STRUCTURAL CALCULATION REPORT

Client Name **Axxxx**

Client Address xxxx

SAMPLE PROJECT

Project Reference: 2024-03- CR08XW

02 TOWERFIELDS WESTERHAM ROAD BROMLEY, BR2 6HF

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Document Control:

Purpose/Status	Date	Rev.	Comments	Structural Engineer
Approval Issue	22/03/2024		B'Regs Issue	MM

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Job Ref. 2024-03-CR08XW	**Structural Engineer** **MM**		**Date 22/03/2024**

Project Information

Design Codes – Eurocodes and their respective National Annexes:

BS EN 1990. Eurocode 0: 'Basis of structural design'

BS EN 1991. Eurocode 1: 'Actions on structures'

BS EN 1992. Eurocode 2: 'Design of concrete structures'

BS EN 1993. Eurocode 3: 'Design of steel structures'

BS EN 1995. Eurocode 5: 'Design of timber structures'

BS EN 1996. Eurocode 6: 'Design of masonry structures' BS EN 1997. Eurocode 7: 'Geotechnical Design'

ASSUMPTIONS

THE FOLLOWING ASSUMPTIONS ARE MADE ABOUT THE SITE. THEY ARE TO BE CHECKED ON SITE BY THE CONTRACTOR AND BUILDING CONTROL OFFICER PRIOR TO THE START OF THE WORKS. ANY DIFFERENCES ARE TO BE REPORTED TO PEPP IMMEDIATELY.

1. The existing masonry is assumed to be minimum 3.6N/mm^2 blockwork in a 1:2:8 mortar
2. Floor joists are assumed to span as indicated on the drawings.
3. The external walls are assumed to be cavity brickwork.

NOTES

Contractor to check all dimensions before ordering any steel.

All materials and workmanship must fully comply with all relevant current British Standard and Codes of practice.

ITEMS

1. **LOADING DETAILS**
2. **TIMBER DESIGN**

- **Stud Wall** 47 x 100 @ 400 c/c (C-24)
- **Double Trimmer** (2) (47x200) (C-24)

3. **LINTEL**

- **IG L1/HD 100** (For Cavity Wall)
- **IG Box HD 100** (For Solid Wall)

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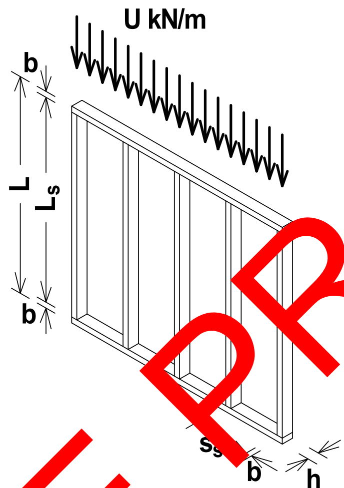
1. LOADING DETAILS

PITCHED ROOF			
Clay Tiles	=	0.65	KN/m^2
Felt and battens	=	0.05	KN/m^2
Timber rafters	=	0.1	KN/m^2
Insulations and other membranes	=	0.1	KN/m^2
Ceiling and services	=	0.2	KN/m^2
Total dead load on the slope	**=**	**1.1**	**KN/m^2**
Live Load	**=**	**0.6**	**KN/m^2**
LOFT FLOOR			
Plywood Flooring	=	0.15	KN/m^2
Timber Joists	=	0.2	KN/m^2
Insulation	=	0.05	KN/m^2
Ceiling and services	=	0.2	KN/m^2
Partitions	=	0.5	KN/m^2
Total dead load	**=**	**1.10**	**KN/m^2**
Live Load	**=**	**1.5**	**KN/m^2**
FIRST FLOOR			
Plywood Flooring	=	0.15	KN/m2
Timber Joists	=	0.2	KN/m2
Insulation	=	0.05	KN/m2
Ceiling and services	=	0.2	KN/m2
Partitions	=	0.5	KN/m^2
Total dead load	=	1.10	**KN/m^2**
Live Load	=	1.5	**KN/m^2**
WALL LOAD			
Brick wall (102 mm)	=	2	KN/m^2
Brick wall with plaster	=	1.9	KN/m^2
Glazing	=	0.5	KN/m^2

2. TIMBER DESIGN

- **Stud Wall** 47 x 100 @ 400 c/c (C-24)

TIMBER STUD DESIGN (BS5268-2:2002)



Stud details

Stud breadth;	b = **47** mm
Stud depth;	h = **100** mm
Number of studs;	N_s = **1**

Strength class C24 timber (Table 8 BS5268:Pt 2:2002)

Section properties

Cross sectional area;	$A = N_s \times b \times h$ = **4700** mm^2
Section modulus;	$Z = N_s \times b \times h^2 / 6$ = **78333** mm^3
Moment of inertia in the major axis;	$I_x = N_s \times b \times h^3 / 12$ = **3916667** mm^4
Moment of inertia in the minor axis;	$I_y = N_s \times h \times b^3 / 12$ = **865192** mm^4
Radius of gyration in the major axis;	$r_x = \sqrt{(I_x / A)}$ = **28.9** mm
Radius of gyration in the minor axis;	$r_y = \sqrt{(I_y / A)}$ = **13.6** mm

Panel details - Studs restrained by sheathing in the plane of the panel

Panel height;	L = **2400** mm
Stud length;	$L_s = L - (2 \times b)$ = **2306** mm
Standard stud spacing;	s_s = **400** mm
Panel opening;	O = **0** mm
Loaded panel length;	$s = \max(s_s, (O + s_s) / 2)$ = **400** mm
Effective length in the major axis;	$L_{ex} = 0.85 \times L_s$ = **1960** mm
Slenderness ratio;	$\lambda = L_{ex} / r_x$ = **67.90**

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Vertical loading details	**Dead loads**	**Imposed loads**
Roof UDL;	U_{r_d} = **5.00** kN/m;	U_{r_i} = **5.00** kN/m
Floor UDL;	U_{f_d} = **5.00** kN/m;	U_{f_i} = **5.00** kN/m
Imposed floor load duration;	**Long term**	

Modification factors

Section depth factor; $K_7 = (300\ \text{mm} / h)^{0.11}$ = **1.13**

Load sharing factor; K_8 = **1.10**

Consider axial compression without bending under medium term loads

Load duration factor; K_3 = **1.25**

Vertical loading; $F = (U_{r\_d} + U_{f\_d} + U_{r\_i} + U_{f\_i})$ ´ s = **[illegible].00** kN

Check compressive stress on stud

Compression member factor; K_{12} = **0.57**

Compression parallel to grain; σ_c = **7.900** N/mm²

Permissible compressive stress; $\sigma_{c\_adm} = \sigma_c \times K_3 \times K_8 \times K_{12}$ = **6.200** N/mm²

Applied compressive stress; $\sigma_{c\_max} = F / (N_s \times b \times h)$ = **1.702** N/mm²

PASS - Applied compressive stress under medium term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor; K_4 = **1.24**

Compression perpendicular to grain (no wane); σ_{cp1} = **2.400** N/mm²

Permissible compressive stress; $\sigma_{cp1\_adm} = \sigma_{cp1} \times K_3 \times K_4$ = **3.717** N/mm²

Applied compressive stress; $\sigma_{cp1\_max} = F / (N_s \times b \times h)$ = **1.702** N/mm²

PASS - Applied compressive stress under medium term loads is within permissible limits

Consider axial compression without bending under long term loads

Load duration factor; K_3 = **1.00**

Vertical loading; $F = (U_{r\_d} + U_{f\_d} + U_{f\_i})$ ´ s = **6.00** kN

Check compressive stress on stud

Compression member factor; K_{12} = **0.61**

Compression parallel to grain; σ_c = **7.900** N/mm²

Permissible compressive stress; $\sigma_{c\_adm} = \sigma_c \times K_3 \times K_8 \times K_{12}$ = **5.301** N/mm²

Applied compressive stress; $\sigma_{c\_max} = F / (N_s \times b \times h)$ = **1.277** N/mm²

PASS - Applied compressive stress under long term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor; K_4 = **1.24**

Compression perpendicular to grain (no wane); σ_{cp1} = **2.400** N/mm²

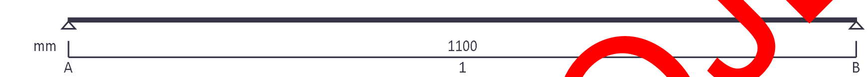
Permissible compressive stress; $\sigma_{cp1\_adm} = \sigma_{cp1} \times K_3 \times K_4$ = **2.974** N/mm²

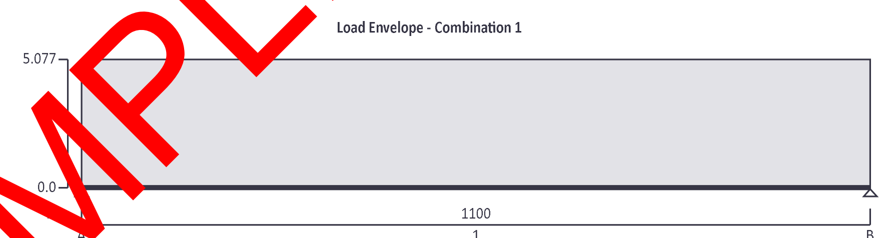
Applied compressive stress; $\sigma_{cp1\_max} = F / (N_s \times b \times h)$ = **1.277** N/mm²

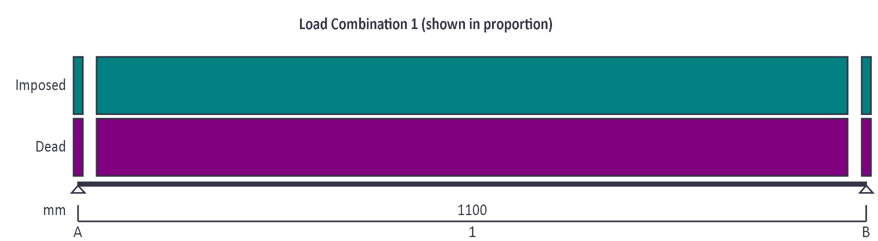
PASS - Applied compressive stress under long term loads is within permissible limits

- **Double Trimmer** (2) (47 x 200) (C-24)

TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002







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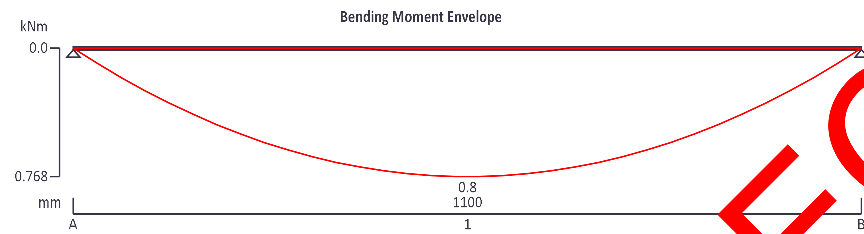
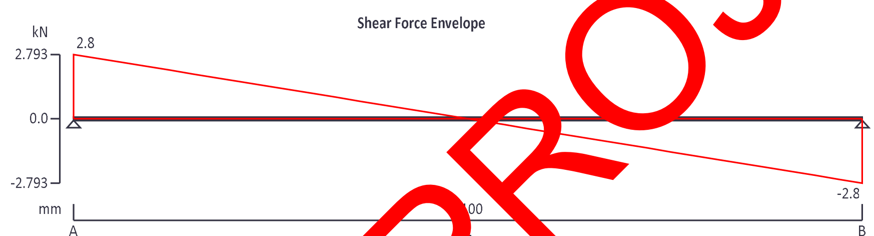




Applied loading

Beam loads

SW	Dead self weight of beam ´ 1
DL	Dead full UDL 3.000 kN/m
LL	Imposed full UDL 2.000 kN/m

Load combinations

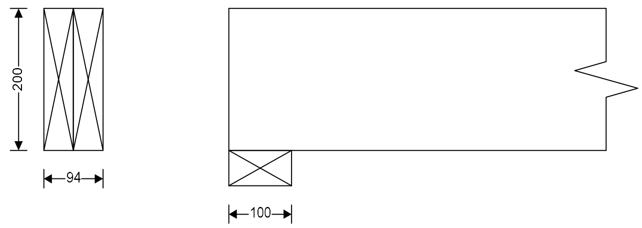
Load combination 1	Support A	Dead ´ 1.00
		Imposed ´ 1.00
	Span 1	Dead ´ 1.00
		Imposed ´ 1.00
	Support B	Dead ´ 1.00
		Imposed ´ 1.00

Analysis results

Maximum moment;	M_{max} = **0.768** kNm;	M_{min} = **0.000** kNm
Design moment;	M = max(abs(M_{max}),abs(M_{min})) = **0.768** kNm	
Maximum shear;	F_{max} = **2.793** kN;	F_{min} = **-2.793** kN
Design shear;	F = max(abs(F_{max}),abs(F_{min})) = **2.793** kN	
Total load on beam;	W_{tot} = **5.585** kN	
Reactions at support A;	R_{A_max} = **2.793** kN;	R_{A_min} = **2.793** kN
Unfactored dead load reaction at support A;	R_{A_Dead} = **1.693** kN	
Unfactored imposed load reaction at support A;	$R_{A\_Imposed}$ = **1.100** kN	
Reactions at support B;	R_{B_max} = **2.793** kN;	R_{B_min} = **2.793** kN

Unfactored dead load reaction at support B; R_{B_Dead} = **1.693** kN

Unfactored imposed load reaction at support B; $R_{B\_Imposed}$ = **1.100** kN



Timber section details

Breadth of sections; b = **47** mm

Depth of sections; h = **200** mm

Number of sections in member; N = **2**

Overall breadth of member; b_b = N × b = **94** mm

Timber strength class; **C24**

Member details

Service class of timber; **2**

Load duration; **Long term**

Length of span; L_{s1} = **1100** mm

Length of bearing; L_b = **100** mm

Section properties

Cross sectional area of member; $A = N \times b \times h =$ **18800** mm^2

Section modulus; $Z_x = N \times b \times h^2 / 6 =$ **626667** mm^3

$Z_y = h \times (N \times b)^2 / 6 =$ **294533** mm^3

Second moment of area; $I_x = N \times b \times h^3 / 12 =$ **62666667** mm^4

$I_y = h \times (N \times b)^3 / 12 =$ **13843067** mm^4

Radius of gyration; $i_x = \sqrt{(I_x / A)} =$ **57.7** mm

$i_y = \sqrt{(I_y / A)} =$ **27.1** mm

Modification factors

Duration of loading - Table 17; K_3 = **1.00**

Bearing stress - Table 18; K_4 = **1.00**

Total depth of member - cl.2.10.6; $K_7 = (300 \text{ mm} / h)^{0.11} =$ **1.05**

Load sharing - cl.2.9; K_8 = **1.00**

Lateral support - cl.2.10.8

Ends held in position

Permissible depth-to-breadth ratio - Table 19; **3.00**

Actual depth-to-breadth ratio; h / (N ´ b) = **2.13**

PASS - Lateral support is adequate

Compression perpendicular to grain

Permissible bearing stress (no wane); $\sigma_{c\_adm} = \sigma_{cp1}$ ´ K_3 ´ K_4 ´ K_8 = **2.400** N/mm^2

Applied bearing stress; $\sigma_{c\_a} = R_{A\_max} / (N ´ b ´ L_b) =$ **0.297** N/mm²

$\sigma_{c\_a} / \sigma_{c\_adm} =$ **0.124**

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permissible bending stress; $\sigma_{m\_adm} = \sigma_m ´ K_3 ´ K_7 ´ K_8 =$ **7.842** N/mm²

Applied bending stress; $\sigma_{m\_a} = M / Z_x =$ **1.225** N/mm²

$\sigma_{m\_a} / \sigma_{m\_adm} =$ **0.156**

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress; $\tau_{adm} = \tau ´ K_3 ´ K_8 =$ **0.710** N/mm²

Applied shear stress; $\tau_a = 3 ´ F / (2 ´ A) =$ **0.2[illegible]3** N/mm²

$\tau_a / \tau_{adm} =$ **0.314**

PASS - Applied shear stress is less than permissible shear stress

Deflection

Modulus of elasticity for deflection; $E = E_{min} =$ **7200** N/mm²

Permissible deflection; $\delta_{adm} = \min(0.551 \text{ in}, 0.003 ´ L_{s1}) =$ **3.300** mm

Bending deflection; $\delta_{b\_s1} =$ **0.215** mm

Shear deflection; $\delta_{v\_s1} =$ **0.109** mm

Total deflection; $\delta_a = \delta_{b\_s1} + \delta_{v\_s1} =$ **0.323** mm

$\delta_a / \delta_{adm} =$ **0.098**

PASS - Total deflection is less than permissible deflection

3. LINTEL

- **IG L1/HD 100** (For Cavity walls with 90-105mm cavity)

We had taken loadings being applied on our lintel:

- Floor Load
- Cavity wall Load

Our load derivation for each source for lintel is as follows;

Floor Load;

Dead Load: 1.1 kN/m^2

Live Lead: 0.6 kN/m^2

Tributary Length = 1.5 m

Dead Load (UDL) = 1.1 x 1.5 = 1.65 kN/m

Live Load (UDL) = 0.6 x 1.5 = 0.96 kN/m

Cavity Wall Load;

Dead Load: 4.4 kN/m^2

Dead Load (UDL) = 11.2 kN/m

Total Dead Load (UDL): = 12.85 KN/m

Total Live Load (UDL): = 1 KN/m

Total Load (UDL) = 13.85 KN/m

Hence,

Required Load Carrying Capacity = 13.85 KN Required

Length = 1000 (with bearing on both sides)

IG L1/HD 100 Lintel for 100 mm cavity of 1000 mm as Per Requirement can carry = 22 KN

Load Carrying capacity of Provided Lintel = 22 KN

Hence,

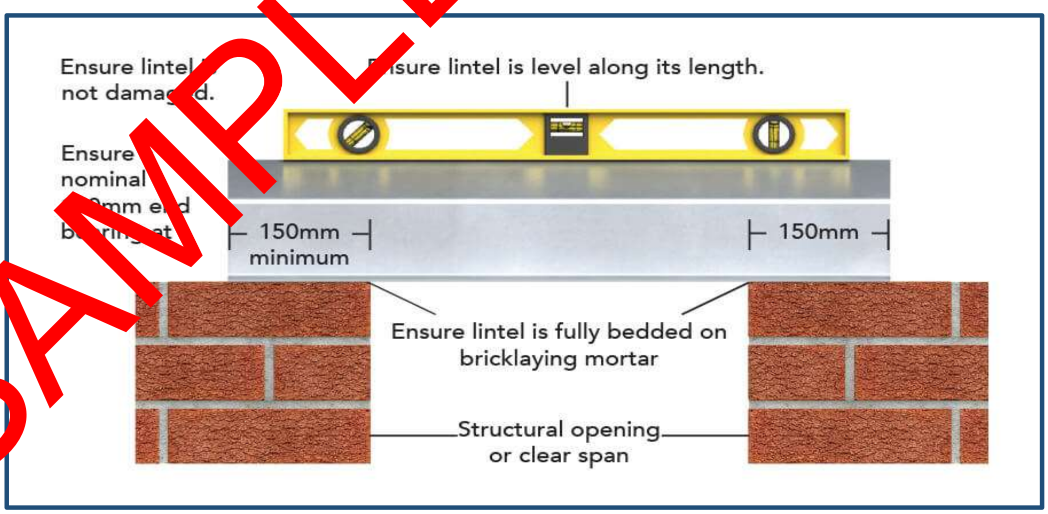
Provided > Required

Select a suitable lintel according to the span

Length	Height	Thickness	Total UDL KN 3:1	Total UDL KN 19:1
600	110	2.9	30	22
1200				
1350	135	2.9	30	[illegible]
1500				
1650	163	2.9	40	35
2100				
2250	203	2.9	[illegible]	35
2550				
2700	203	3.2	40	35
3000				
3150	203	3.2	[illegible]	32
3600				
3750	203	[illegible]	33	28
4200				

Installation

Provide a minimum bearing of 150mm on both sides



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- **IG Box HD 100** (For solid wall)

Select a suitable lintel according to the span

Length (mm)	Height (mm)	Thickness (mm)	Total UDL kN
600	150	2.5	50
1200			
1350	150	2.5	45
1800			
1950	215	2.5	50
2400			
2550	215	2.5	40
2700			

Installation

Provide a minimum bearing of 150 mm on both sides