF THE STEEL BEAM 5 & 6 = 5220mm

LOADING:

DEAD LOAD ON STEEL BEAM 5 & 6:

PITCHED ROOF = 1.26 kN/m^2 x SPAN OF ROOF IN MTS.

= 1.26 kN/m^2 x 0.2m

= 0.25 kN/m

THEREFORE TOTAL DEAD LOAD ON SB5 = 0.25 kN/m

LIVE LOAD ON STEEL BEAM 5 & 6:

PITCHED ROOF = 0.75 kN/m^2 x SPAN OF ROOF IN MTS.

= 0.75 kN/m^2 x 0.2m

= 0.15 kN/m

THEREFORE TOTAL LIVE LOAD ON SB5 = 0.15 kN/m

POINT LOAD FROM STEEL BEAM 4 = 91.00 kN@2.05m from L.H.S

POINT LOAD FROM ROOF BEAM = 10.90 kN@2.05m from L.H.S

PARTIAL UDL FROM 2050mm to 5220mm

TIMBER FLOOR = 0.50 kN/m^2 x SPAN OF FLOOR IN MTS

= 0.50 kN/m^2 x 0.2m

= 0.10 kN/m

BRICK WORK (225mm) = 22 kN/m^3 x THICKNES OF WALL x HEIGHT OF WALL IN MTS.

= 22 kN/m^3 x 0.225m x 2.6m

= 12.87 kN/m

PITCHED ROOF = 1.26 kN/m^2 x SPAN OF ROOF IN MTS.

= 1.26 kN/m^2 x 0.2m

= 0.25 kN/m

THEREFORE TOTAL PARTIAL DEAD LOAD ON SB5=0.10+12.87+0.25=13.22kN/m

TIMBER FLOOR = 1.5 kN/m^2 x SPAN OF FLOOR IN MTS

= 1.5 kN/m^2 x 0.2m

= 0.30 kN/m

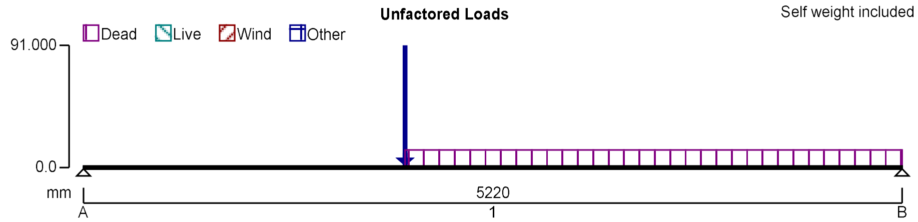
PITCHED ROOF = 0.75 kN/m^2 x SPAN OF ROOF IN MTS.

= 0.75 kN/m^2 x 0.2m

= 0.15 kN/m

THEREFORE TOTAL PARTIAL LIVE LOAD ON SB5 = 0.30 + 0.15 = 0.45 kN/m

STRUCTURAL REPORT FOR STEEL BEAM 5 & 6:



BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **1**

Material Properties:

Modulus of elasticity = **205** kN/mm^2 Material density = **7860** kg/m^3

Support Conditions:

Support A Vertically **"Restrained"** Rotationally **"Free"**

Support B Vertically **"Restrained"** Rotationally **"Free"**

Span Definitions:

Span 1 Length = **5220** mm Cross-sectional area = **10964** mm^2 Moment of inertia = **94.5×10^6** mm^4

LOADING DETAILS

Beam Loads:

Load 1 Self weight Dead load = **1.000**

Load 2 UDL Dead load **0.5** kN/m

Load 3 UDL Live load **0.3** kN/m

Load 4 Point Other load **91.0** kN at **2.050** m

Load 5 Point Other load **10.9** kN at **2.050** m

Load 6 Partial UDL Dead load **13.2** kN/m from **2.050** m to **5.220** m

Load 7 Partial UDL Live load **0.5** kN/m from **2.050** m to **5.220** m

LOAD COMBINATIONS

Load combination 1

Span 1 1.4×Dead + 1.6×Live + 1×Wind + 1×Other

BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

Support A Max react = **-86.6** kN Min react = **-86.6** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

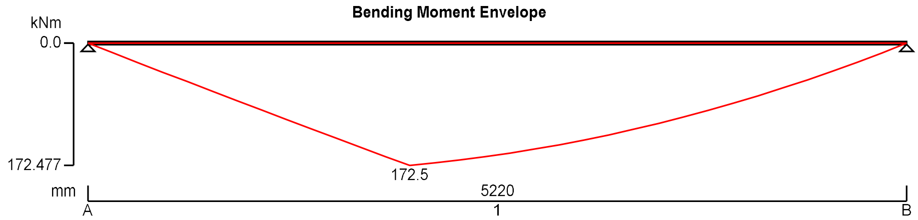
Support B Max react = **-88.6** kN Min react = **-88.6** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

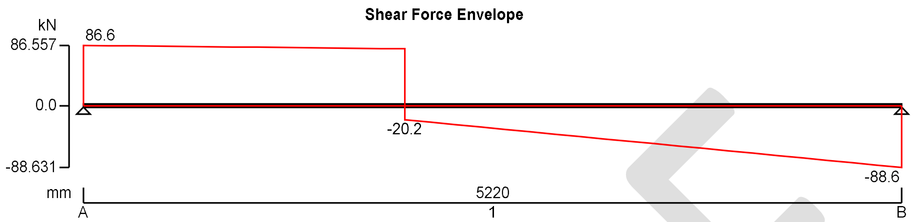
Beam Max/Min results - Combination Summary

Maximum shear = **86.6** kN Minimum shearF_{min} = **-88.6** kN

Maximum moment = **172.5** kNm Minimum moment = **0.0** kNm

Maximum deflection = **22.2** mm Minimum deflection = **0.0** mm





DESIGN SPAN 1

Member design checks for a simply-supported steel beam to BS 5950 (with LTB)

Summary of results

Material	Grade = **"S355"**	p_y = **345** N/mm^2	
Section	**"UC 203x203x86"**	Classification	**"Plastic"**

Check	*Load*	*Capacity*	*Notes*	*Result*
Deflection	δ_{y_max} = **0.3** mm	δ_{lim} = **14.0** mm	**Span / 360 or 14.0 mm**	**Pass**
Shear	F_{vy} = **88.6** kN	P_{vy} = **584.1** kN	**Low shear**	**Pass**
Moment	M_x = **172.5** kNm	M_{cx} = **337.0** kNm	**Low shear**	**Pass**
LTB	M_{LT} = **172.5** kNm	M_b / m_{LT} = **235.9** kNm	L_{E_LT} = **6.8** m m_{LT} = **1.00**	**Pass**

LOAD CALCULATIONS FOR STEEL BEAM 7:

CLEAR SPAN OF THE STEEL BEAM 7 = 4000mm

LOADING:

DEAD LOAD ON STEEL BEAM 7:

PITCHED ROOF = 1.26 kN/m^2 x SPAN OF ROOF IN MTS.

= 1.26 kN/m^2 x 0.2

= 0.25 kN/m

BRICK WORK = 22 kN/m^2 x THICKNES OF WALL x HEIGHT OF WALL IN MTS.
(225mm)

= 22 kN/m^2 x 0.100m x 0.6m x2

= 2.64 kN/m

THEREFORE TOTAL DEAD LOAD ON SB7 = 0.25 + 2.64 = 2.89 kN/m

LIVE LOAD ON STEEL BEAM 7:

FLAT ROOF = 0.75 kN/m^2 x SPAN OF ROOF IN MTS.

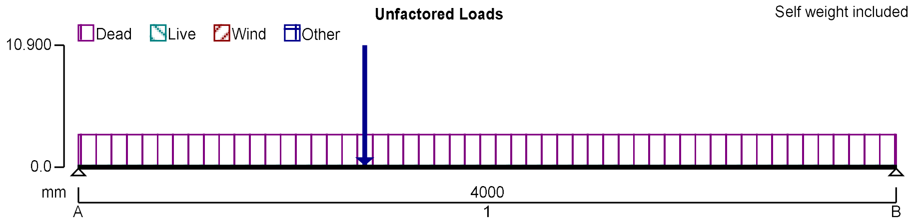
= 0.75 kN/m^2 x 0.2

= 0.15 kN/m

THEREFORE TOTAL LIVE LOAD ON SB7 = 0.15 kN/m

POINT LOAD FROM ROOF BEAM = 10.90 kN@1.40m from L.H.S

STRUCTURAL REPORT FOR STEEL BEAM 7:



BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **1**

Material Properties:

Modulus of elasticity = **205** kN/mm^2 Material density = **7860** kg/m^3

Support Conditions:

Support A Vertically **"Restrained"** Rotationally **"Free"**

Support B Vertically **"Restrained"** Rotationally **"Free"**

Span Definitions:

Span 1 Length = **4000** mm Cross-sectional area = **3821** mm^2 Moment of inertia = **29.0×10^6** mm^4

LOADING DETAILS

Beam Loads:

Load 1 Self weight Dead load = **1.000**

Load 2 UDL Dead load **2.9** kN/m

Load 3 UDL Live load **0.2** kN/m

Load 4 Point Other load **10.9** kN at **1.400** m

LOAD COMBINATIONS

Load combination 1

Span 1 1.4×Dead + 1.6×Live + 1×Other

BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

Support A Max react = **-16.5** kN Min react = **-16.5** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

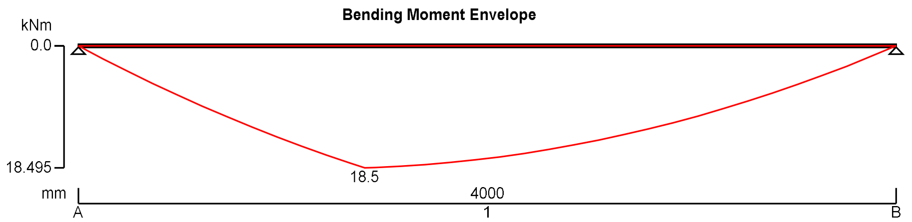
Support B Max react = **-13.2** kN Min react = **-13.2** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

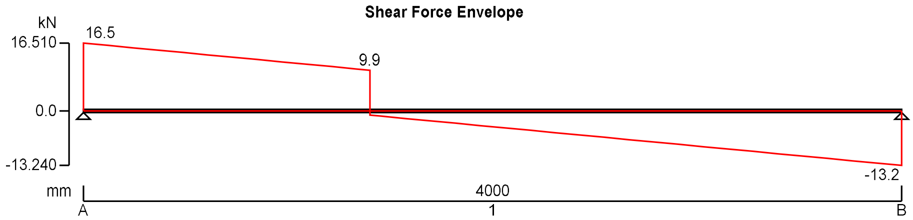
Beam Max/Min results - Combination Summary

Maximum shear = **16.5** kN Minimum shearF_{min} = **-13.2** kN

Maximum moment = **18.5** kNm Minimum moment = **0.0** kNm

Maximum deflection = **4.8** mm Minimum deflection = **0.0** mm





DESIGN SPAN 1

Member design checks for a simply-supported steel beam to BS 5950 (with LTB)

Summary of results

Material	Grade = **"S355"**	p_y = **355** N/mm^2	
Section	**"UB 203x133x30"**	Classification	**"Plastic"**

Check	*Load*	*Capacity*	*Notes*	*Result*
Deflection	δ_{y_max} = **0.1** mm	δ_{lim} = **11.0** mm	**Span / 360 or 11.0 mm**	**Pass**
Shear	F_{vy} = **16.5** kN	P_{vy} = **281.9** kN	**Low shear**	**Pass**
Moment	M_x = **18.5** kNm	M_{cx} = **111.6** kNm	**Low shear**	**Pass**
LTB	M_{LT} = **18.5** kNm	M_b / m_{LT} = **41.9** kNm	L_{E_LT} = **5.2** m m_{LT} = **1.00**	**Pass**

LOAD CALCULATIONS FOR RHS COLUMN 1, 2 & 3:

HEIGHT OF RHS COLUMN = 2800mm

ASSUME A RHS COLUMN = 200 x 100 x 12.5mm RHS

LOAD FROM STEEL BEAM 5 = 91.00 kN

TOP & BOTTOM PLATES = 20mm THICK

BOLTES = 4NOS M20 GR.8.8 BOLTS

LOAD CALCULATIONS FOR RHS COLUMN 1, 2 & 3:

STEEL MEMBER DESIGN TO BS5950: PART 1: 2000

Member design checks for a steel member to BS 5950:2000

Section properties

Try RHS 200x100x12.5 section.

D = **200** mm B = **100** mm T = t = **12.5** mm A_g = A = **67.1** cm^2

$d_x = D - 3 \times t$ = **162.5** mm $b_x = B - 3 \times t$ = **62.5** mm $b_y = d_x$ $d_y = b_x$

I_x = **3136** cm^4 I_y = **1004** cm^4 r_x = **6.84** cm r_y = **3.87** cm

S_x = **408.2** cm^3 S_y = **244.7** cm^3 Z_x = **313.6** cm^3 Z_y = **200.8** cm^3

$A_{vy} = A \times D / (D + B)$ = **44.7** cm^2 $A_{vx} = A \times B / (D + B)$ = **22.4** cm^2

$d_{vx} = A_{vx} / (2 \times t)$ = **89.4** mm $d_{vy} = A_{vy} / (2 \times t)$ = **178.9** mm

$S_{vx} = 2 \times t \times d_{vy}^2 / 4$ = **199.9** cm^3 $S_{vy} = 2 \times t \times d_{vx}^2 / 4$ = **50.0** cm^3

Strut curve (a) for x-axis and y-axis. (Tables 23 & 24) $z_1 = 5/3$ $z_2 = 5/3$

Steel grade **"S355"** p_y = **355** N/mm^2 $p_{yw} = p_y$ $\varepsilon = \sqrt{(275\ N/mm^2 / p_y)}$ = **0.880** K_e = **1.1**

Cl. 3.1.1 & 3.4.3

Geometry

Member has no intermediate restraint.

L = **2800** mm

Buckling:	Restraint:	End 1:	End 2:
Normal to x-axis	Position	**X**	**X**
	Direction		
Normal to y-axis	Position	**X**	**X**
	Direction		

For strut buckling normal to x-axis K_x = **1.00** L_{Ex} = **2800** mm

For strut buckling normal to y-axis K_y = **1.00** L_{Ey} = **2800** mm

Cl. 4.3.5 & 4.7.3

Loading

Internal forces & moments on member under factored loading for uls design:

F_t = 0 kN F_c = **91.00** kN $n = F_c / (A \times p_y)$ = **0.038**

F_{vx} = 0 kN

F_{vy} = 0 kN

M_x = 0 kNm

M_y = 0 kNm

Section classification

b_x / t = **5.0** d_x / t = **13.0** b_y / t = **13.0** d_y / t = **5.0**

$r_{1x} = \min(1.0, \max(-1.0, F_c / (2 \times d_x \times t \times p_{yw})))$ = **0.063**

$r_{1y} = \min(1.0, \max(-1.0, F_c / (2 \times d_y \times t \times p_{yw})))$ = **0.164**

$r_2 = F_c / (A_g \times p_{yw})$ = **0.038**

Section classification is Plastic

Cl. 3.5.1 - 3.5.5

Compression resistance - strut buckling about x-axis

F_c = **91.0** kN L_{Ex} = **2.80** m $\lambda_x = L_{Ex} / r_x$ = **41**

Strut curve (a) applies $\lambda_0 = 0.2 \times (\pi^2 \times E_{S5950} / p_y)^{0.5}$ = **15** a_x = **2.0**

$\eta_x = \max(0, a_x \times (\lambda_x - \lambda_0) / 1000)$ = **0.052** $p_{ex} = \pi^2 \times E_{S5950} / \lambda_x^2$ = **1207** N/mm^2

$\phi_x = (p_y + (\eta_x + 1) \times p_{ex}) / 2$ $p_{cx} = p_{ex} \times p_y / (\phi_x + (\phi_x^2 - p_{ex} \times p_y)^{0.5})$ = **331** N/mm^2

p_{cx} = **331** N/mm^2 $P_{cx} = A \times p_{cx}$ = **2222.7** kN

Check $F_c \le P_{cx}$ Pass - Compression

Slenderness less than 180

Cl. 4.7.4 & Annex C

Compression resistance - strut buckling about y axis

F_c = **91.0** kN L_{Ey} = **2.80** m $\lambda_y = L_{Ey} / r_y$ = **72**

Strut curve (a) applies $\lambda_0 = 0.2 \times (\pi^2 \times E_{S5950} / p_y)^{0.5}$ = **15** a_y = **2.0**

$\eta_y = \max(0, a_y \times (\lambda_y - \lambda_0) / 1000)$ = **0.115** $p_{ey} = \pi^2 \times E_{S5950} / \lambda_y^2$ = **386** N/mm^2

$\phi_y = (p_y + (\eta_y + 1) \times p_{ey}) / 2$ $p_{cy} = p_{ey} \times p_y / (\phi_y + (\phi_y^2 - p_{ey} \times p_y)^{0.5})$ = **262** N/mm^2

$P_{cy} = A \times p_{cy}$ = **1756.4** kN

Check $F_c \le P_{cy}$ Pass - Compression

Slenderness less than 180

Cl. 4.7.4 & Annex C

Results summary

Summary of results

Material	Grade = **"S355"**	p_y = **355** N/mm^2	
Section	**"RHS 200x100x12.5"**	Classification	**"Plastic"**

Check	*Load*	*Capacity*	*Notes*	*Result*
Strut buckling (x-axis)	F_c = **91.0** kN	P_{cx} = **2222.7** kN	L_{Ex} = **2.8** m **Slenderness < 180**	**Pass**
Strut buckling (y-axis)	F_c = **91.0** kN	P_{cy} = **1756.4** kN	L_{Ey} = **2.8** m **Slenderness < 180**	**Pass**

LOAD CALCULATIONS FOR FOOTING:

ASSUME THE FOLLOWING

Length of pad foundation = 1000mm

Width of pad foundation = 1000mm

Depth of pad foundation = 1100mm

Eccentricity = 0mm

Allowable Bearing Pressure = 100.00kN/m2
Of Soil

LOAD ON PAD FOUNDATION FROM RHS COLUMN:

Load from the rhs column = 91.00 kN [Worst Case Loading]

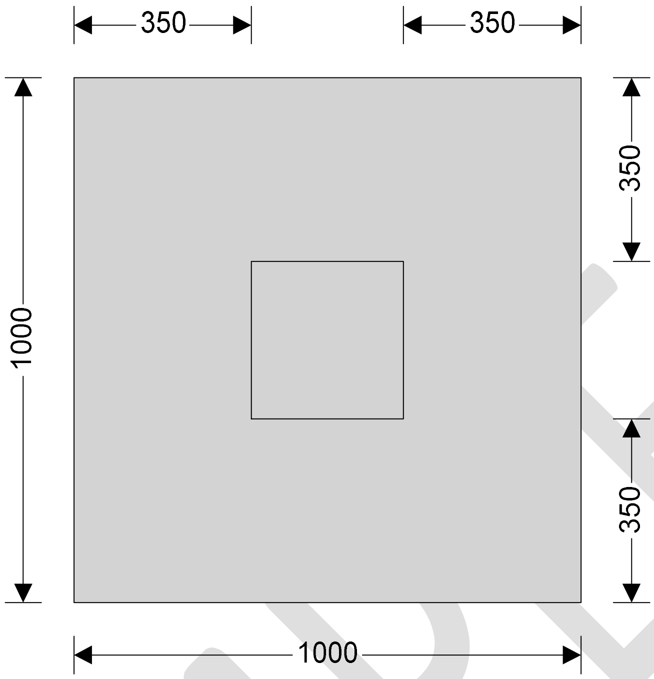
Total unfactored load = 91.00 kN x 0.7

= 63.70 kN

STRUCTURAL REPORT FOR FOOTING:

PAD FOOTING ANALYSIS AND DESIGN (BS8110-1:1997)

TEDDS calculation version 2.0.03.00



Pad footing details	
Length of pad footing	L = **1000** mm
Width of pad footing	B = **1000** mm
Area of pad footing	A = L × B = **1.000** m^2
Depth of pad footing	h = **1100** mm
Depth of soil over pad footing	h_{soil} = **200** mm
Density of concrete	ρ_{conc} = **23.6** kN/m^3
Column details	
Column base length	l_A = **300** mm
Column base width	b_A = **300** mm
Column eccentricity in x	e_{PxA} = **0** mm
Column eccentricity in y	e_{PyA} = **0** mm
Soil details	
Dense, moderately graded, sub-angular, gravel	
Mobilisation factor	m = **1.5**
Density of soil	ρ_{soil} = **20.0** kN/m^3
Design shear strength	ϕ' = **25.0** deg
Design base friction	δ = **19.3** deg
Allowable bearing pressure	$P_{bearing}$ = **100** kN/m^2
Axial loading on column	
Dead axial load on column	P_{GA} = **63.7** kN
Imposed axial load on column	P_{QA} = **0.0** kN
Wind axial load on column	P_{WA} = **0.0** kN
Total axial load on column	P_A = **63.7** kN
Foundation loads	
Dead surcharge load	F_{Gsur} = **0.000** kN/m^2

Imposed surcharge load F_{Qsur} = **0.000** kN/m^2

Pad footing self weight $F_{swt} = h \times \rho_{conc}$ = **25.960** kN/m^2

Soil self weight $F_{soil} = h_{soil} \times \rho_{soil}$ = **4.000** kN/m^2

Total foundation load $F = A \times (F_{Gsur} + F_{Qsur} + F_{swt} + F_{soil})$ = **30.0** kN

Calculate pad base reaction

Total base reaction $T = F + P_A$ = **93.7** kN

Eccentricity of base reaction in x $e_{Tx} = (P_A \times e_{PxA} + M_{xA} + H_{xA} \times h) / T$ = **0** mm

Eccentricity of base reaction in y $e_{Ty} = (P_A \times e_{PyA} + M_{yA} + H_{yA} \times h) / T$ = **0** mm

Check pad base reaction eccentricity

$abs(e_{Tx}) / L + abs(e_{Ty}) / B$ = **0.000**

Base reaction acts within middle third of base

Calculate pad base pressures

$q_1 = T / A - 6 \times T \times e_{Tx} / (L \times A) - 6 \times T \times e_{Ty} / (B \times A)$ = **93.660** kN/m^2

$q_2 = T / A - 6 \times T \times e_{Tx} / (L \times A) + 6 \times T \times e_{Ty} / (B \times A)$ = **93.660** kN/m^2

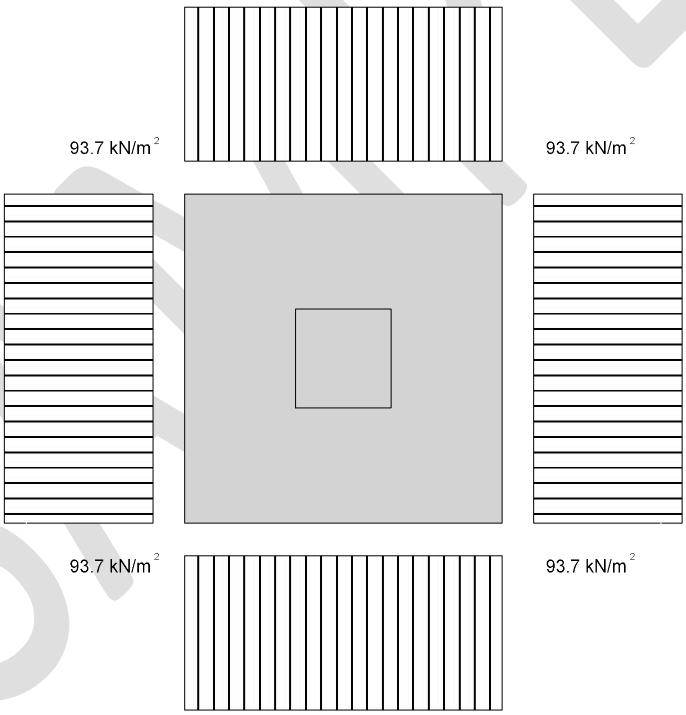
$q_3 = T / A + 6 \times T \times e_{Tx} / (L \times A) - 6 \times T \times e_{Ty} / (B \times A)$ = **93.660** kN/m^2

$q_4 = T / A + 6 \times T \times e_{Tx} / (L \times A) + 6 \times T \times e_{Ty} / (B \times A)$ = **93.660** kN/m^2

Minimum base pressure $q_{min} = min(q_1, q_2, q_3, q_4)$ = **93.660** kN/m^2

Maximum base pressure $q_{max} = max(q_1, q_2, q_3, q_4)$ = **93.660** kN/m^2

PASS - Maximum base pressure is less than allowable bearing pressure



Material details

Characteristic strength of concrete f_{cu} = **30** N/mm^2

Calculate pad lengths in x direction

Left hand length $L_L = L / 2 + e_{PxA}$ = **500** mm

Right hand length $L_R = L / 2 - e_{PxA}$ = **500** mm

Calculate rate of change of base pressure in x direction

Length of base reaction $L_x = L$ = **1000** mm

Rate of change of base pressure $C_x = [(q_1 + q_2) - (q_3 + q_4)] / (2 \times L_x)$ = **0.000** kN/m^2/m

Calculate pad lengths in y direction

Top length	$L_T = B / 2 - e_{PyA} =$ **500** mm
Bottom length	$L_B = B / 2 + e_{PyA} =$ **500** mm

Calculate rate of change of base pressure in y direction

Length of base reaction	$L_y = B =$ **1000** mm
Rate of change of base pressure	$C_y = [(q_1 + q_3) - (q_2 + q_4)] / (2 \times L_y) =$ **0.000** $kN/m^2/m$

Calculate minimum depth of unreinforced pad footing

Average pressure to left of pad footing	$q_L = (q_1 + q_2) / 2 - C_x \times (L_L - l_A / 2) / 2 =$ **93.660** kN/m^2
Minimum depth to left of pad footing	$h_{Lmin} = (L_L - l_A/2) \times \max(0.15 \times [(q_L/1kN/m^2)^2 /(f_{cu}/1N/mm^2)]^{1/4}, 1) =$ **350** mm
Average pressure to right of pad footing	$q_R = (q_3 + q_4) / 2 - C_x \times (L_R - l_A / 2) / 2 =$ **93.660** kN/m^2
Minimum depth to right of pad footing	$h_{Rmin} = (L_R - l_A/2) \times \max(0.15 \times [(q_R/1kN/m^2)^2 /(f_{cu}/1N/mm^2)]^{1/4}, 1) =$ **350** mm
Average pressure to top of pad footing	$q_T = (q_2 + q_4) / 2 - C_y \times (L_T - b_A / 2) / 2 =$ **93.660** kN/m^2
Minimum depth to top of pad footing	$h_{Tmin} = (L_T - b_A/2) \times \max(0.15 \times [(q_T/1kN/m^2)^2 /(f_{cu}/1N/mm^2)]^{1/4}, 1) =$ **350** mm
Average pressure to bottom of pad footing	$q_B = (q_1 + q_3) / 2 - C_y \times (L_B - b_A / 2) / 2 =$ **93.660** kN/m^2
Minimum depth to bottom of pad footing	$h_{Bmin} = (L_B - b_A/2) \times \max(0.15 \times [(q_B/1kN/m^2)^2 /(f_{cu}/1N/mm^2)]^{1/4}, 1) =$ **350** mm
Minimum depth of unreinforced pad footing	$h_{min} = \max(h_{Lmin}, h_{Rmin}, h_{Tmin}, h_{Bmin}, 300\ mm) =$ **350** mm

PASS - Unreinforced pad footing depth is greater than minimum

LOAD CALCULATIONS FOR TIMBER RAFTERS:

SPAN OF RAFTERS = 3150mm

ASSUME RAFTERS = 50mm x 150mm

TIMBER GRADE = C24

JOISTS CENTERS = 400mm

LOADING:

DEAD LOAD ON TIMBER RAFTERS:

PITCHED ROOF = 1.26 kN / m2 x SPAN OF ROOF IN MTS.

= 1.26 x 0.4

= 0.50 kN/m

THEREFORE TOTAL DEAD LOAD ON TIMBER RAFTERS = 0.50 kN/m

LIVE LOAD ON TIMBER RAFTERS:

PITCHED ROOF = 0.75 kN / m2 x SPAN OF ROOF IN MTS.

= 0.75 x 0.4

= 0.30 kN/m

THEREFORE TOTAL LIVE LOAD ON TIMBER RAFTERS = 0.30 kN/m

LOAD CALCULATIONS FOR TIMBER RAFTERS:

Analysis for a simply-supported single-span timber beam to BS 5268

TEDDS calculation version 1.0.02

Span length & partial factors for loading

Span	Factors for moments & forces			Factors for deflection		
(mm)	γ_{fd}	γ_{fi}	γ_{fw}	γ_{dd}	γ_{di}	γ_{dw}
3150	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Loading data (unfactored)

Ref.	Category	Type	Load kN/m	Position mm	Load kN/m	Position mm
1	**"Dead"**	UDL	**0.5**	**0**	-	**3150**
2	**"Imposed"**	UDL	**0.3**	**0**	-	**3150**

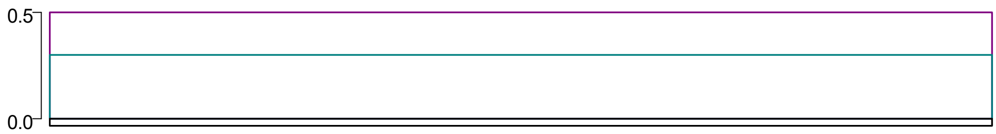
Analysis results - entire span

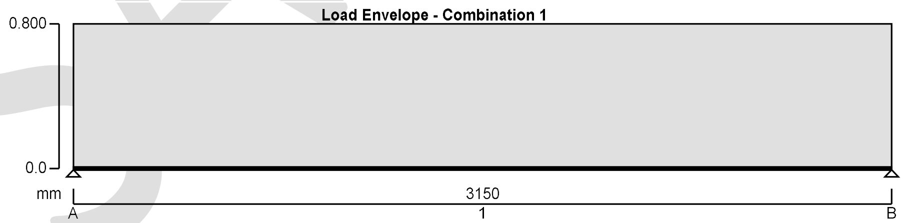
R_a	R_b	V	M		Deflection: δEI	
kN (fac)	kN (fac)	kN (fac)	kNm (fac)	Sense	kNm^3	Direction
1.3	**1.3**	**1.3**	**1.0**	**"Sagging"**	**1.03**	**"Down"**

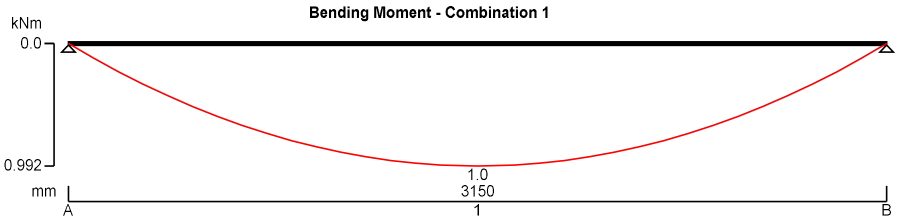
Unfactored support reactions

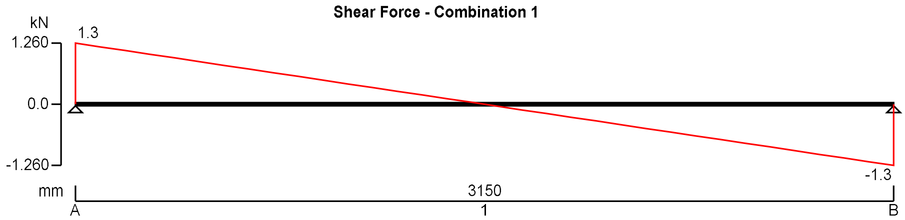
Support A	Dead load **-0.8** kN	Live load **-0.5** kN	Wind load **0.0** kN
Support B	Dead load **-0.8** kN	Live load **-0.5** kN	Wind load **0.0** kN

Beam Loads









Member design checks for a simply-supported single-span timber beam to BS 5268

Timber member design BS 5268-2:2002

Summary of results				
Section size	D = **150** mm	B = **50** mm	A= **7500** mm^2	
Section properties (x-x)	I_{xx} = **14062500** mm^4	Z_{xx} = **187500** mm^3	r_{xx} = **43.3** mm	
(y-y)	I_{yy} = **1562500** mm^4	Z_{yy} = **62500** mm^3	r_{yy} = **14.4** mm	
Grade	**"C24"**	σ_c = **7.90** N/ mm^2		
Check	*Stress*	*Capacity*	*Notes*	*Result*
Bending stress	$\sigma_{m.a.para}$ = M / Z_{xx} = **5.29** N/mm^2	$\sigma_{m.adm.para}$ = **8.09** N/mm^2	Moment M = **1.0** kNm	**Pass**
Shear stress	τ_a = **0.25** N/mm^2	τ_{adm} = **0.71** N/mm^2	Shear V = **1.3** kN	**Pass**
Deflection	δ = **7.0** mm	14 mm		**Pass**
	δ / L_s = **0.00222**	0.003		**Pass**

Padstone Calculator

COMPLIES WITH LATEST DESIGN CODES

structural calculations for padstones for Steel Beam 7

Beam End Reaction = **16.50** kN (factored) Variable Load Safety Factor = 1.5
Factored Load at End of Beam Permanent Load Safety Factor = 1.35

Characteristic strength of masonry = **2.6** N/mm^2 (Brickwork usually = 4.5 N/mm^2)
(3.6N Blockwork usually = 2.6 N/mm^2)
Width of beam end bearing = **100** mm (A Engineering Brick = 13.2 N/mm^2)
Length of beam end bearing = **200** mm (B Engineering Brick = 10.5 N/mm^2)
(Weak Brickwork = approx 2.8 N/mm^2)
(7.3N Blockwork usually = 4.2 N/mm^2)
(10.4N Blockwork usually = 5.4 N/mm^2)

$\gamma m = 3.0$

Bearing Factor = **1.25**

Results

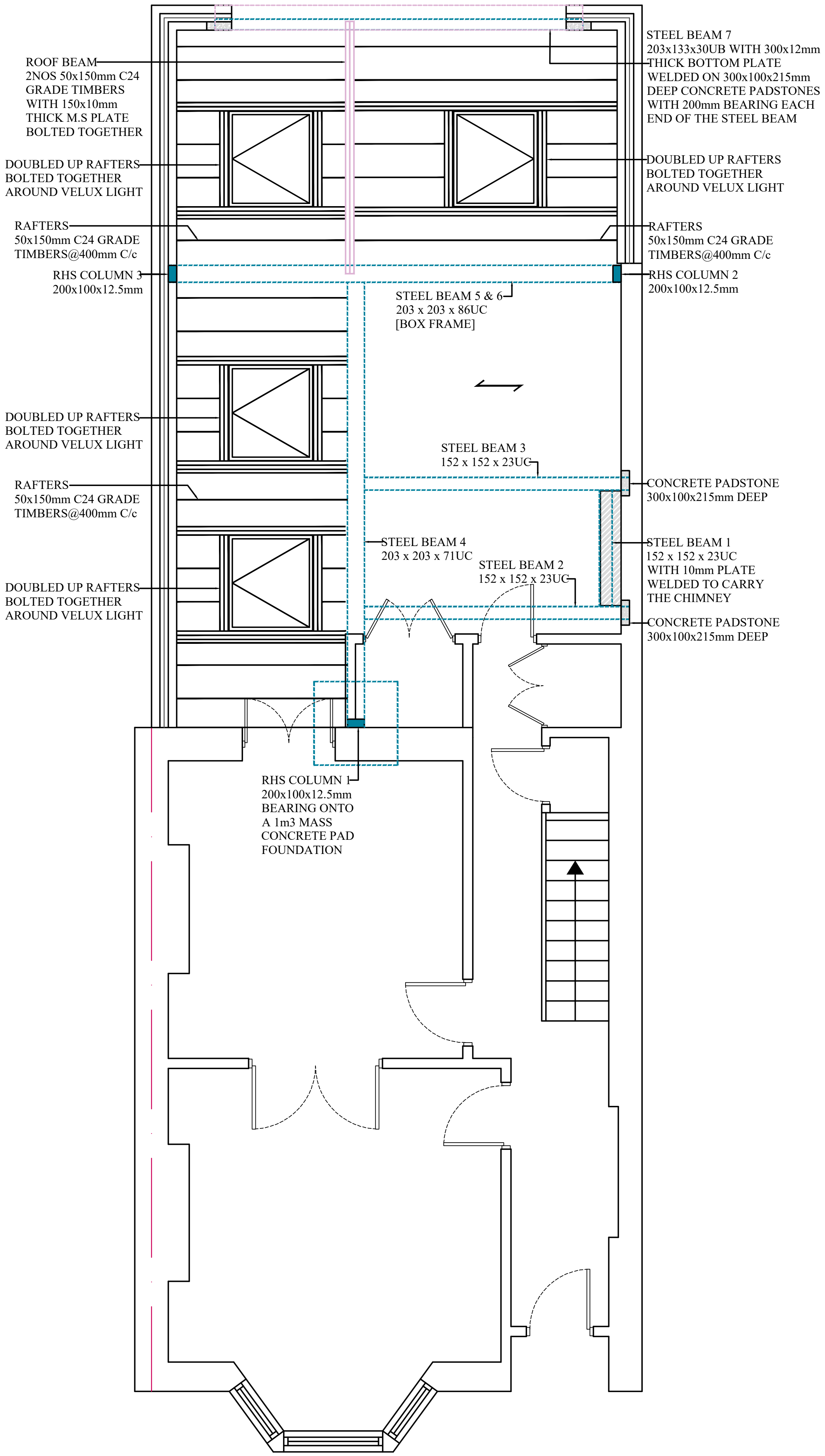
Maximum Bearing Stress =	1.08	N/mm^2
Actual Bearing Stress =	0.83	N/mm^2

Padstone Not Required

Padstone Results

Characteristic strength of Padstone = **40.0** N/mm^2 (A Engineering Brick = 13.2 N/mm^2)
(B Engineering Brick = 10.5 N/mm^2)
Width of Padstone = **100** mm (Concrete C15 = 15 N/mm^2)
Length of Padstone = **300** mm (Concrete C30 = 30 N/mm^2)
(Concrete C40 = 40 N/mm^2)
(Steel Plate = 275 N/mm^2)

Allowable padstone stress =	16.67	N/mm^2	
Stress under beam end bearing =	0.83	N/mm^2	Therefore Padstone Stress OK
Allowable masonry stress =	1.08	N/mm^2	
Stress under padstone =	0.55	N/mm^2	Therefore Masonry Stress OK



PROJECT	N19 4QP
DESCRIPTION	PROPOSED GROUND FLOOR STRUCTURAL PLAN
SCALE	NOT TO SCALE
DRAWINGS NO.	S01
DATE	24-04-2026

DADA STRUCTURAL CONSULTANTS
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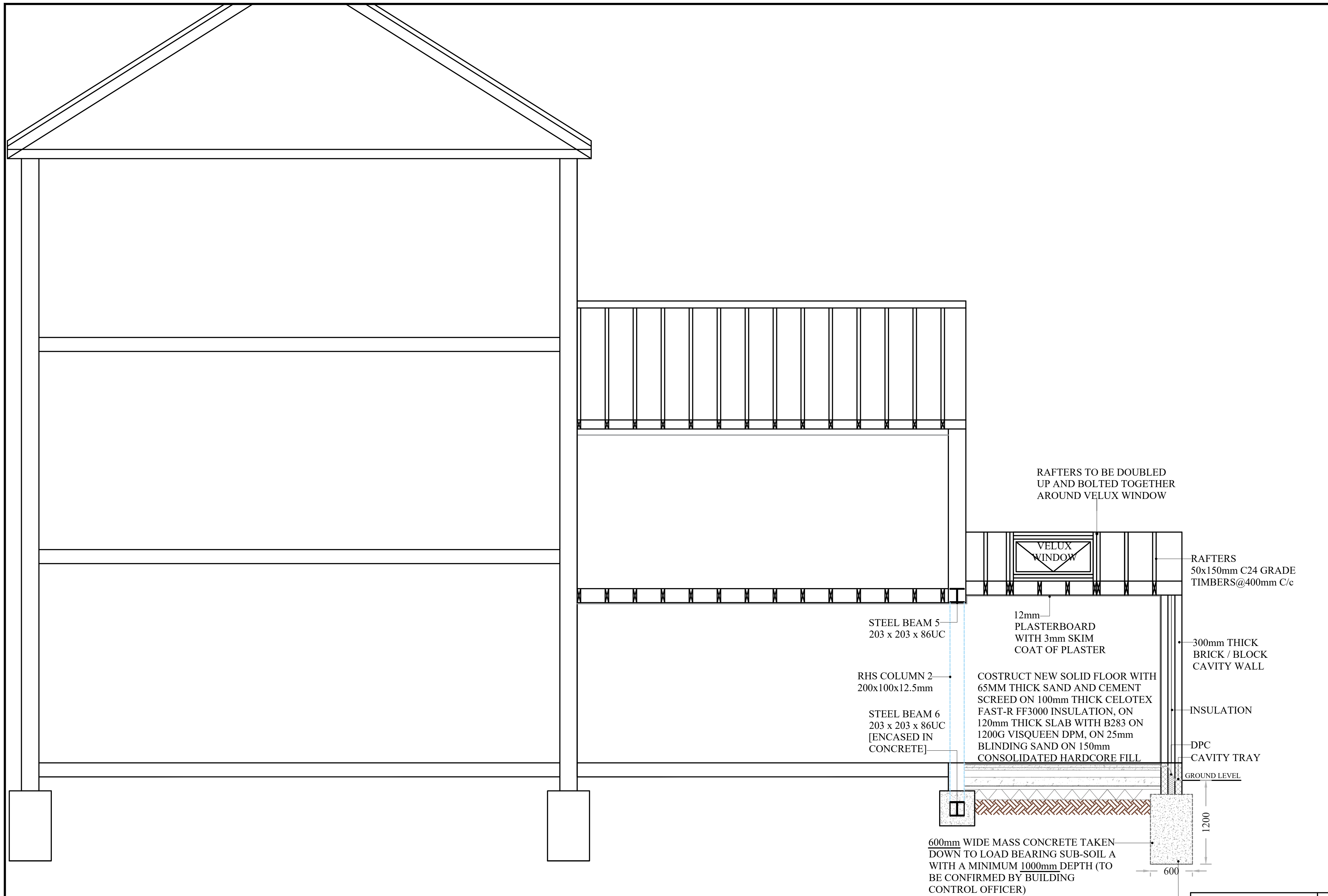
Tel: 07741025944
E-mail: info@dadastructuralconsultants.co.uk
Website:www.dadastructuralconsultants.co.uk

SAMPLE DRAWING



FOUNDATION IS TO BE 600mm WIDE TRENCH CONCRETE FOOTING WITH 1:2:4 CONCRETE MIX.FOUNDATION TO BE 1M DEEP(TO BE DETERMINED BY BUILDING CONTROL).ANY DRAINS PASSING THROUGH FOUNDATION ARE TO BE PROTECTED USING UPVC SLEEVING AND 150X100mm RC BLOCK LINTEL.

FOUNDATION DEPTH ACCORDING TO NHBC FOUNDATION CALCULATOR.FINAL DESIGN AND DEPTHS TO BE DETERMINED BY BUILDING CONTROL

PROJECT	N19 4QP
DESCRIPTION	PROPOSED SECTION
SCALE	NOT TO SCALE
DRAWINGS NO.	S02
DATE	24-04-2026

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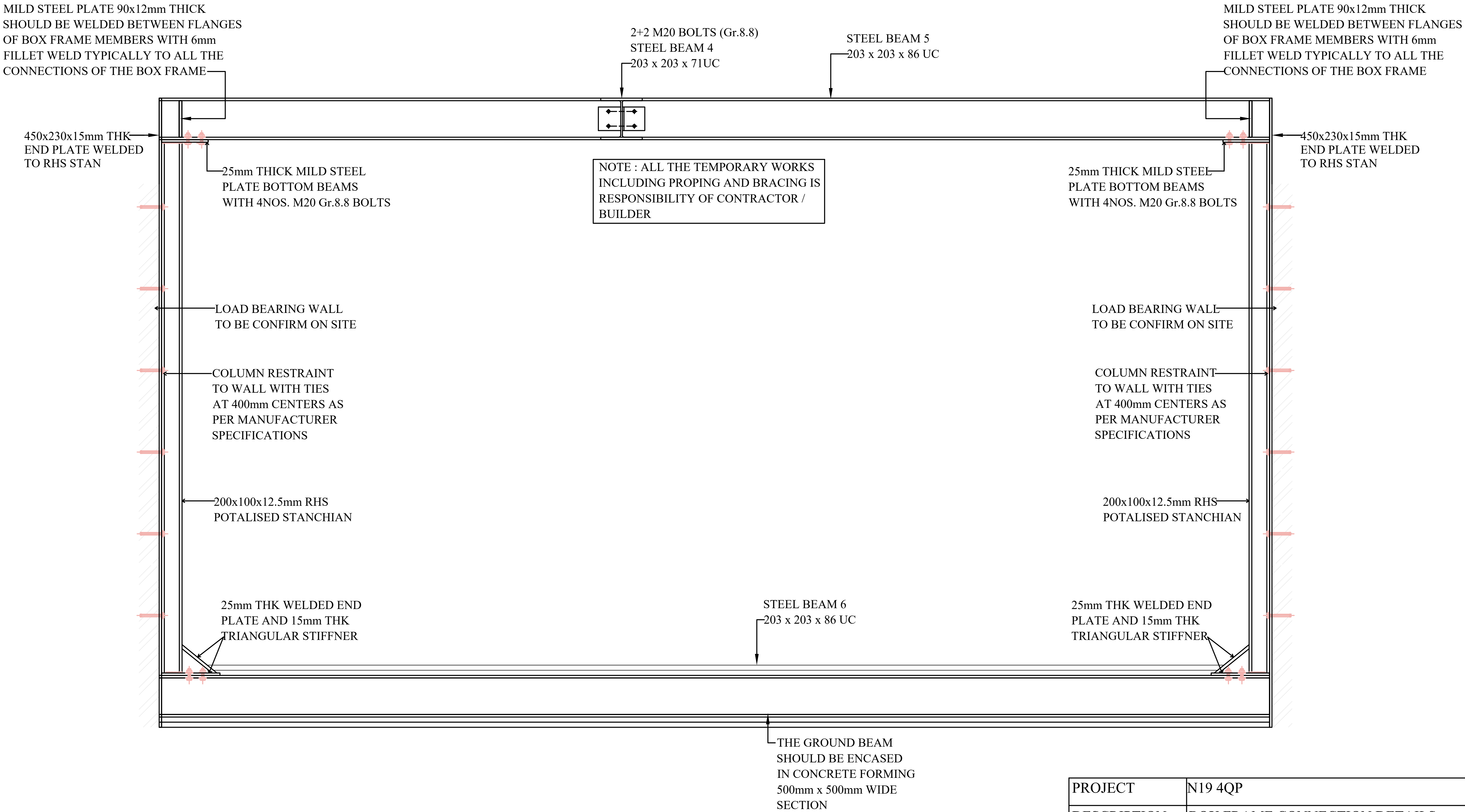
SAMPLE DRAWING



PROJECT	N19 4QP
DESCRIPTION	BOX FRAME CONNECTION DETAILS
SCALE	NOT TO SCALE
DRAWINGS NO.	S03
DATE	24-04-2026

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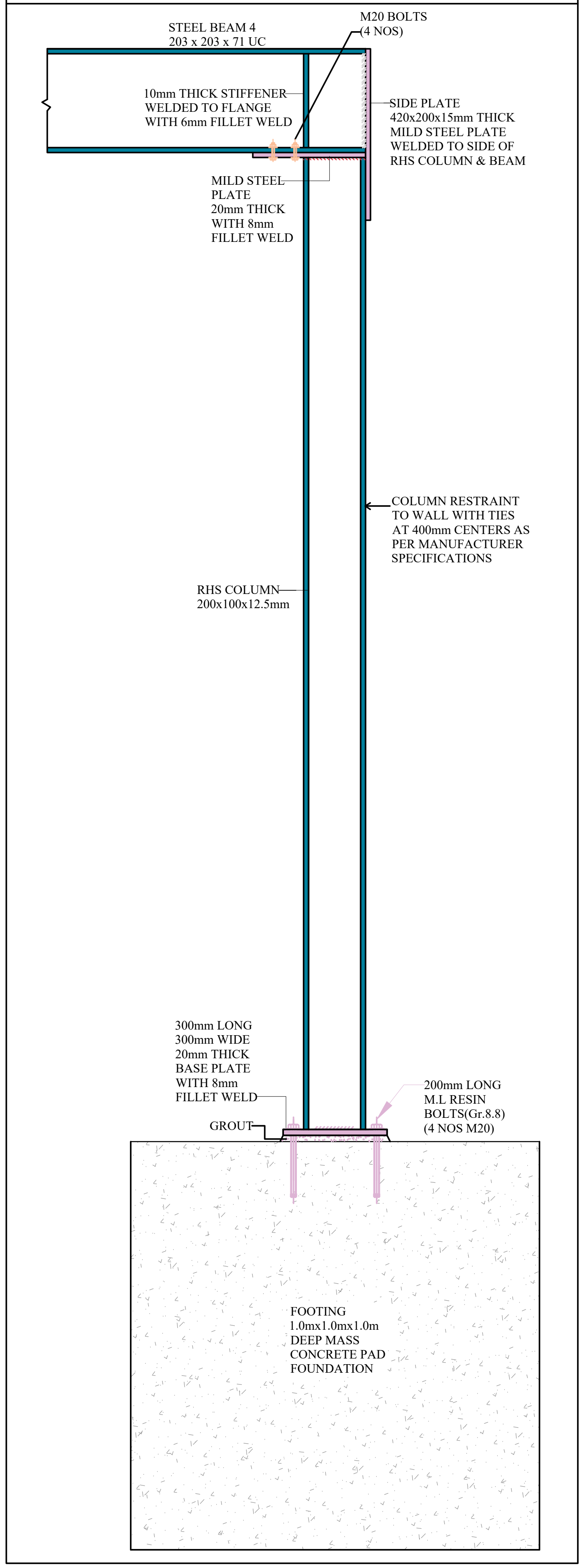
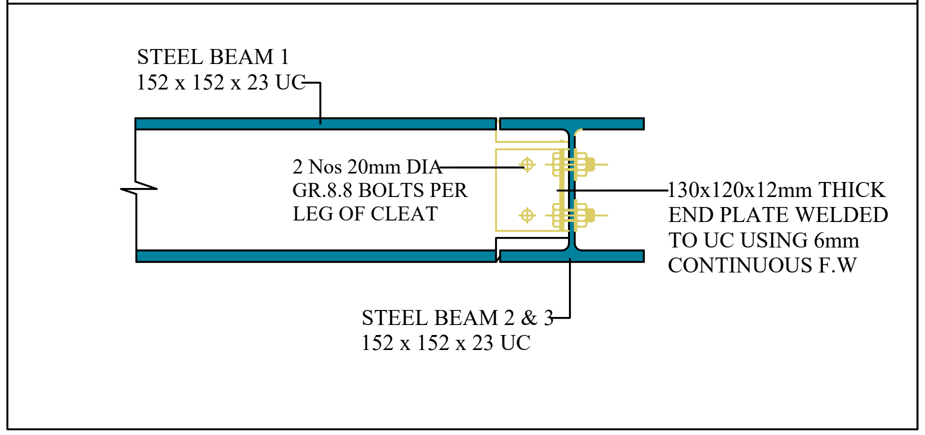
SAMPLE DRAWING

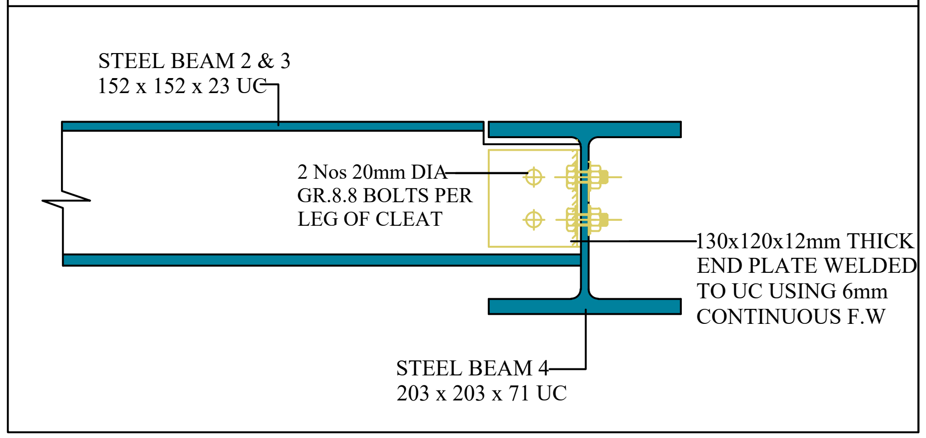
STEEL BEAM 4 TO RHS COLUMN TO PAD FOOTING CONNECTION DETAILS



STEEL BEAM 1 TO STEEL BEAM 2 & 3 CONNECTION DETAILS



STEEL BEAM 2 & 3 TO STEEL BEAM 4 CONNECTION DETAILS



PROJECT	N19 4QP
DESCRIPTION	CONNECTIONS
SCALE	NOT TO SCALE
DRAWINGS NO.	S04
DATE	24-04-2026

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SAMPLE DRAWING