

**CROUCH
WATERFALL**

ON BEHALF OF



**Structural Design
Proposed House
adjacent to
51 Longwood Avenue**

Job Number: 16-465G-1 (Edition 1)

JULY 2017

**Proposed House
adjacent to
51 Longwood Avenue**

Document: 16-465G-1 (Edition 1)

	Edition 1		Edition 2		Edition 3	
History	Initial Issue					
	Date	Initials	Date	Initials	Date	Initials
Prepared by	12.07.17					
Checked by	12.07.17					
Approved by	12.07.17					

FOR CROUCH WATERFALL

Suite 5.01
Network House
Basing View
Basingstoke
RG21 4HG

DESIGN CRITERIA

**CROUCH
WATERFALL**

Project Title

Proposed House adjacent to 51 Longwood Avenue

Job No

16-465G

By

GL

Date

July 2017

Date

July '17

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Design Criteria

References

Element of Works

Design of New Detached house

Results

Intended Use

Domestic

Loading

As detailed on loading schedules

Standards Adopted

BS-6399

BS-5950

BS-5628

BS-5268

BS-8110

Materials

Loadings

Steel

Masonry

Timber

Concrete

Design Assumptions / Limitations

None

Computer Analysis Reference

Tedds

Design Check Level

Internal

A

Internal

B

External

C

Checked Externally By :-

Comments

Company:-

Date :-

CALCULATION SHEET				CROUCH WATERFALL
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		Checked BS	Date July 2017	Page of Contents
References	<u>Calculations - Contents</u>			Results
	1 Loading Schedule 1-3 2 Posi-Joist Design 4-5 3 Beam and Column Design 6-7 4 Beam and Block Design 8 5 Timber Stud Wall Design 9 6 Foundation Design 10 7 Overturning Check due to Wind Load 11-13 8 Lintel Design 14-17			
	<u>Sketches</u>			
	Foundation			
	First Floor			
	Section			

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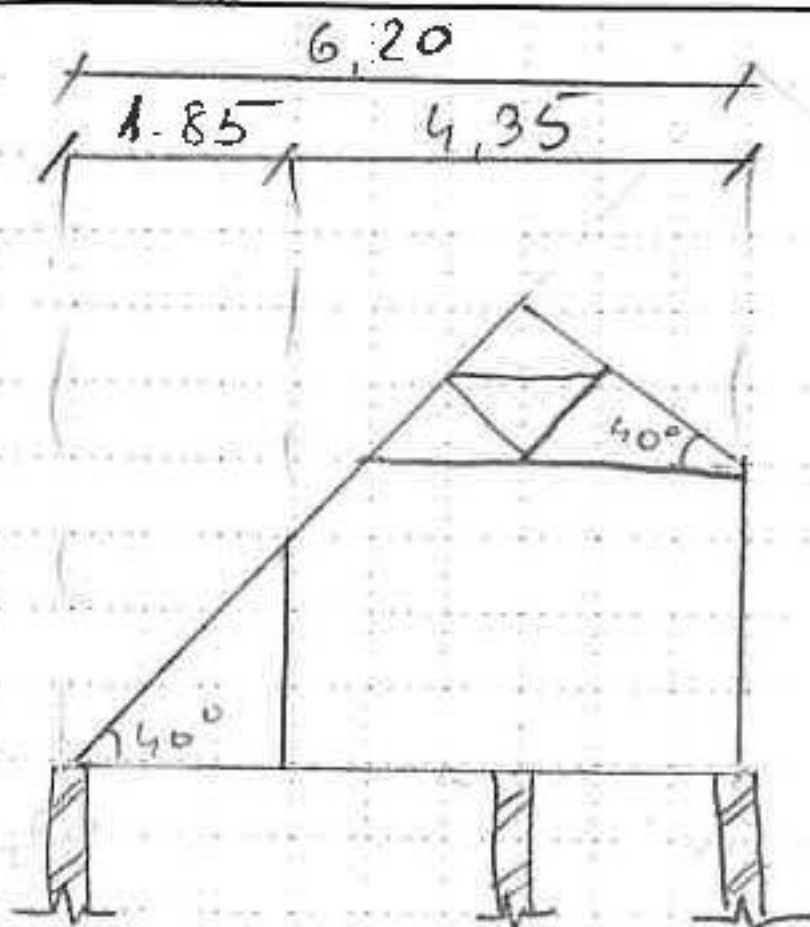
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Derivation of Loading

1.1. Roof - Dead Load

- Clay Tiles 0,71 kN/m²
- Insulation (Mineral Wool) 175mm 0,06 kN/m²
- Rafters / Counter Battens 0,14 kN/m²
- Plywood sheet 0,12 kN/m²
- Plaster board 12.5mm 0,11 kN/m²

$$\Sigma = 1,14 \text{ kN/m}^2$$

$$\text{On plan: } 1,14 / \cos 40^\circ = 1,49 \text{ kN/m}^2 \approx \underline{\underline{1,50 \text{ kN/m}^2}}$$

1.2 Roof - Imposed - Live Load 0,75 kN/m²

1.3 First Floor - Dead Load

- Per-Joint - 0,4 kN/m²
- Insulation - 0,06 kN/m²
- Plaster Board - 0,11 kN/m²
- Partitions - 1 kN/m²
- Ceiling and services - 0,25 kN/m²

$$\Sigma = \underline{\underline{1,82 \text{ kN/m}^2}}$$

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1.4 First Floor - Imposed - Line Load 1.5 kN/m^2

1.5 Wall - Partition (Timber Wall)

→ Boarding 0.16

→ Studs 0.20

→ Insulation 0.05

→ Board lining 0.15

→ Master Board 0.13

$$\Sigma = 0.69 \text{ kN/m}^2$$

For $H = 1.82 \Rightarrow 0.69 \cdot 1.82 = \underline{1.26 \text{ kN/m (linear)}}$

1.6 Wall - External - Timber

→ Brickwork $102.5 \text{ mm} = 2.25 \text{ kN/m}^2$

→ 18 mm Plywood 0.12 kN/m^2

→ Studs 0.15 kN/m^2

→ Mineral Wool insulation 0.10 kN/m^2

→ Plaster (inside face) 0.25 kN/m^2

$$\Sigma = \underline{2.87 \text{ kN/m}^2}$$

1.7 Ground floor - Dead Load →

Screed 1.80

Insulation 0.10

Beam and Block 2.50

Finishes 0.10

Underfloor heating 0.15

$$\Sigma = \underline{4.65 \text{ kN/m}^2}$$

1.8 Ground Floor - Line Load - imposed

$$\underline{1.50 \text{ kN/m}^2}$$

CALCULATION SHEET		CROUCH WATERFALL	
Project Title 51 Longwood Avenue		Job No 16-4656	By GL
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References	Summary of Loading Roof - Δ 1.50 kN/m² - i 0.75 kN/m² First Floor - Δ 1.82 kN/m² - i 1.50 kN/m² Wall - Partition - Δ 1.26 kN/m² Wall - External - Δ 2.87 kN/m² Ground Floor - Δ 4.65 kN/m² - i 1.50 kN/m²		Results

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References

Results

Poi - Joint Design (1/2)

Loading

Roof

Δ

$$\frac{6,2}{2} \cdot 1,5 = 4,65 \text{ kN/m}$$

i

$$\frac{6,2}{2} \cdot 0,75 = 2,335 \text{ kN/m}$$

Wall

Δ

$$1,80 \cdot 0,69 = 1,25 \text{ kN/m}$$

Floor & Ceiling

Δ

$$0,82 \text{ kN/m}^2$$

L

$$1,5 \text{ kN/m}^2$$

P

$$1 \text{ kN/m}^2$$

Assume 600 % spacing $\Rightarrow$

$\Rightarrow$

$$W = 0,6 \times (0,82 + 1,5 + 1) = 2 \text{ kN/m}$$

$$P = 0,6 \times (4,65 + 2,33 + 1,25) = 4,94 \text{ kN}$$

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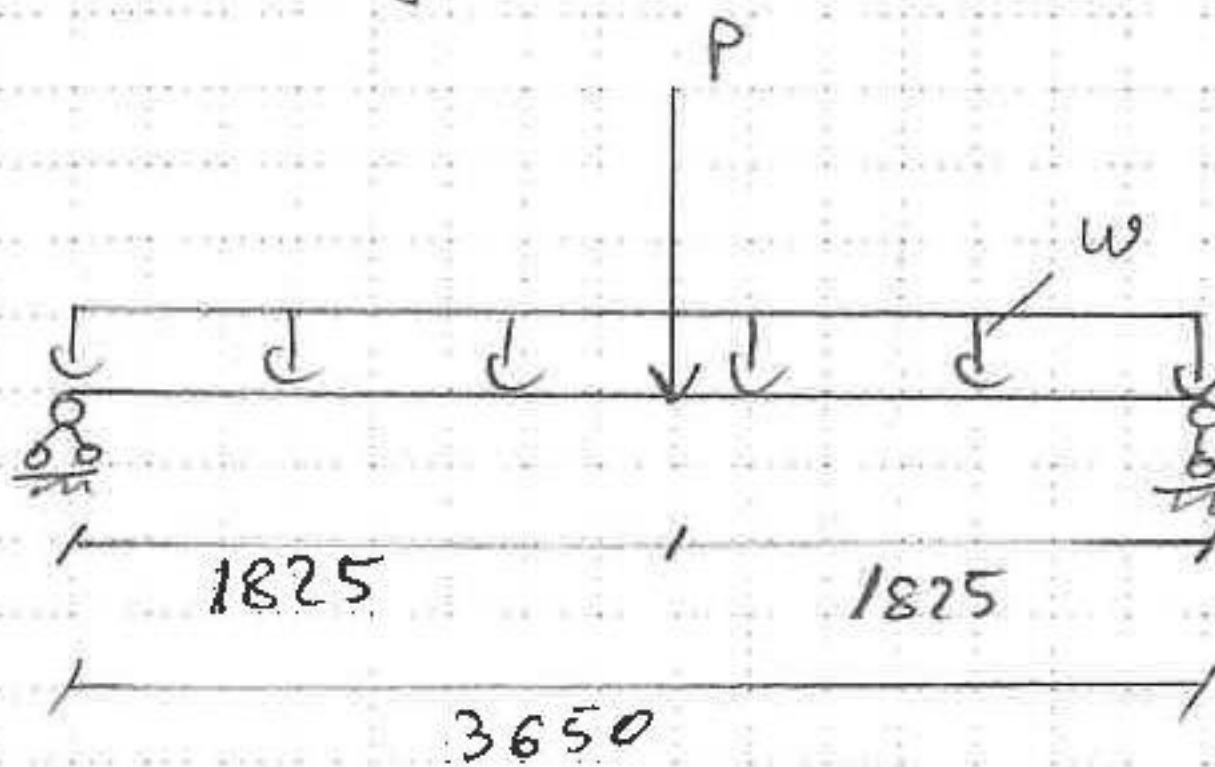
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Pier - Joint Design (2/2)

Assume - $L_s = 3650$ mm

Spacing - $\Delta = 600$ mm

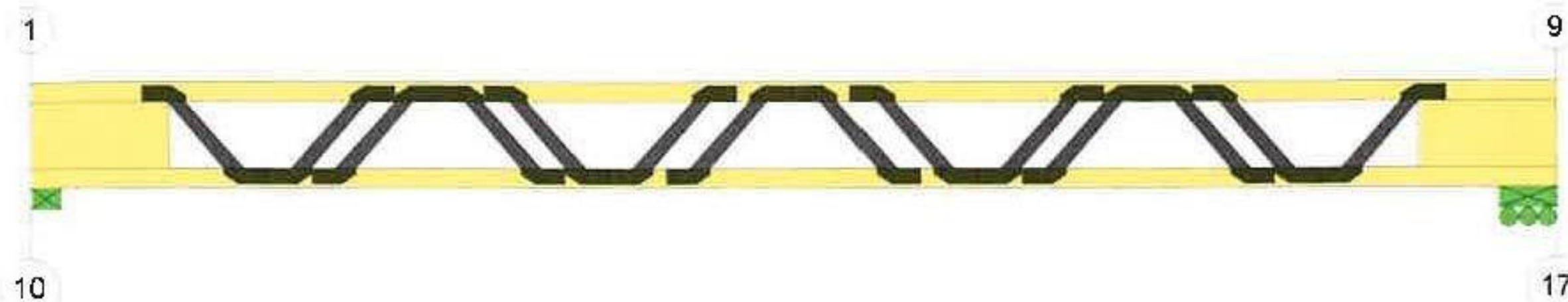


$$\begin{cases} w = 2 \text{ kN/m} \\ P = 4.94 \text{ kN} \quad \left(\begin{array}{l} \Delta 354 \text{ kN} \\ \Delta 1.40 \text{ kN} \end{array} \right) \end{cases}$$

$$\delta_{\text{max}} = \frac{5}{384} \cdot \frac{w l^4}{E I} + \frac{P l^3}{48 E I} = (4.62 + 5.4) / E I = 8.86 / E I \quad (\text{m})$$

$$M_{\text{max}} = w l^2 / 8 + P l / 4 = 7.84 \text{ kN.m}$$

PS-10 N - Top and Bottom Chord: 122 X 47 C24
@ 600 mm Depth: 253 mm



Scale 1:25

Truss Input Parameters:

Span	3650	Spacing	600
Beam Depth	253	Transport Length	3650
Left Cantilever	0	Right Cantilever	0
Left Overhang	0	Right Overhang	0

General Specification:

British Standard BS 5268 Structural Use of Timber

- Part 2: Code of Practice for Permissible Stress Design, Materials and Workmanship 1996,
- Part 3: Code of Practice for Trussed Rafter Roofs 1998.

British Standard BS 6399: Loading of Buildings:

- Part 1: Code of Practice for Dead and Imposed Loads 1996.

Timber Properties

Grade	Bending N/mm ²	Tension N/mm ²	Tens Perp. N/mm ²	Comp N/mm ²	C. Perp N/mm ²	Shear N/mm ²	E _{min} kN/mm ²	E kN/mm ²
C16	5.3	3.2	0.20	6.8	2.2	0.6	5.8	8.8
C24	7.5	4.5	0.23	7.9	2.4	0.7	7.2	10.8
TR26	10.0	6.0	0.36	8.2	2.5	1.1	7.4	11.0

Materials:

Timber:

Top chord	122x47 TR26 R/W
Bottom chord	122x47 TR26 R/W
Block	47x159 TR26 R/W

Approvals:

Connector Plates: Tested and approved to ETA-07/0161

Posi-Joists: Tested and approved to EN 1075 / EN 14545

Designed by:

MiTek Industries Limited
MiTek House,, Grazebrook Industrial Park,, Peartree Lane,, Dudley,, West Midlands, DY2 0XW
Phone: 01384 451400
Fax: 01384 451411
Date: 13 Jul 2017

Standard Loading:

Floor Load Imposed	1.500 kN/m ²
Floor Load Dead	0.250 kN/m ²
Bottom Chord Dead	0.250 kN/m ²
Partition Load	1.000 kN/m ²

Load Cases Considered:

1: Vibration Check	Dead+M.Term
2: Long Term Floor	Dead+Floor Live



Additional Concentrated Loads :

Type	X	Chord	Load (kN)	Direction	From
Dead	1825	Top	3.540	Down	

Design Results (Member):

Member Type Timber			CSI	LC	SSI	LC	Length & Angle		Buck Len	IP	OP	Maximum			Start		End	
												F (kN)	M (kNm)	V (kN)	F (kN)	M (kNm)	F (kN)	M (kNm)
1-2	TC	122x47 TR26	0.254	OP	2		265	0	530	265		-8.51	0.017		0.00	0.002	-8.51	0.024
2-3	TC	122x47 TR26	0.470	IP	2	0.152	2	711	0	414	710	-11.94	-0.111	0.704	-11.94	-0.115	-11.94	0.017
3-4	TC	122x47 TR26	0.906	IP	2	0.131	2	713	0	713	713	-25.25	0.107	0.606	-25.25	0.034	-25.25	0.044
4-5	TC	122x47 TR26	0.948	OP	2	0.231	2	136	0	136	135	-27.66	0.127	1.069	-27.66	0.022	-27.66	0.138
5-6	TC	122x47 TR26	0.948	OP	2	0.231	2	136	0	136	136	-27.66	0.127	1.068	-27.66	0.138	-27.66	0.023
6-7	TC	122x47 TR26	0.904	IP	2	0.131	2	711	0	711	711	-25.25	0.106	0.604	-25.25	0.044	-25.25	0.034
7-8	TC	122x47 TR26	0.471	IP	2	0.153	2	713	0	417	713	-11.94	-0.111	0.706	-11.94	0.017	-11.94	-0.115
8-9	TC	122x47 TR26	0.254	OP	2		265	0	530	265		-8.51	0.017		-8.51	0.024	0.00	0.002
10-11	BC	122x47 TR26	0.601	IP	2	0.308	2	568	0	568		8.51	-0.219	1.423	3.71	0.019	8.51	0.114
11-12	BC	122x47 TR26	0.620	IP	2	0.051	2	819	0	776		19.54	0.105	0.236	19.54	0.114	19.54	-0.028
12-13	BC	122x47 TR26	0.771	IP	2	0.214	2	136	0	136		27.66	0.092	0.992	27.66	-0.028	27.66	0.105
13-14	BC	122x47 TR26	0.838	IP	2	0.010	2	605	0	605		29.02	0.112	0.046	29.02	0.108	29.02	0.108
14-15	BC	122x47 TR26	0.771	IP	2	0.214	2	136	0	136		27.66	0.092	0.992	27.66	0.105	27.66	-0.028
15-16	BC	122x47 TR26	0.621	IP	2	0.051	2	819	0	776		19.57	0.105	0.236	19.57	-0.028	19.57	0.114
16-17	BC	122x47 TR26	0.600	IP	2	0.307	2	568	0	568		8.51	-0.219	1.422	8.51	0.114	3.71	0.019
2-11	WB	PS-10N	0.790	IP	2		366	-34	329			4.15			4.15		4.15	
16-8	WB	PS-10N	0.789	IP	2		366	34	329			4.14			4.14		4.14	
11-3	WB	PS-10N	0.457	IP	2		458	27	412			-4.26			-4.26		-4.26	
11-3	WB	PS-10N	0.457	IP	2		458	27	412			-4.26			-4.26		-4.26	
7-16	WB	PS-10N	0.458	IP	2		459	-27	413			-4.27			-4.27		-4.27	
7-16	WB	PS-10N	0.458	IP	2		459	-27	413			-4.27			-4.27		-4.27	
3-12	WB	PS-10N	0.414	IP	2		459	-27	413			3.19			3.19		3.19	
3-12	WB	PS-10N	0.414	IP	2		459	-27	413			3.19			3.19		3.19	
12-4	WB	PS-10N	0.629	IP	2		366	34	329			-2.91			-2.91		-2.91	
15-7	WB	PS-10N	0.412	IP	2		458	27	412			3.18			3.18		3.18	
15-7	WB	PS-10N	0.412	IP	2		458	27	412			3.18			3.18		3.18	
6-15	WB	PS-10N	0.629	IP	2		366	-34	329			-2.91			-2.91		-2.91	
13-5	WB	PS-10N	0.355	IP	2		366	34	329			-1.65			-1.65		-1.65	
5-14	WB	PS-10N	0.356	IP	2		366	-34	329			-1.65			-1.65		-1.65	

*=No. of Braces.

Design Results (Joint):

Joint	Member	Timber	LC	Coordinates		Force	Moment	C.S.I.
				X	Y	kN	kNm	
2	WB	PS-10N	1	265	230	2.32	0.000	0.000
3	WB	PS-10N	1	976	230	1.10	0.000	0.000
4	TC	122x47 TR26	2	1689	230	-27.66	-0.008	0.584
5	WB	PS-10N	1	1825	229	-0.41	0.000	0.000
6	WB	PS-10N	1	1961	230	-0.97	0.000	0.000
7	WB	PS-10N	1	2672	230	-2.31	0.000	0.000
8	TC	122x47 TR26	2	3385	230	-8.51	-0.008	0.449
11	WB	PS-10N	1	568	24	-2.30	0.000	0.000
12	WB	PS-10N	1	1387	24	-0.98	0.000	0.000
13	WB	PS-10N	1	1523	24	-0.41	0.000	0.000



Design Results (Joint):

Joint	Member	Timber	LC	Coordinates		Force	Moment	C.S.I.
				X	Y	kN	kNm	
14	BC	122x47 TR26	2	2128	24	27.66	-0.028	0.825
15	WB	PS-10N	1	2264	24	1.10	0.000	0.000
16	WB	PS-10N	1	3083	24	2.32	0.000	0.000

Maximum Summations:

	Member	Joint
Top Panel C.S.I.	0.948 4-5	Top Joint C.S.I. 0.774 5
Bottom Panel C.S.I.	0.838 13-14	Bottom Joint C.S.I. 0.825 14

Maximum Reactions (kN) and Minimum Bearings (mm):

Joint	LC	Vertical	Min. Brg	Input Brg
10	2	-5.055	16	70
17	2	-5.055	16	140

Vibration Check

Maximum Deflection in Vibration Check = 3.88mm

Permissible Deflection in vibration check is the lesser of 0.003×3650 or $12.04\text{mm} = 10.96\text{mm}$

Camber

Beam has been pre-cambered to at least the deadload deflection

Camber at mid span in member 13-14 = 2.74mm

Deflections

Maximum Bottom Chord Deflection in loadcase 2 in member 10-17 = $3.88 - 2.74 = 1.1\text{mm}$

Permissible Bottom Chord Deflection = $0.003 \times 3650 = 10.95\text{mm}$

Reactions / Load Case:

Joint	Load Case	Vertical
10	1	-3.285
	2	-5.055
17	1	-3.285
	2	-5.055

Design Notes:

- This design conforms to the input data entered. Please ensure that the dimensions, loadings and other design considerations have been correctly entered.
- Stiffness matrix analysis has been used.
- Load sharing factor 1.1 used.
- Truss weight = 34kg
- Chords restraint provided by floor and ceiling material.

Quote Ref: V0.2
 Beam Ref: 170713

Top Dead Load: 0.250 kN/m²
 Posi Weight: 34 kg (per ply)
 Posi Thickness: 122 mm
 Posi Quantity: 1

Top Live Load: 1.500 kN/m²
 Posi Spacing: 600 mm
 Treatment: PS-10N

Member
 TC 1-9
 BC 10-17
 OT

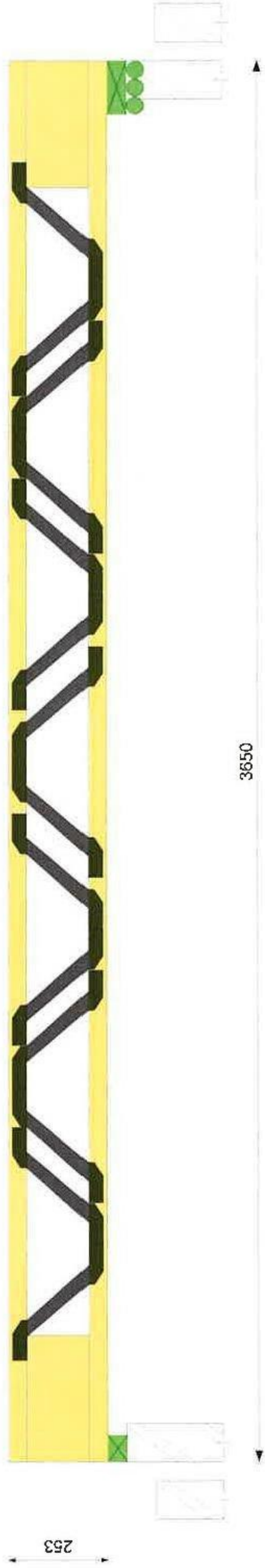
Size
 47x122
 47x122
 159x47

Grade
 TR26
 TR26
 TR26

Joint No.	Brg Width
10	70
17	140

Customer:

Site:



Scale 1:16



MiTek Industries Limited
 MiTek House, Grazebrook Industrial Park, Peartree Lane, Dudley,
 We
 Tel: 01384 451400 Fax: 01384 451411

Strongbacks: 0No. 47x122 TR26 as indicated fixed in accordance
 with MiTek Industries recommended fixing details.

Date: 13 Jul 2017
 Drawing No: Mitek User/V0.2
 Version: 5.500 Release Date: Jul 14 2010



Report: POSIPI.OT

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Beam to support Pen - Joint:

First Floor - $\Delta \quad \frac{6,2 \times 1,82}{2} = 5,64 \text{ kN/m}$

- i $\quad \frac{6,2 \times 1,5}{2} = 4,65 \text{ kN/m}$

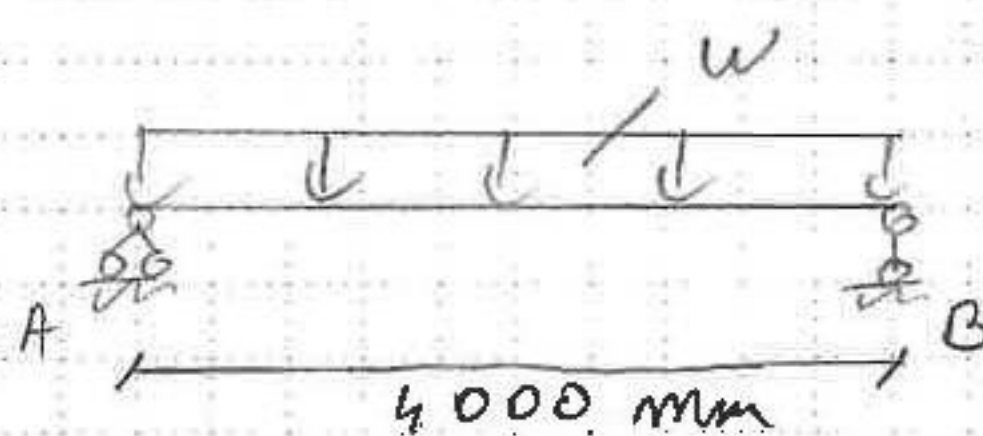
Point Load - $\Delta \quad 4,65/2 = 2,33 \text{ kN/m}$

- i $\quad 2,33/2 = 1,17 \text{ kN/m}$

$\Sigma \Delta = 7,97 \text{ kN/m} \quad \Sigma i = 5,82 \text{ kN/m}$

$W_D = 1,4 \Delta + 1,6 L = 20,47 \text{ kN/m}$

$L_s = 4,00 \text{ m}$



$M_{max} = \frac{w l^2}{8} = \frac{20,47 \times 4^2}{8} = 40,94 \text{ kNm}$

$i_{min} = 2,29 \frac{w l^2}{1,50} = 2,29 \times \frac{20,47 \times 4^2}{1,50}$

$i_{min} = 500 \text{ cm}^4$

British Steel : 178 x 102 UB 15 $\rightarrow$ $M_{rd} = 60,7 \text{ kNm}$
S355

Vertical Reactions: $R_v = 20,47 \times 4/2 = 40,94 \text{ kN}$

We choose 203 x 133 UB 25 $\left\{ \begin{array}{l} M_{rd} = 91,6 \text{ kNm} \\ i = 2340 \text{ cm}^4 \end{array} \right.$

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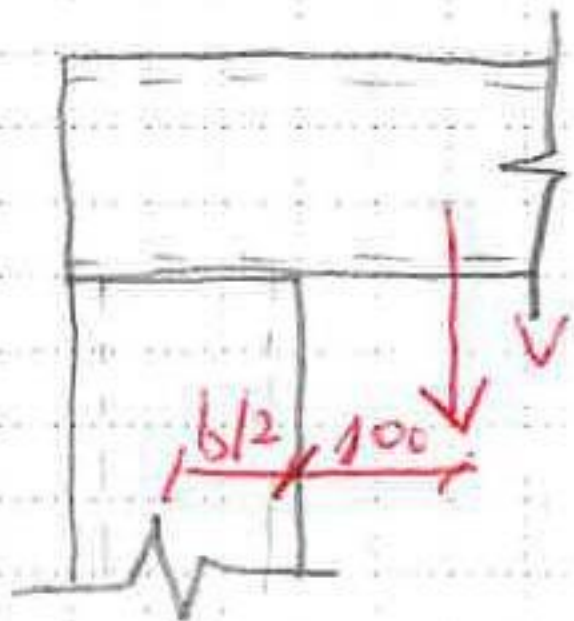
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Column (To support UB 19 Beam)

Vertical (Axial) force: $20,47 \cdot \frac{4}{2} = 41 \text{ kN}$

Moment: $M = 41 \cdot (0,1 + 0,05) = 6,15 \text{ kNm}$

Tata Steel Bluebook $\Rightarrow$ SLS 180 x 80 SHS 3.0



$\left\{ \begin{array}{l} M_{red} = 9,90 \text{ kNm} \\ N_{pl,red} = 345 \text{ kN} \end{array} \right.$

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Beam and Block Design

$G = 2.15 \text{ kN/m}^2$

$L = 1.5 \text{ kN/m}^2$

Max Span: 3650 mm

BT02 Beams $\rightarrow$ 1:1 Span case

@ 525

Ground Floor Load

Soled

1.80

Insulation

0.10

Finishes

0.10

Underfloor Heating

0.15

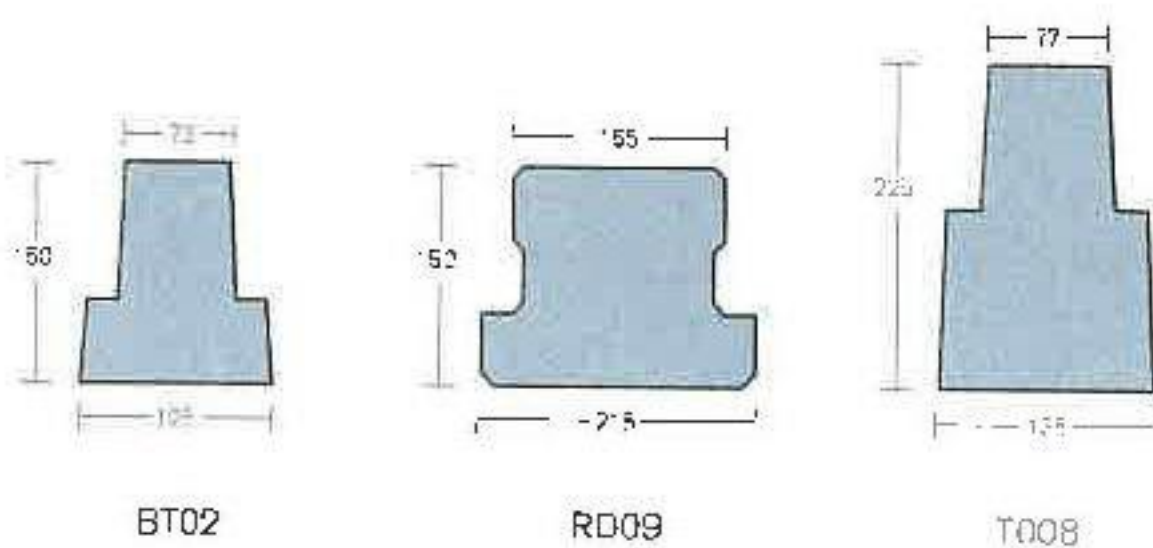
$\Sigma = 2.15 \text{ kN/m}^2$

Beam & Block

LOADSPAN TABLES

Prestressed Beams

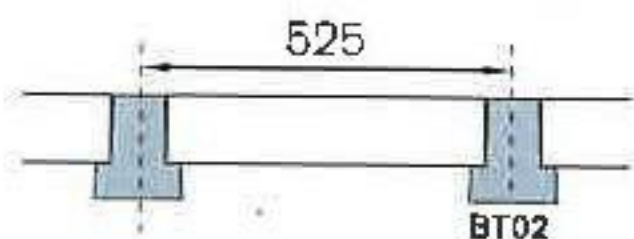
Beam details



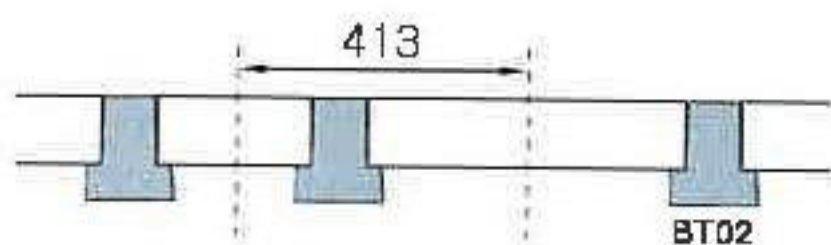
Beam Reference	Width (mm)	Height (mm)	Weight (kN/m)	Weight (kg/m)
BT02	125	150	0.326	33.24
RD09	215	150	0.522	53.40
T008	135	225	0.576	58.74

The loadspan tables below are given as a guide only, further advice is available on request.

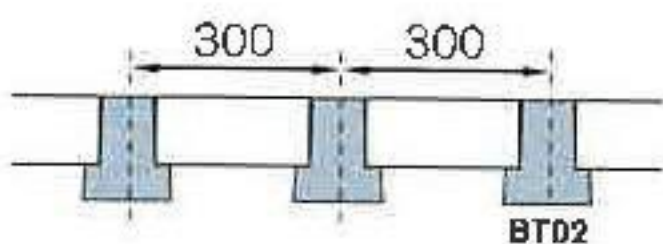
Load span table (150mm deep)



Floor Case		Finishes = 1.5 kN/m ²						Finishes = 2.0 kN/m ²					
		Superimposed Loadings in kN/m ²						Superimposed Loadings in kN/m ²					
		1.5	2.0	2.5	3.0	4.0	5.0	1.5	2.0	2.5	3.0	4.0	5.0
		Maximum Clear Span (m)						Maximum Clear Span (m)					
IJ1	1.83	4.25	4.04	3.86	3.70	3.42	3.19	4.04	3.86	3.70	3.56	3.31	3.10



		Maximum Clear Span (m)						Maximum Clear Span (m)					
IJ2	1.94	4.75	4.52	4.32	4.14	3.84	3.59	4.52	4.32	4.14	3.99	3.72	3.49



		Maximum Clear Span (m)						Maximum Clear Span (m)					
IJ3	2.18	5.40	5.20	4.98	4.79	4.46	4.17	5.20	4.98	4.79	4.62	4.32	4.06

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1. internal Slud Wall Design
 { $H = 2500 \text{ mm}$
 $\Delta = 600 \text{ mm}$
 Strength class C24

Load on stud

Roof { $\Delta L \quad 1.50 \cdot (4.35/2 + 1.85/2)/2 = 1.50 \cdot 1.55 = 2.325 \text{ kN/m}$
 $- LL \quad 0.75 \cdot 1.55 = 1.163 \text{ kN/m}$

First Floor { $\Delta L \quad 1.82 \cdot 3.1 = 5.64 \text{ kN/m}$

Wall { $- LL \quad 1.5 \cdot 3.1 = 4.65 \text{ kN/m}$
 $\Delta L \quad 0.69 \cdot 2.5 = 1.725 \text{ kN/m}$
 According to TEAD Calc $\Rightarrow OK$

$\frac{38 \times 89}{@ 600} \text{ C24}$

2. External Wall
 { $H = 2950 \text{ mm}$
 $b \times h \quad 50 \times 140$
 Strength class C24

Load on stud

Roof { $\Delta L \quad 1.50 \cdot [1.85/2 + (4.35/2 + 1.85/2)/2] = 1.5 \cdot 2.475 = 3.71 \text{ kN/m}$
 $- LL \quad 0.75 \cdot 2.475 = 1.86 \text{ kN/m}$

Floor { $\Delta L \quad 1.82 \cdot 2.55/2 = 2.32 \text{ kN/m}$
 $- LL \quad 1.5 \cdot 2.55/2 = 1.91 \text{ kN/m}$

Wall - $\Delta L \quad 2.07 \cdot 2.95 = 6.11 \text{ kN/m}$

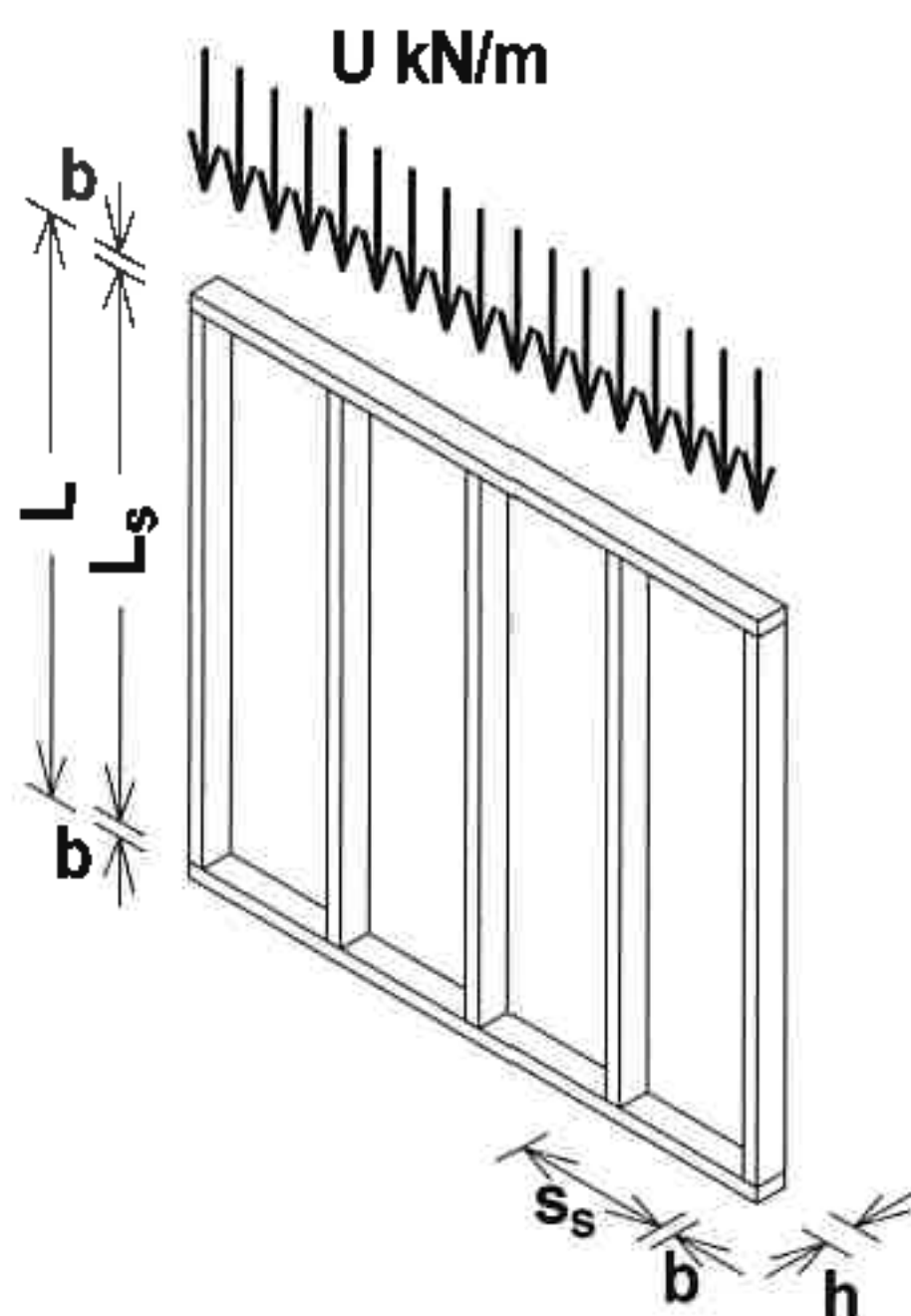
According to TEAD Calc $\Rightarrow OK$

$\frac{38 \times 140}{@ 600} \text{ C24}$

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TIMBER STUD DESIGN (BS5268-2:2002)

TEDDS calculation version 1.0.05



Stud details

Stud breadth	$b = 38 \text{ mm}$
Stud depth	$h = 89 \text{ mm}$
Number of studs	$N_s = 1$

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

Section properties

Cross sectional area	$A = N_s \times b \times h = 3382 \text{ mm}^2$
Section modulus	$Z = N_s \times b \times h^2 / 6 = 50166 \text{ mm}^3$
Moment of inertia in the major axis	$I_x = N_s \times b \times h^3 / 12 = 2232402 \text{ mm}^4$
Moment of inertia in the minor axis	$I_y = N_s \times h \times b^3 / 12 = 406967 \text{ mm}^4$
Radius of gyration in the major axis	$r_x = \sqrt{I_x / A} = 25.7 \text{ mm}$
Radius of gyration in the minor axis	$r_y = \sqrt{I_y / A} = 11.0 \text{ mm}$

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

Panel height	$L = 2500 \text{ mm}$
Stud length	$L_s = L - (2 \times b) = 2424 \text{ mm}$
Standard stud spacing	$s_s = 600 \text{ mm}$
Panel opening	$O = 0 \text{ mm}$
Loaded panel length	$s = \max(s_s, (O + s_s) / 2) = 600 \text{ mm}$
Effective length in the major axis	$L_{ex} = 1.00 \times L_s = 2424 \text{ mm}$
Slenderness ratio	$\lambda = L_{ex} / r_x = 94.35$

Vertical loading details

Wall UDL	Dead loads $U_{w,d} = 1.73 \text{ kN/m}$	Imposed loads
Roof UDL	$U_{r,d} = 2.33 \text{ kN/m}$	$U_{r,i} = 1.16 \text{ kN/m}$

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Floor UDL $U_{f,d} = 5.64 \text{ kN/m}$ $U_{f,i} = 4.65 \text{ kN/m}$
Imposed floor load duration **Long term**

Modification factors

Section depth factor $K_7 = (300 \text{ mm} / h)^{0.11} = 1.14$
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 $F = (U_{w,d} + U_{r,d} + U_{f,d} + U_{f,i} + U_{f,i}) \times s = 9.30 \text{ kN}$

Check compressive stress on stud

Compression member factor $K_{12} = 0.38$
Compression parallel to grain $\sigma_c = 7.900 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{c,adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = 4.148 \text{ N/mm}^2$
Applied compressive stress $\sigma_{c,max} = F / (N_s \times b \times h) = 2.750 \text{ N/mm}^2$

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

Check compressive stress on rail

Bearing stress modification factor $K_4 = 1.36$
Compression perpendicular to grain (no wane) $\sigma_{cp1} = 2.400 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{cp1,adm} = \sigma_{cp1} \times K_3 \times K_4 = 4.070 \text{ N/mm}^2$
Applied compressive stress $\sigma_{cp1,max} = F / (N_s \times b \times h) = 2.750 \text{ N/mm}^2$

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 $F = (U_{w,d} + U_{r,d} + U_{f,d} + U_{f,i}) \times s = 8.60 \text{ kN}$

Check compressive stress on stud

Compression member factor $K_{12} = 0.43$
Compression parallel to grain $\sigma_c = 7.900 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{c,adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = 3.754 \text{ N/mm}^2$
Applied compressive stress $\sigma_{c,max} = F / (N_s \times b \times h) = 2.544 \text{ N/mm}^2$

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

Check compressive stress on rail

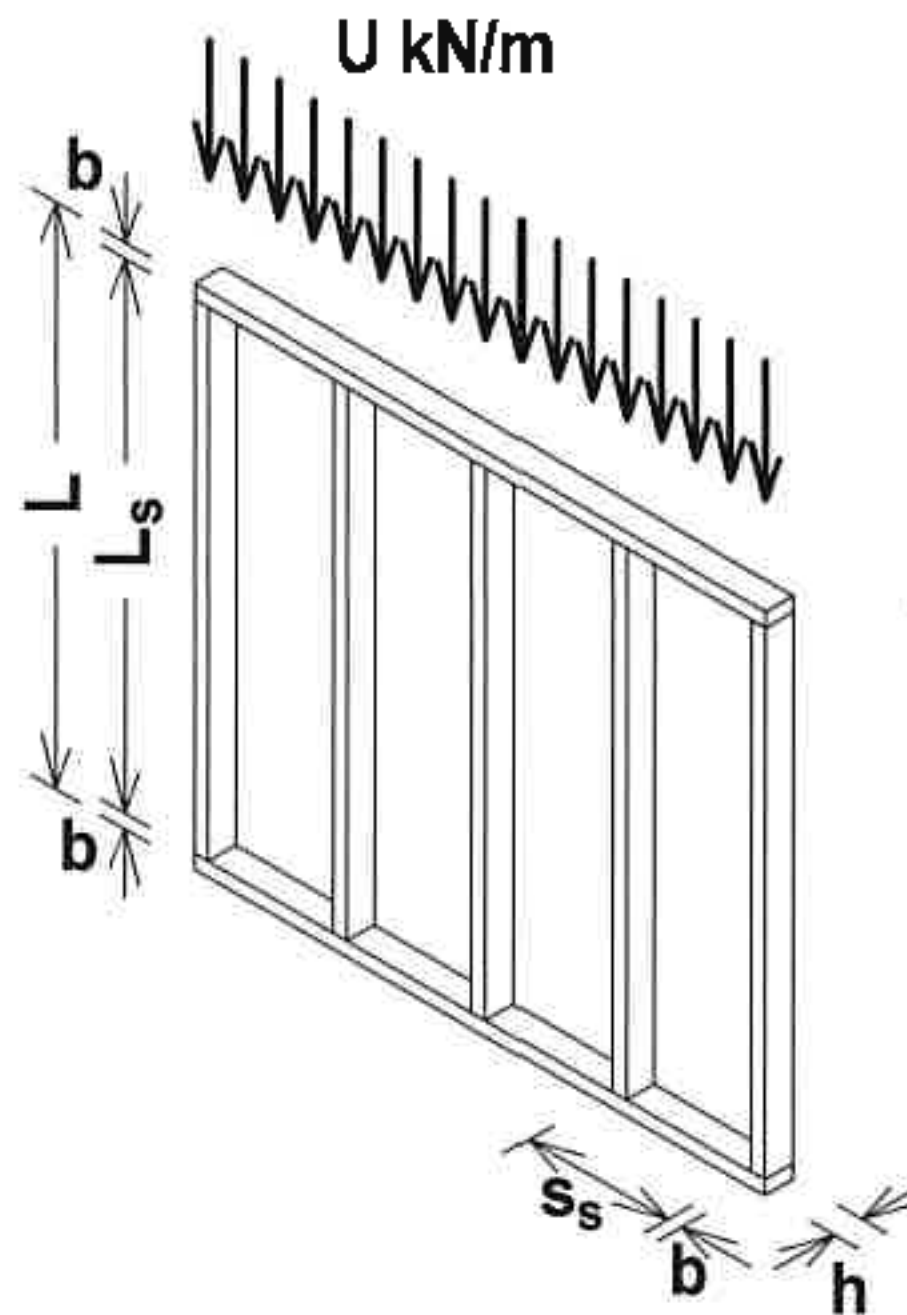
Bearing stress modification factor $K_4 = 1.36$
Compression perpendicular to grain (no wane) $\sigma_{cp1} = 2.400 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{cp1,adm} = \sigma_{cp1} \times K_3 \times K_4 = 3.256 \text{ N/mm}^2$
Applied compressive stress $\sigma_{cp1,max} = F / (N_s \times b \times h) = 2.544 \text{ N/mm}^2$

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

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TIMBER STUD DESIGN (BS5268-2:2002)

TEDDS calculation version 1.0.05



Stud details

Stud breadth	$b = 38 \text{ mm}$
Stud depth	$h = 140 \text{ mm}$
Number of studs	$N_s = 1$

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

Section properties

Cross sectional area	$A = N_s \times b \times h = 5320 \text{ mm}^2$
Section modulus	$Z = N_s \times b \times h^2 / 6 = 124133 \text{ mm}^3$
Moment of inertia in the major axis	$I_x = N_s \times b \times h^3 / 12 = 8689333 \text{ mm}^4$
Moment of inertia in the minor axis	$I_y = N_s \times h \times b^3 / 12 = 640173 \text{ mm}^4$
Radius of gyration in the major axis	$r_x = \sqrt{I_x / A} = 40.4 \text{ mm}$
Radius of gyration in the minor axis	$r_y = \sqrt{I_y / A} = 11.0 \text{ mm}$

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

Panel height	$L = 2950 \text{ mm}$
Stud length	$L_s = L - (2 \times b) = 2874 \text{ mm}$
Standard stud spacing	$s_s = 600 \text{ mm}$
Panel opening	$O = 0 \text{ mm}$
Loaded panel length	$s = \max(s_s, (O + s_s) / 2) = 600 \text{ mm}$
Effective length in the major axis	$L_{ex} = 1.00 \times L_s = 2874 \text{ mm}$
Slenderness ratio	$\lambda = L_{ex} / r_x = 71.11$

Vertical loading details

Wall UDL	Dead loads $U_{w,d} = 6.11 \text{ kN/m}$	Imposed loads
Roof UDL	$U_{r,d} = 3.71 \text{ kN/m}$	$U_{r,i} = 1.86 \text{ kN/m}$

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Floor UDL $U_{f,d} = 2.32 \text{ kN/m}$ $U_{f,i} = 1.91 \text{ kN/m}$
Imposed floor load duration **Long term**

Modification factors

Section depth factor $K_7 = (300 \text{ mm} / h)^{0.11} = 1.09$
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 $F = (U_{w,d} + U_{r,d} + U_{f,d} + U_{r,i} + U_{f,i}) \times s = 9.55 \text{ kN}$

Check compressive stress on stud

Compression member factor $K_{12} = 0.54$
Compression parallel to grain $\sigma_c = 7.900 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{c,adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = 5.919 \text{ N/mm}^2$
Applied compressive stress $\sigma_{c,max} = F / (N_s \times b \times h) = 1.794 \text{ N/mm}^2$

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

Check compressive stress on rail

Bearing stress modification factor $K_4 = 1.36$
Compression perpendicular to grain (no wane) $\sigma_{cp1} = 2.400 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{cp1,adm} = \sigma_{cp1} \times K_3 \times K_4 = 4.070 \text{ N/mm}^2$
Applied compressive stress $\sigma_{cp1,max} = F / (N_s \times b \times h) = 1.794 \text{ N/mm}^2$

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 $F = (U_{w,d} + U_{r,d} + U_{f,d} + U_{f,i}) \times s = 8.43 \text{ kN}$

Check compressive stress on stud

Compression member factor $K_{12} = 0.59$
Compression parallel to grain $\sigma_c = 7.900 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{c,adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = 5.100 \text{ N/mm}^2$
Applied compressive stress $\sigma_{c,max} = F / (N_s \times b \times h) = 1.585 \text{ N/mm}^2$

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

Check compressive stress on rail

Bearing stress modification factor $K_4 = 1.36$
Compression perpendicular to grain (no wane) $\sigma_{cp1} = 2.400 \text{ N/mm}^2$
Permissible compressive stress $\sigma_{cp1,adm} = \sigma_{cp1} \times K_3 \times K_4 = 3.256 \text{ N/mm}^2$
Applied compressive stress $\sigma_{cp1,max} = F / (N_s \times b \times h) = 1.585 \text{ N/mm}^2$

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

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Foundation Design

External Foundation

1.1 Dead Load on foundations (G)

$$\rightarrow \text{Roof} \quad 1.5 \times 6.2 / 2 = 4.65 \text{ kN/m}$$

$\rightarrow$ Wall (Timber)

$$2.87 \times 6 = 17.22 \text{ kN/m}$$

$\rightarrow$ First Floor

$$1.82 \times \frac{3.65}{2} = 3.32 \text{ kN/m}$$

$\rightarrow$ Ground Floor

$$4.65 \times \frac{3.65}{2} = 8.49 \text{ kN/m}$$

$$\Sigma G = 33.68 \text{ kN/m}$$

1.2 Live Load on foundations (Q)

$$\rightarrow \text{Roof} \quad 0.75 \times \frac{4.35}{2} = 1.63 \text{ kN/m}$$

$$\rightarrow \text{First Floor} \quad 1.5 \times \frac{3.65}{2} = 2.74 \text{ kN/m}$$

$$\rightarrow \text{Ground Floor} \quad 1.5 \times \frac{3.65}{2} = 2.74 \text{ kN/m}$$

$$\Sigma Q = 7.11 \text{ kN/m}$$

$$\text{Total Load: } G + Q = 40.79 \text{ kN/m} \approx 41 \text{ kN/m}$$

Assume weak soil, with Bearing Pressure 100 kN/m²

$$\Rightarrow \text{Required width: } 41 / 100 = 0.41 \text{ m} \Rightarrow \text{We provide } \underline{\underline{600 \text{ mm width}}}$$

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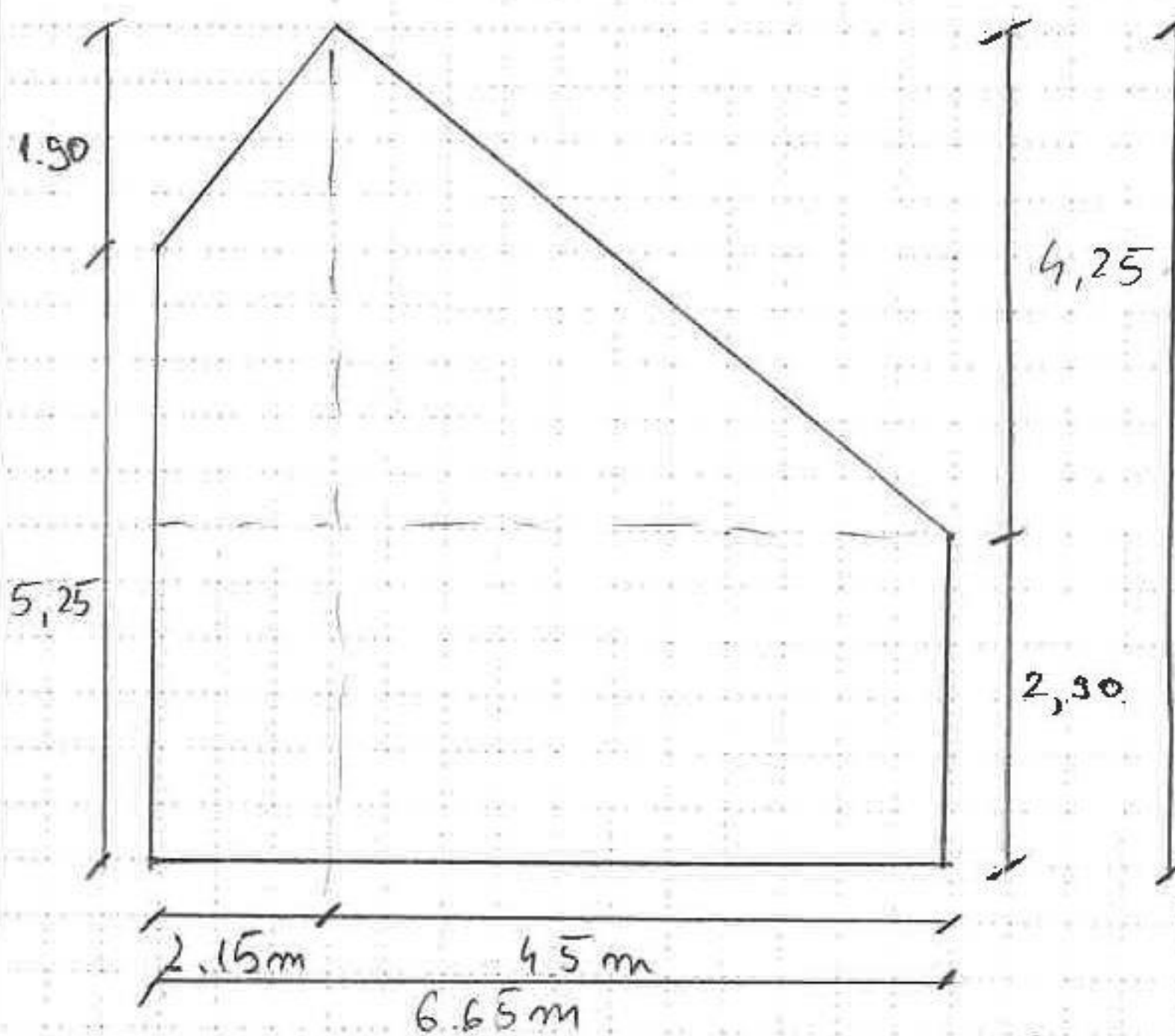
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Wind Load - Overturning check
Conservative design: use consider $q = 1.2 \text{ kN/m}^2$

Ground level $\approx 55 \text{ m}$

Pitch roof $\rightarrow \alpha = 40^\circ$



$$B = 6.65 \text{ m}$$

$$L \approx 12 \text{ m}$$

$$B/L = 0.55$$

$$B/D \approx 0.5$$

$$D/H \approx 0.93 (\leq 1)$$

$\rightarrow$ Overall load coeff
1.20

BS - 6399 - 2:1997:

C_{pe}:

Front:

0.8

Rear:

-0.4

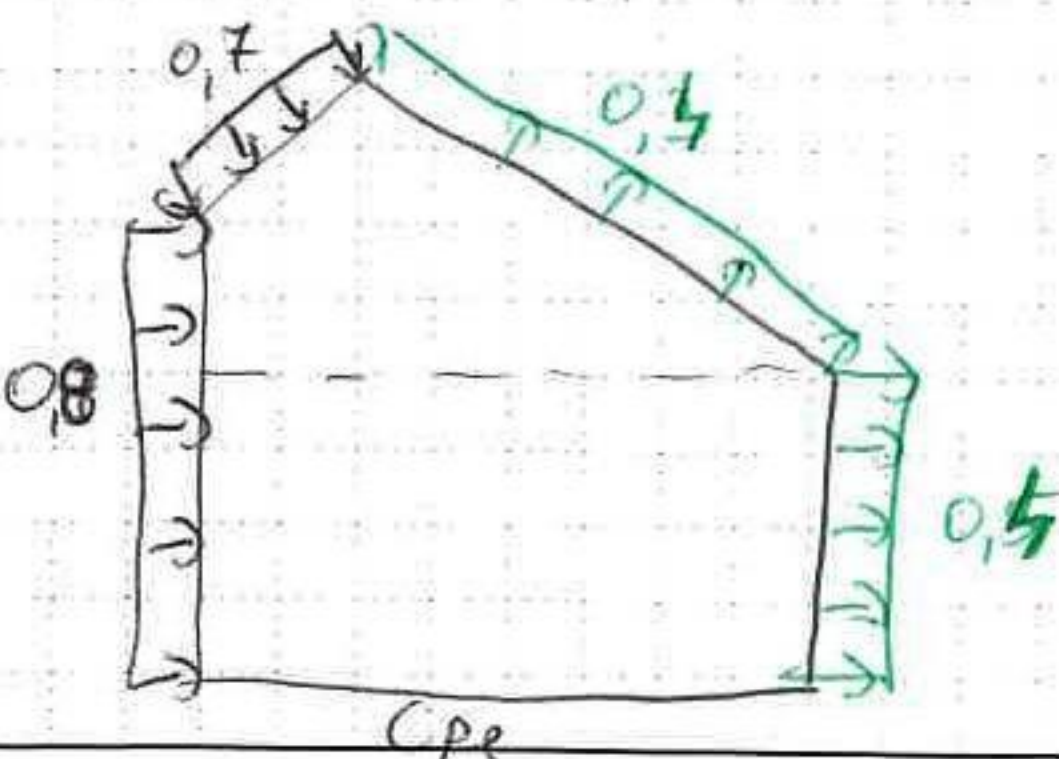
C

0.7

G

-0.3

$$\sum = 1.2$$



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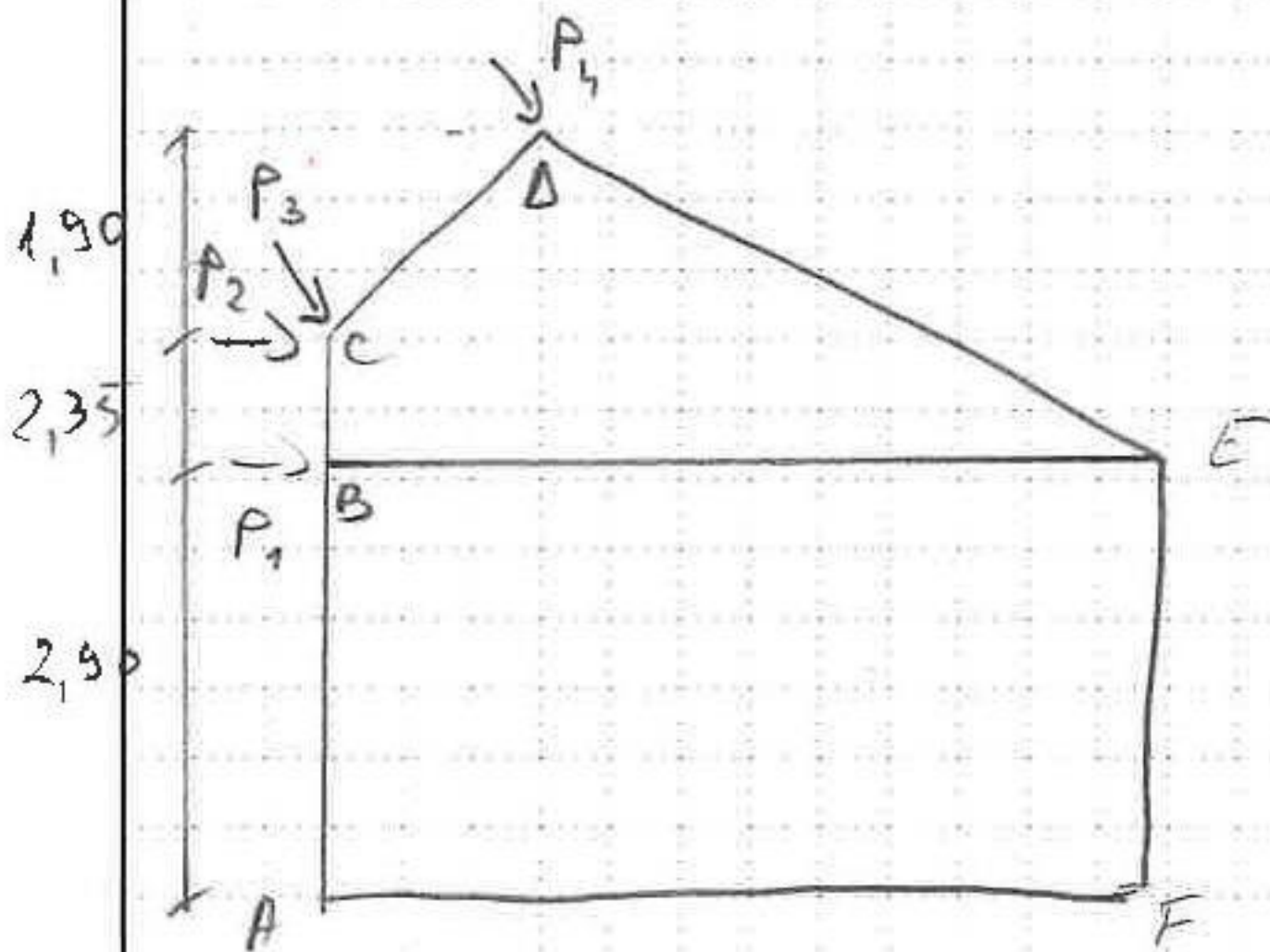
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$$P_1 = 12 \cdot 1 \cdot (1,45 + 0,675) \cdot 0,8 = 2,04 \text{ kN}$$

$$P_2 = 12 \cdot 1 \cdot (0,75 + 0,95) \cdot 0,8 = 1,63 \text{ kN}$$

$$P_4 = P_3 = 1,2 \cdot 1 \cdot (2,15 / \cos 40^\circ) \cdot 0,7 = 2,36 \text{ kN}$$

$$P_{C, \text{HORIZ}} = P_2 + P_3 \sin 40^\circ = 3,15 \text{ kN}$$

$$P_{C, V} = P_3 \cos 40^\circ = 1,81 \text{ kN}$$

$$P_{D, V} = P_{C, V} = 1,81 \text{ kN}$$

$$P_{D, H} = 2,36 \sin 40^\circ = 1,52 \text{ kN}$$

$$P_{D, H} = P_3 \sin 40^\circ = 1,52 \text{ kN}$$

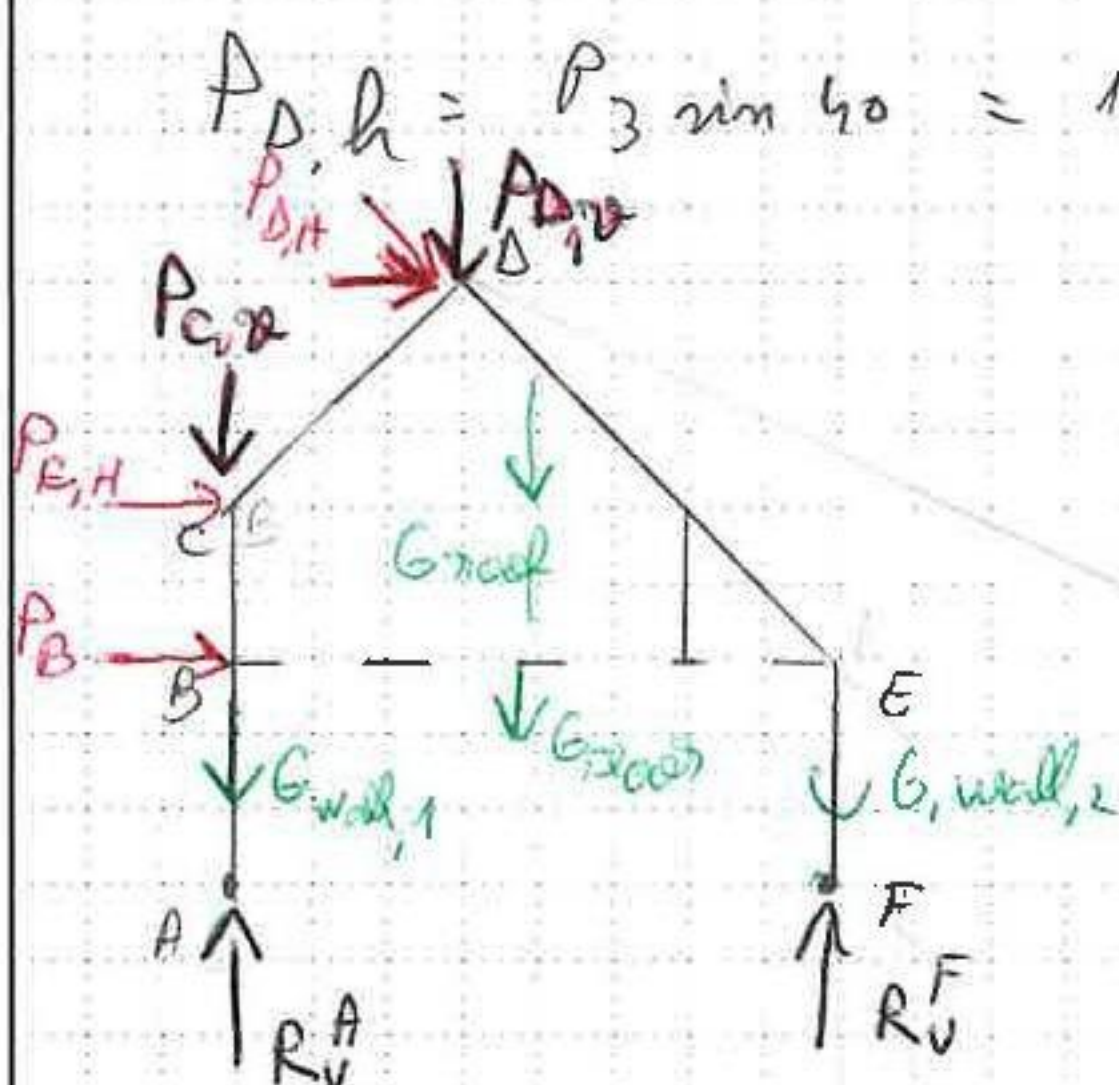
Per meter of structure: (Nm)

$$G_{\text{wall}, 1} = 5,25 \times 2,87 = 15,07 \text{ kN}$$

$$G_{\text{roof}} = 6,2 \times 1,5 = 9,3 \text{ kN}$$

$$G_{\text{wall}, 2} = 2,9 \times 2,87 = 8,32 \text{ kN}$$

$$G_{\text{floor}} = 6,2 \times 1,82 = 11,23 \text{ kN}$$



$$\sum M_F = 0 \Rightarrow [R_v^A \cdot 6,65 + (P_B \cdot 2,90 + P_{C,H} \cdot 5,25 + P_{D,H} \cdot 7,15) \cdot 1,4] - [G_{w,1} \cdot 6,65 + G_{\text{roof}} \cdot 3,1 + G_{\text{floor}} \cdot 3,1]$$

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$$R_{\text{wall}}^{\text{A}} = \left[(15,07 \cdot 6,65 + 9,3 \cdot 3,1 + 11,23 \cdot 3,1) - (2,06 \cdot 2,9 + 3,15 \cdot 5,25 + 1,52 \cdot 7,15) \cdot 1,4 \right] / 6,65 =$$

$$= (163,86 - 33,38) / 6,65 = \underline{19,62 \text{ kN} > 0}$$

Conclusion: There is no tension at the base of the structural timber wall, taking into account a conservative design. Therefore, no anchoring is required (there is no risk of overturning).

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Lintel Design - Outer Leaf

{ Outer Leaf - 102.5mm Traditional Red Brickwork
{ Cavity width - 68 mm (consider 70 mm)

1. Ground Floor Lintels

1.1 South East

W05 and E D02 - Double Door - $\angle$ 1575 mm $\Rightarrow$ Span S = 1800 mm

$$G = 2,25 \times 1,8 \times 0,9 = \underline{3,65 \text{ kN}} \Rightarrow \text{T/K 70 (SWL = 5 kN)}$$

W05 - Window

1575

G = 1,44 kN

1,8

0,9

T/K 70

(SWL = 5 kN)

1.2 North - West

E D01 - 1350 mm $\Rightarrow$ Span S = 1500 mm

$$G = 2,25 \times 1,5^2 / 2 = \underline{2,53 \text{ kN}} \Rightarrow \text{T/K 70 (SWL = 5 kN)}$$

W01 - 630 mm $\Rightarrow$ Span = 750 mm

$$G = 2,25 \times 0,75^2 / 2 = \underline{0,63 \text{ kN}} \Rightarrow \text{T/K 70 (SWL = 4 kN)}$$

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1.3 North East

W06 900 mm $\Rightarrow$ Span = 1050 mm

$$G = 2,25 \times 1,05 \times 0,575 = \underline{1,36 \text{ kN}} \Rightarrow T/K70 \text{ (SWL = 4 kN)}$$

W07: 1013 mm $\Rightarrow$ Span = 1200 mm

$$G = 2,25 \times 1,2 \times 0,6 = \underline{1,62 \text{ kN}} \Rightarrow T/K70 \text{ (SWL = 4 kN)}$$

1.4 South West

W03 and W04 788 mm $\Rightarrow$ Span = 1050 mm

$$G < 4 \text{ kN} \Rightarrow T/K70$$

2. Front Floor Lintels

1.1 South East

W09 (See E002 and W05) 1575 mm $\Rightarrow$ Span = 1800 mm

$$G = \underline{3,65 \text{ kN}} < \underline{5} \Rightarrow T/K70$$

1.2 North West

W08 1125 mm $\Rightarrow$ Span = 1350 mm

$$G = 2,25 \times 1,35 \times 0,675 = \underline{2,05 \text{ kN}} \Rightarrow T/K70$$

1.3 North East

W10 900 mm $\Rightarrow$ Span = 1050 mm (see W06)

$$G < 4 \text{ kN} \Rightarrow T/K70$$

CAVITY WALL - TIMBER FRAME

Cavity widths 50-105mm

OUTER LEAF
102mm

T/K

For use with timber frame construction. The T/K lintel must be used in conjunction with lateral restraint clips and a tight fitting timber batten, as shown, to prevent twisting. The T/K range can be supplied to suit wider cavities: e.g. specify T/K-70, T/K-90. Lintels may be propped to facilitate speed of construction. See Lintel Installation guide on page 6.



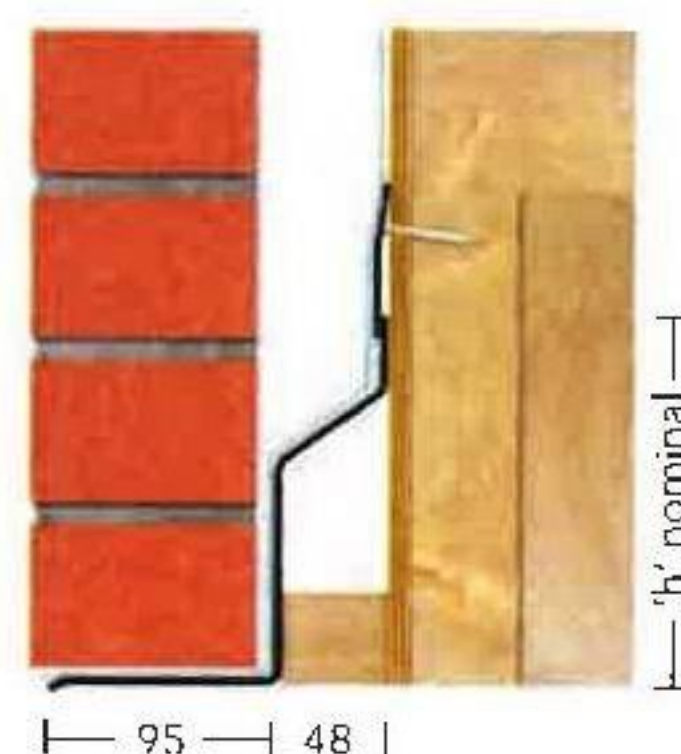
Standard Load

T/K-50 (For cavity widths 50-65mm)

Manufactured length 150mm increments	600- 1200	1350- 1800	1950- 2400	2550- 3600	3750- 4800
Height 'h'	110	110	135	175	250
Thickness	2.0	2.5	2.5	2.8	3.0
Total UDL kN	4	5	5	9	12

For installation please refer to installation notes on page 6.

50-65mm Cavity

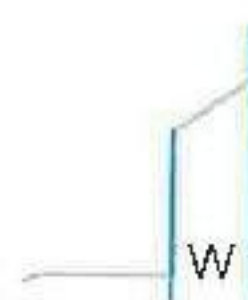
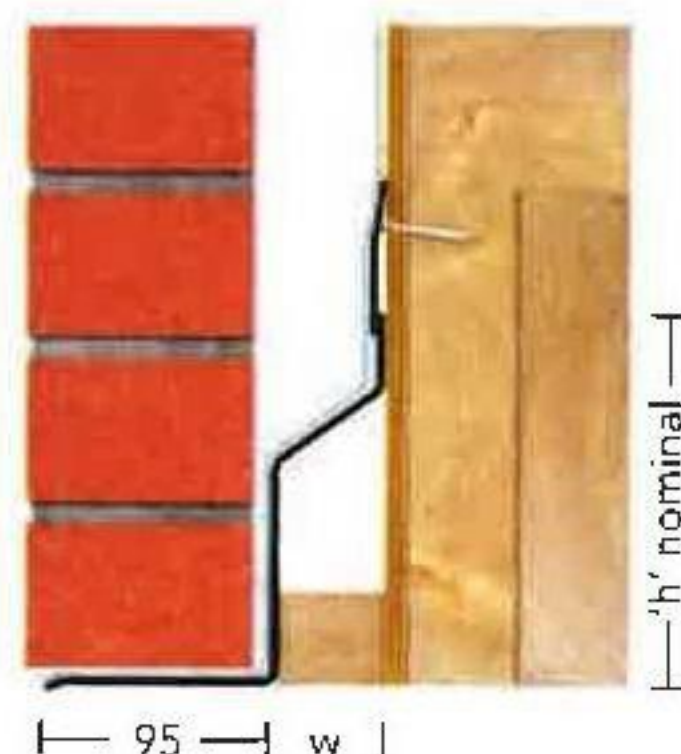


T/K-70 & T/K-90

Manufactured length 150mm increments	600- 1200	1350- 1800	1950- 2400	2550- 3600	3750- 4800
Height 'h'	110	110	135	175	250
Thickness	2.0	2.5	2.5	2.8	3.0
Total UDL kN	4	5	5	9	12

For installation please refer to installation notes on page 6.

Specified Cavity Width



T/K-70 W = 68mm - for 70 to 85mm cavity widths
T/K-90 W = 88mm - for 90 to 105mm cavity widths

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3. Timber Lintel Design (internal Leaf)

We consider 2x (38x140) C24 Lintels

3.1 EDO2 and W05 (S.E) 1575 mm $\Rightarrow$ Span = 1800 mm

Dead Load Wall $2,87 \times \frac{1,8}{2} = 2,583 \text{ kN/m}$

slab $1,82 \times 1,0 = 1,82 \text{ kN/m}$

$\Sigma = 4,403 \text{ kN/m}$

Line Load Slab - imposed $1,5 \times 1,0 = 1,5 \text{ kN/m}$

3.2 W07 (N.E) 1013 mm $\Rightarrow$ Span = 1200 mm

Dead Load Wall $2,87 \times \frac{1,2}{2} = 1,72 \text{ kN/m}$

slab $1,82 \times \frac{2,4}{2} = 2,19 \text{ kN/m}$

$\Sigma = 3,91 \text{ kN/m}$

Line Load 1st floor - imposed $1,5 \times \frac{2,4}{2} = 1,8 \text{ kN/m}$

3.3 W10 (N.E) 900 mm $\Rightarrow$ Span = 1050 mm

Dead Load Wall $2,87 \times 0,21 = 0,60 \text{ kN/m}$

Roof $1,50 \times \frac{4,35}{2} = 3,26 \text{ kN/m}$

$\Sigma = 3,86 \text{ kN/m}$

Line Load Roof $0,75 \times \frac{4,35}{2} = 1,63 \text{ kN/m}$

CONCLUSION

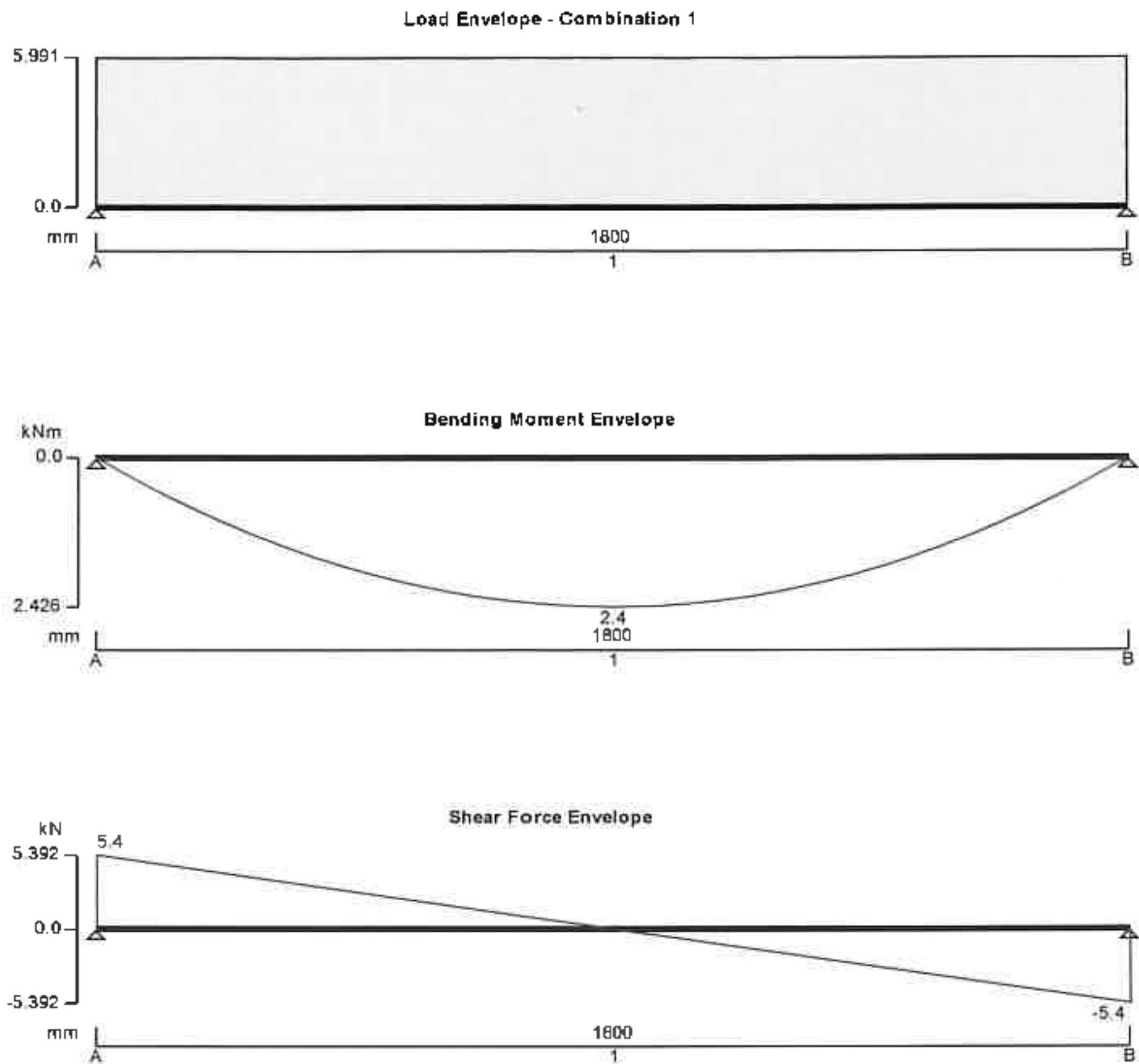
All doors and windows, except W09, W05 and EDO2: TK-70 (standard)
supported on 3x38x140 C24 timber lintel.

W09, W05 and EDO2: TK-70 supported on 4x38x140, C24

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	Timber Inner Lintel (ED02 and W05)			1	
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TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.6.00



Applied loading

Beam loads

Imposed full UDL 1.500 kN/m
Dead full UDL 4.403 kN/m
Dead self weight of beam x 1

Load combinations

Load combination 1

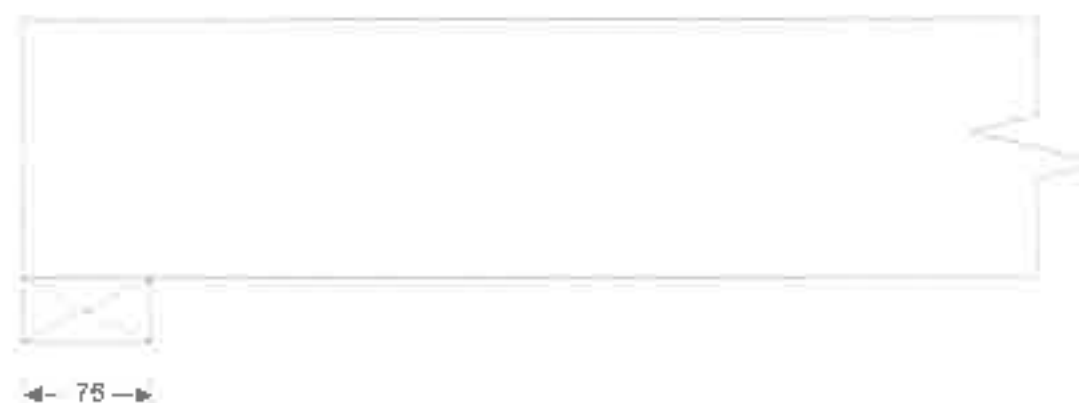
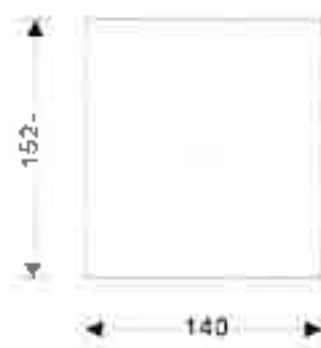
Support A Dead x 1.00
 Imposed x 1.00
Span 1 Dead x 1.00
 Imposed x 1.00
Support B Dead x 1.00
 Imposed x 1.00

Analysis results

Maximum moment M_{max} = 2.426 kNm M_{min} = 0.000 kNm
Design moment M = max(abs(M_{max}),abs(M_{min})) = 2.426 kNm
Maximum shear F_{max} = 5.392 kN F_{min} = -5.392 kN
Design shear F = max(abs(F_{max}),abs(F_{min})) = 5.392 kN
Total load on beam W_{tot} = 10.783 kN

CROUCH WATERFALL Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project				Job no.	
	51 Longwood Avenue				16-465G	
	Calcs for				Start page no./Revision	
	Timber Inner Lintel (ED02 and W05)				2	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	GL	13/07/2017	BS	13/07/2017		

Reactions at support A	$R_{A_max} = 5.392 \text{ kN}$	$R_{A_min} = 5.392 \text{ kN}$
Unfactored dead load reaction at support A	$R_{A_Dead} = 4.042 \text{ kN}$	
Unfactored imposed load reaction at support A	$R_{A_Imposed} = 1.350 \text{ kN}$	
Reactions at support B	$R_{B_max} = 5.392 \text{ kN}$	$R_{B_min} = 5.392 \text{ kN}$
Unfactored dead load reaction at support B	$R_{B_Dead} = 4.042 \text{ kN}$	
Unfactored imposed load reaction at support B	$R_{B_Imposed} = 1.350 \text{ kN}$	



Timber section details

Breadth of sections	$b = 140 \text{ mm}$
Depth of sections	$h = 152 \text{ mm}$
Number of sections in member	$N = 1$
Overall breadth of member	$b_b = N \times b = 140 \text{ mm}$
Timber strength class	C24

Member details

Service class of timber	1
Load duration	Long term
Length of bearing	$L_b = 76 \text{ mm}$

Section properties

Cross sectional area of member	$A = N \times b \times h = 21280 \text{ mm}^2$
Section modulus	$Z_x = N \times b \times h^2 / 6 = 539093 \text{ mm}^3$ $Z_y = h \times (N \times b)^2 / 6 = 496533 \text{ mm}^3$
Second moment of area	$I_x = N \times b \times h^3 / 12 = 40971093 \text{ mm}^4$ $I_y = h \times (N \times b)^3 / 12 = 34757333 \text{ mm}^4$
Radius of gyration	$i_x = \sqrt{I_x / A} = 43.9 \text{ mm}$ $i_y = \sqrt{I_y / A} = 40.4 \text{ mm}$

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	$K_7 = (300 \text{ mm} / h)^{0.11} = 1.08$
Load sharing - cl.2.9	$K_8 = 1.00$

Lateral support - cl.2.10.8

No lateral support	
Permissible depth-to-breadth ratio - Table 19	2.00
Actual depth-to-breadth ratio	$h / (N \times b) = 1.09$

PASS - Lateral support is adequate

Compression perpendicular to grain

Permissible bearing stress (no wane)	$\sigma_{c_adm} = \sigma_{cp1} \times K_3 \times K_4 \times K_8 = 2.400 \text{ N/mm}^2$
Applied bearing stress	$\sigma_{c_a} = R_{A_max} / (N \times b \times L_b) = 0.507 \text{ N/mm}^2$
	$\sigma_{c_a} / \sigma_{c_adm} = 0.211$

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

 Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project			Job no.		
	51 Longwood Avenue			16-465G		
	Calcs for			Start page no./Revision		
	Timber Inner Lintel (ED02 and WD5)			3		
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	GL	13/07/2017	BS	13/07/2017		

Bending parallel to grain

Permissible bending stress

$$\sigma_{m_adm} = \sigma_m \times K_3 \times K_7 \times K_9 = 8.082 \text{ N/mm}^2$$

Applied bending stress

$$\sigma_{m_a} = M / Z_x = 4.501 \text{ N/mm}^2$$

$$\sigma_{m_a} / \sigma_{m_adm} = 0.557$$

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress

$$\tau_{adm} = \tau \times K_3 \times K_8 = 0.710 \text{ N/mm}^2$$

Applied shear stress

$$\tau_a = 3 \times F / (2 \times A) = 0.380 \text{ N/mm}^2$$

$$\tau_a / \tau_{adm} = 0.535$$

PASS - Applied shear stress is less than permissible shear stress

Deflection

Modulus of elasticity for deflection

$$E = E_{min} = 7200 \text{ N/mm}^2$$

Permissible deflection

$$\delta_{adm} = \min(0.551 \text{ in}, 0.003 \times L_{s1}) = 5.400 \text{ mm}$$

Bending deflection

$$\delta_{b_s1} = 2.776 \text{ mm}$$

Shear deflection

$$\delta_{v_s1} = 0.304 \text{ mm}$$

Total deflection

$$\delta_a = \delta_{b_s1} + \delta_{v_s1} = 3.080 \text{ mm}$$

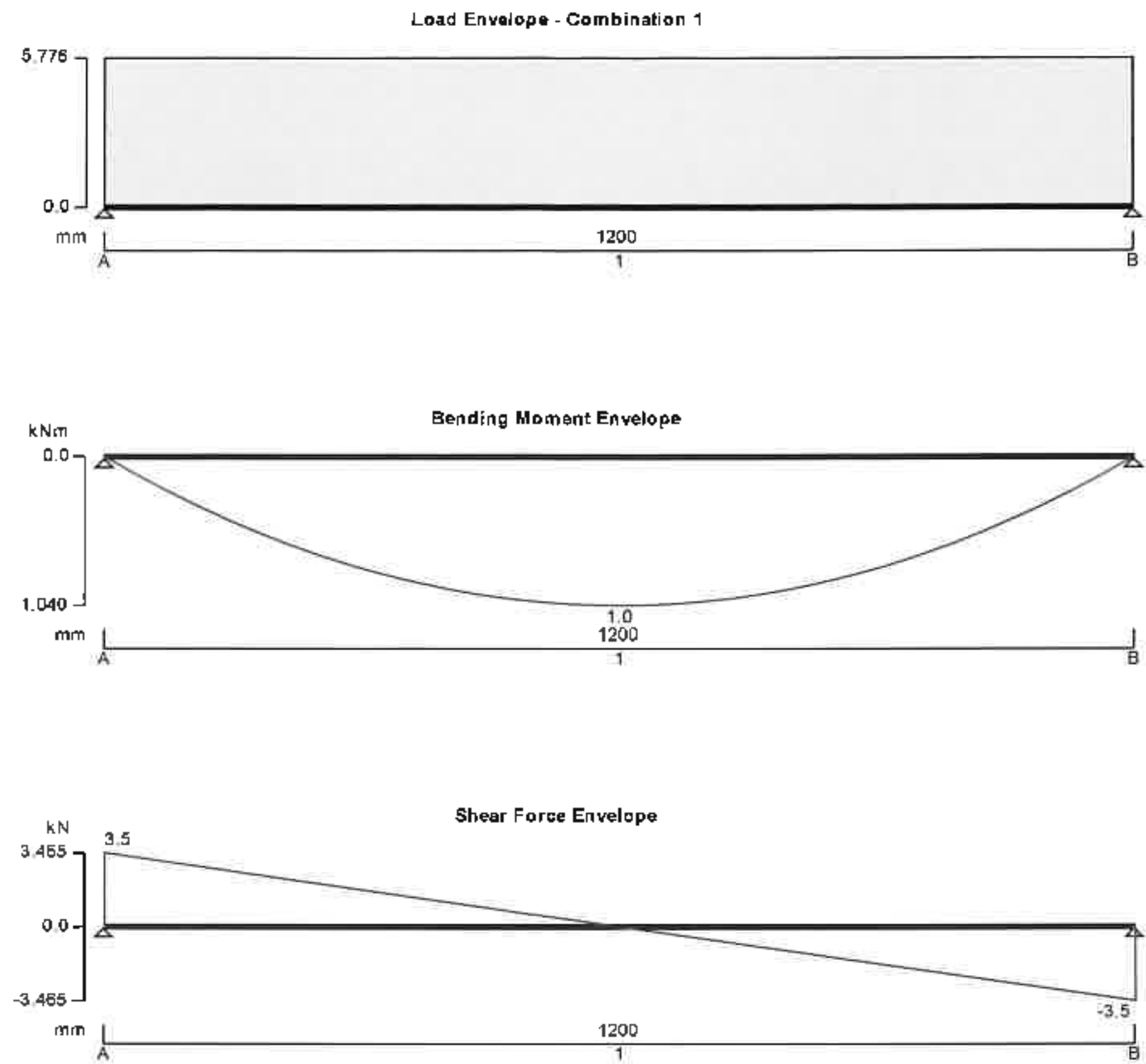
$$\delta_a / \delta_{adm} = 0.570$$

PASS - Total deflection is less than permissible deflection

CROUCH WATERFALL Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project				Job no.	
	51 Longwood Avenue				16-465G	
	Calcs for				Start page no./Revision	
	Timber Inner Lintel (W07)				1	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	GL	13/07/2017	BS	13/07/2017		

TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.6.00



Applied loading

Beam loads

Imposed full UDL 1.800 kN/m
Dead full UDL 3.910 kN/m
Dead self weight of beam x 1

Load combinations

Load combination 1

Support A Dead x 1.00
 Imposed x 1.00

Span 1 Dead x 1.00
 Imposed x 1.00

Support B Dead x 1.00
 Imposed x 1.00

Analysis results

Maximum moment M_{max} = 1.040 kNm M_{min} = 0.000 kNm
Design moment M = max(abs(M_{max}),abs(M_{min})) = 1.040 kNm
Maximum shear F_{max} = 3.465 kN F_{min} = -3.465 kN
Design shear F = max(abs(F_{max}),abs(F_{min})) = 3.465 kN
Total load on beam W_{tot} = 6.931 kN

CROUCH WATERFALL Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project				Job no.	
	51 Longwood Avenue				16-465G	
	Calcs for				Start page no./Revision	
	Timber Inner Lintel (W07)				2	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	GL	13/07/2017	BS	13/07/2017		

Reactions at support A

$$R_{A_max} = 3.465 \text{ kN}$$

$$R_{A_min} = 3.465 \text{ kN}$$

Unfactored dead load reaction at support A

$$R_{A_Dead} = 2.385 \text{ kN}$$

Unfactored imposed load reaction at support A

$$R_{A_Imposed} = 1.080 \text{ kN}$$

Reactions at support B

$$R_{B_max} = 3.465 \text{ kN}$$

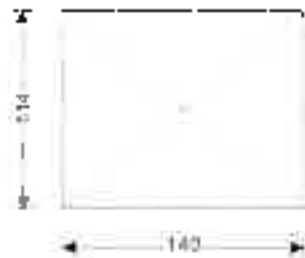
$$R_{B_min} = 3.465 \text{ kN}$$

Unfactored dead load reaction at support B

$$R_{B_Dead} = 2.385 \text{ kN}$$

Unfactored imposed load reaction at support B

$$R_{B_Imposed} = 1.080 \text{ kN}$$



Timber section details

Breadth of sections

$$b = 140 \text{ mm}$$

Depth of sections

$$h = 114 \text{ mm}$$

Number of sections in member

$$N = 1$$

Overall breadth of member

$$b_b = N \times b = 140 \text{ mm}$$

Timber strength class

C24

Member details

Service class of timber

1

Load duration

Long term

Length of bearing

$$L_b = 76 \text{ mm}$$

Section properties

Cross sectional area of member

$$A = N \times b \times h = 15960 \text{ mm}^2$$

Section modulus

$$Z_x = N \times b \times h^2 / 6 = 303240 \text{ mm}^3$$

$$Z_y = h \times (N \times b)^2 / 6 = 372400 \text{ mm}^3$$

Second moment of area

$$I_x = N \times b \times h^3 / 12 = 17284680 \text{ mm}^4$$

$$I_y = h \times (N \times b)^3 / 12 = 26068000 \text{ mm}^4$$

Radius of gyration

$$i_x = \sqrt{I_x / A} = 32.9 \text{ mm}$$

$$i_y = \sqrt{I_y / A} = 40.4 \text{ mm}$$

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

$$K_7 = (300 \text{ mm} / h)^{0.11} = 1.11$$

Load sharing - cl.2.9

$$K_8 = 1.00$$

Lateral support - cl.2.10.8

No lateral support

Permissible depth-to-breadth ratio - Table 19

$$2.00$$

Actual depth-to-breadth ratio

$$h / (N \times b) = 0.81$$

PASS - Lateral support is adequate

Compression perpendicular to grain

Permissible bearing stress (no wane)

$$\sigma_{c_adm} = \sigma_{cp1} \times K_3 \times K_4 \times K_8 = 2.400 \text{ N/mm}^2$$

Applied bearing stress

$$\sigma_{c_a} = R_{A_max} / (N \times b \times L_b) = 0.326 \text{ N/mm}^2$$

$$\sigma_{c_a} / \sigma_{c_adm} = 0.136$$

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

 Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project				Job no.	
	51 Longwood Avenue				16-465G	
	Calcs for				Start page no./Revision	
	Timber Inner Lintel (W07)				3	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	GL	13/07/2017	BS	13/07/2017		

Bending parallel to grain

Permissible bending stress

$$\sigma_{m_adm} = \sigma_m \times K_3 \times K_7 \times K_8 = 8.342 \text{ N/mm}^2$$

Applied bending stress

$$\sigma_{m_a} = M / Z_x = 3.428 \text{ N/mm}^2$$

$$\sigma_{m_a} / \sigma_{m_adm} = 0.411$$

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress

$$\tau_{adm} = \tau \times K_3 \times K_8 = 0.710 \text{ N/mm}^2$$

Applied shear stress

$$\tau_a = 3 \times F / (2 \times A) = 0.326 \text{ N/mm}^2$$

$$\tau_a / \tau_{adm} = 0.459$$

PASS - Applied shear stress is less than permissible shear stress

Deflection

Modulus of elasticity for deflection

$$E = E_{min} = 7200 \text{ N/mm}^2$$

Permissible deflection

$$\delta_{adm} = \min(0.551 \text{ in}, 0.003 \times L_{s1}) = 3.600 \text{ mm}$$

Bending deflection

$$\delta_{b_s1} = 1.253 \text{ mm}$$

Shear deflection

$$\delta_{v_s1} = 0.174 \text{ mm}$$

Total deflection

$$\delta_a = \delta_{b_s1} + \delta_{v_s1} = 1.427 \text{ mm}$$

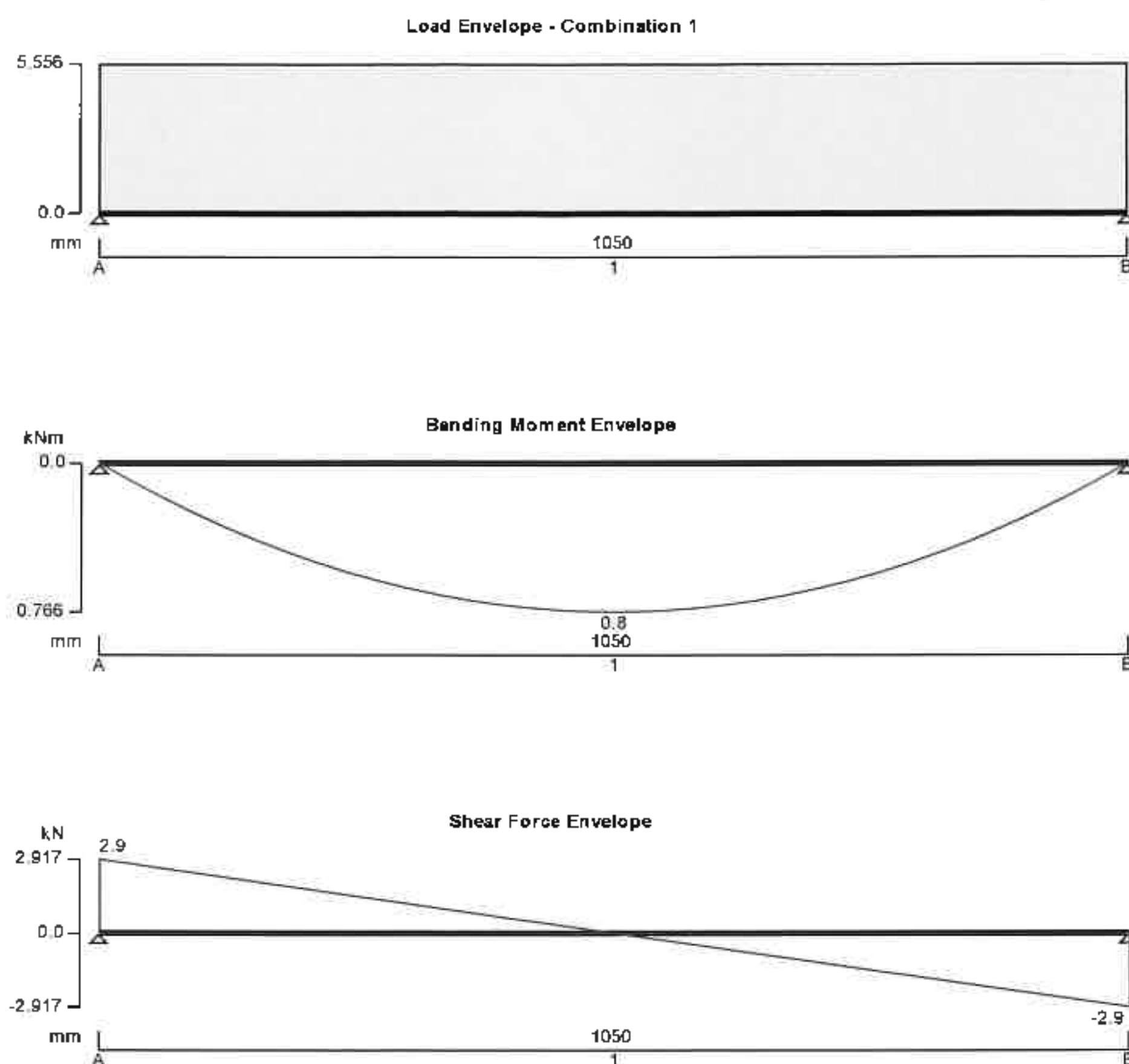
$$\delta_a / \delta_{adm} = 0.396$$

PASS - Total deflection is less than permissible deflection

CROUCH WATERFALL Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project 51 Longwood Avenue				Job no. 16-465G	
	Calcs for Timber Inner Lintel (W10)				Start page no./Revision 1	
	Calcs by GL	Calcs date 13/07/2017	Checked by BS	Checked date 13/07/2017	Approved by	Approved date

TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.6.00



Applied loading

Beam loads

Imposed full UDL 1.630 kN/m

Dead full UDL 3.860 kN/m

Dead self weight of beam $\times 1$

Load combinations

Load combination 1

Support A

Dead $\times 1.00$

Imposed $\times 1.00$

Span 1

Dead $\times 1.00$

Imposed $\times 1.00$

Support B

Dead $\times 1.00$

Imposed $\times 1.00$

Analysis results

Maximum moment

$M_{max} = 0.766$ kNm

$M_{min} = 0.000$ kNm

Design moment

$M = \max(\text{abs}(M_{max}), \text{abs}(M_{min})) = 0.766$ kNm

Maximum shear

$F_{max} = 2.917$ kN

$F_{min} = -2.917$ kN

Design shear

$F = \max(\text{abs}(F_{max}), \text{abs}(F_{min})) = 2.917$ kN

Total load on beam

$W_{tot} = 5.834$ kN

CROUCH WATERFALL Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project				Job no.	
	51 Longwood Avenue				16-465G	
	Calcs for				Start page no./Revision	
	Timber Inner Lintel (W10)				2	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	GL	13/07/2017	BS	13/07/2017		

Reactions at support A

$$R_{A_max} = 2.917 \text{ kN}$$

$$R_{A_min} = 2.917 \text{ kN}$$

Unfactored dead load reaction at support A

$$R_{A_Dead} = 2.061 \text{ kN}$$

Unfactored imposed load reaction at support A

$$R_{A_Imposed} = 0.856 \text{ kN}$$

Reactions at support B

$$R_{B_max} = 2.917 \text{ kN}$$

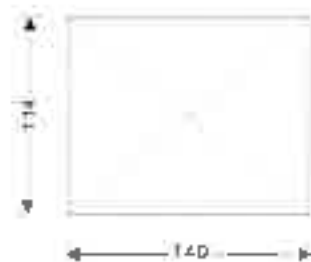
$$R_{B_min} = 2.917 \text{ kN}$$

Unfactored dead load reaction at support B

$$R_{B_Dead} = 2.061 \text{ kN}$$

Unfactored imposed load reaction at support B

$$R_{B_Imposed} = 0.856 \text{ kN}$$



Timber section details

Breadth of sections

$$b = 140 \text{ mm}$$

Depth of sections

$$h = 114 \text{ mm}$$

Number of sections in member

$$N = 1$$

Overall breadth of member

$$b_b = N \times b = 140 \text{ mm}$$

Timber strength class

$$C24$$

Member details

Service class of timber

$$1$$

Load duration

$$\text{Long term}$$

Length of bearing

$$L_b = 76 \text{ mm}$$

Section properties

Cross sectional area of member

$$A = N \times b \times h = 15960 \text{ mm}^2$$

Section modulus

$$Z_x = N \times b \times h^2 / 6 = 303240 \text{ mm}^3$$

$$Z_y = h \times (N \times b)^2 / 6 = 372400 \text{ mm}^3$$

Second moment of area

$$I_x = N \times b \times h^3 / 12 = 17284680 \text{ mm}^4$$

$$I_y = h \times (N \times b)^3 / 12 = 26068000 \text{ mm}^4$$

Radius of gyration

$$i_x = \sqrt{I_x / A} = 32.9 \text{ mm}$$

$$i_y = \sqrt{I_y / A} = 40.4 \text{ mm}$$

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

$$K_7 = (300 \text{ mm} / h)^{0.11} = 1.11$$

Load sharing - cl.2.9

$$K_8 = 1.00$$

Lateral support - cl.2.10.8

No lateral support

Permissible depth-to-breadth ratio - Table 19

$$2.00$$

Actual depth-to-breadth ratio

$$h / (N \times b) = 0.81$$

PASS - Lateral support is adequate

Compression perpendicular to grain

Permissible bearing stress (no wane)

$$\sigma_{c_adm} = \sigma_{cp1} \times K_3 \times K_4 \times K_8 = 2.400 \text{ N/mm}^2$$

Applied bearing stress

$$\sigma_{c_a} = R_{A_max} / (N \times b \times L_b) = 0.274 \text{ N/mm}^2$$

$$\sigma_{c_a} / \sigma_{c_adm} = 0.114$$

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

 Crouch Waterfall Suite 5.01, Network House, Basing View Basingstoke RG21 4HG	Project				Job no.	
	51 Longwood Avenue				16-465G	
	Calcs for				Start page no./Revision	
	Timber Inner Lintel (W10)				3	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	GL	13/07/2017	BS	13/07/2017		

Bending parallel to grain

Permissible bending stress

$$\sigma_{m_adm} = \sigma_m \times K_3 \times K_7 \times K_8 = 8.342 \text{ N/mm}^2$$

Applied bending stress

$$\sigma_{m_a} = M / Z_x = 2.525 \text{ N/mm}^2$$

$$\sigma_{m_a} / \sigma_{m_adm} = 0.303$$

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress

$$\tau_{adm} = \tau \times K_3 \times K_8 = 0.710 \text{ N/mm}^2$$

Applied shear stress

$$\tau_a = 3 \times F / (2 \times A) = 0.274 \text{ N/mm}^2$$

$$\tau_a / \tau_{adm} = 0.386$$

PASS - Applied shear stress is less than permissible shear stress

Deflection

Modulus of elasticity for deflection

$$E = E_{min} = 7200 \text{ N/mm}^2$$

Permissible deflection

$$\delta_{adm} = \min(0.551 \text{ in}, 0.003 \times L_{s1}) = 3.150 \text{ mm}$$

Bending deflection

$$\delta_{b_s1} = 0.707 \text{ mm}$$

Shear deflection

$$\delta_{v_s1} = 0.128 \text{ mm}$$

Total deflection

$$\delta_a = \delta_{b_s1} + \delta_{v_s1} = 0.834 \text{ mm}$$

$$\delta_a / \delta_{adm} = 0.265$$

PASS - Total deflection is less than permissible deflection

CALCULATION SHEET

**CROUCH
WATERFALL**

Project Title

51 Longwood Avenue

Job No

16-4656

By

GL

Date

JULY 17

Checked

BS

Date

JULY 17

Page

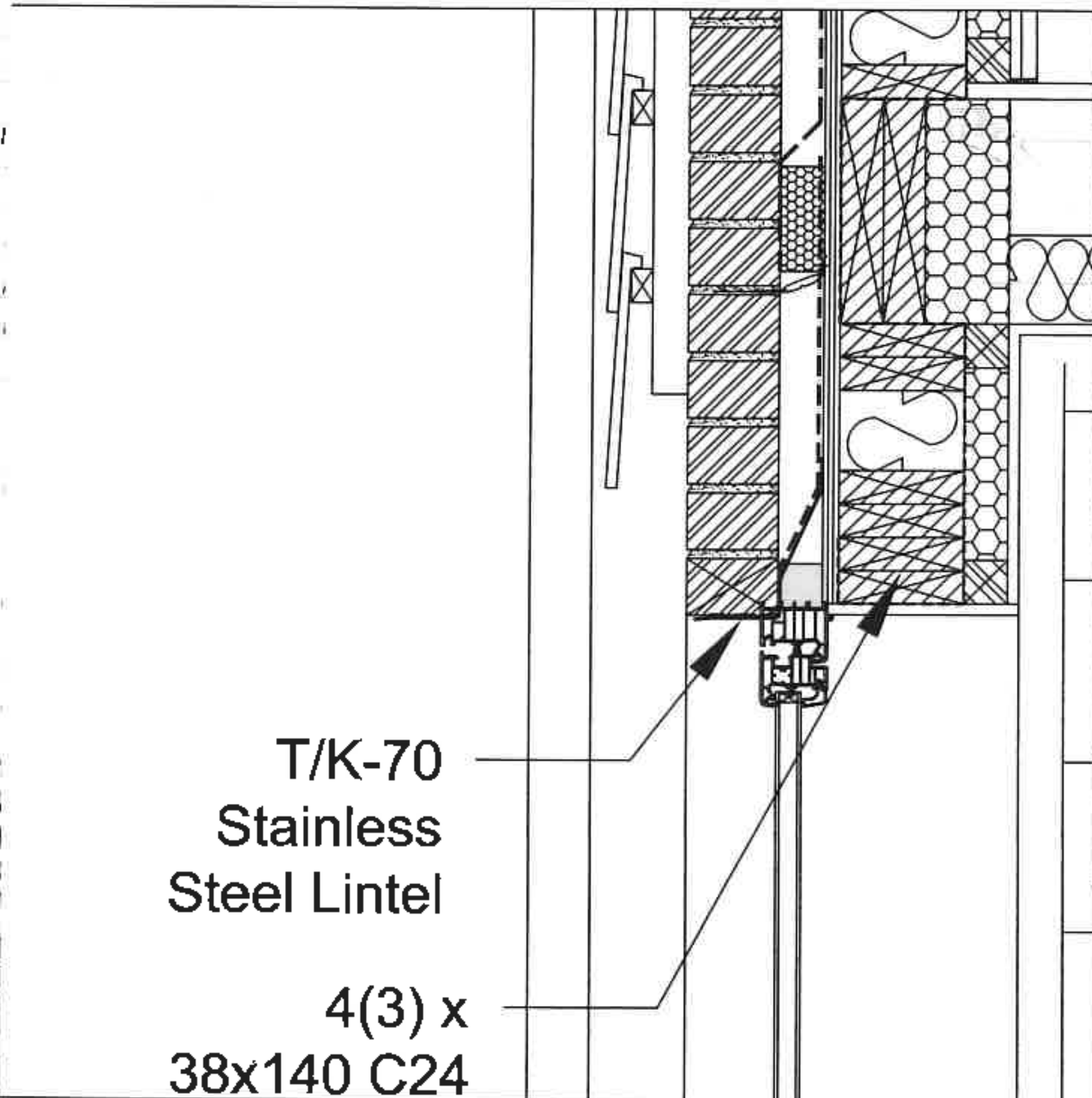
17

of

17

References

Results

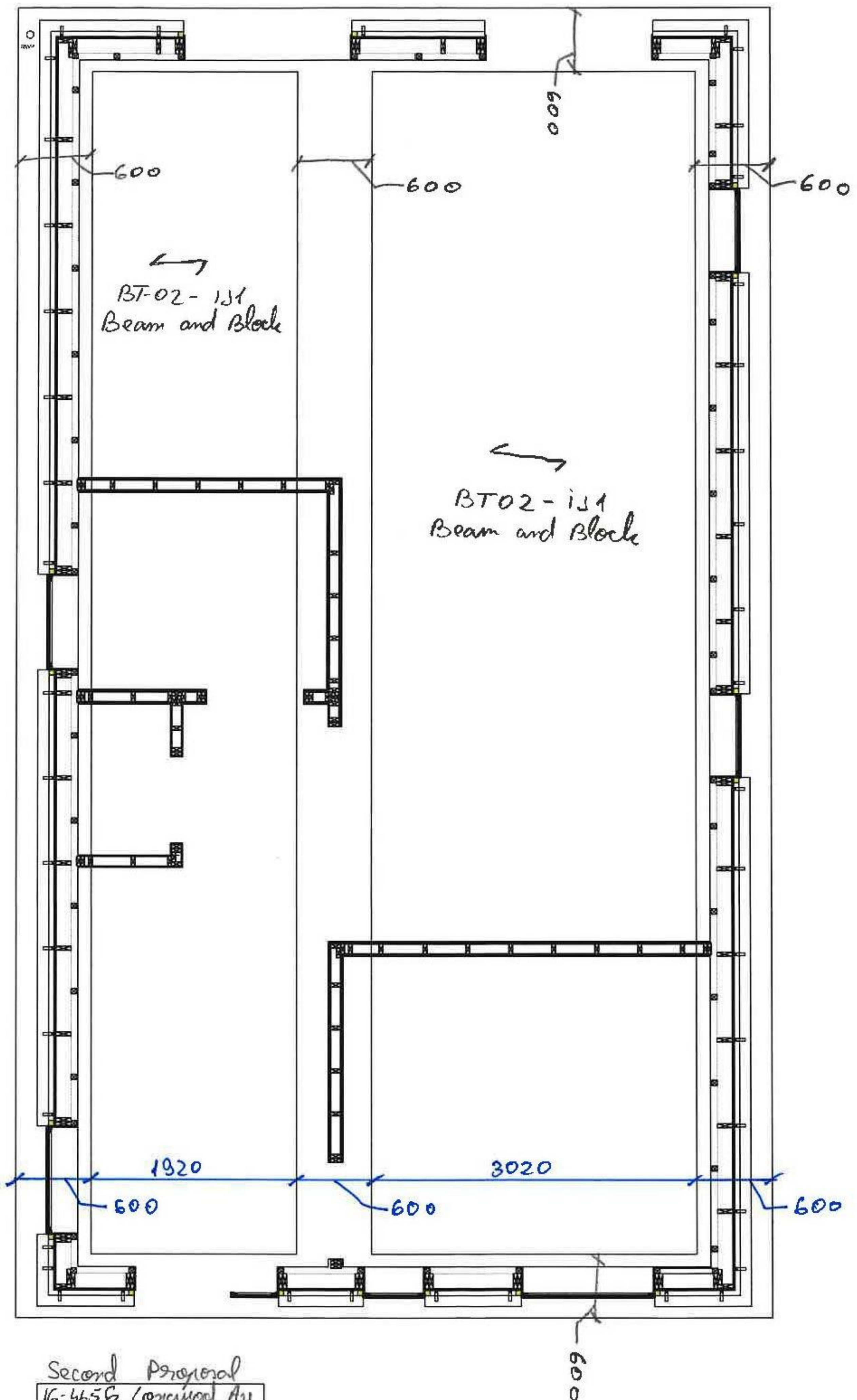


T/K-70
Stainless
Steel Lintel

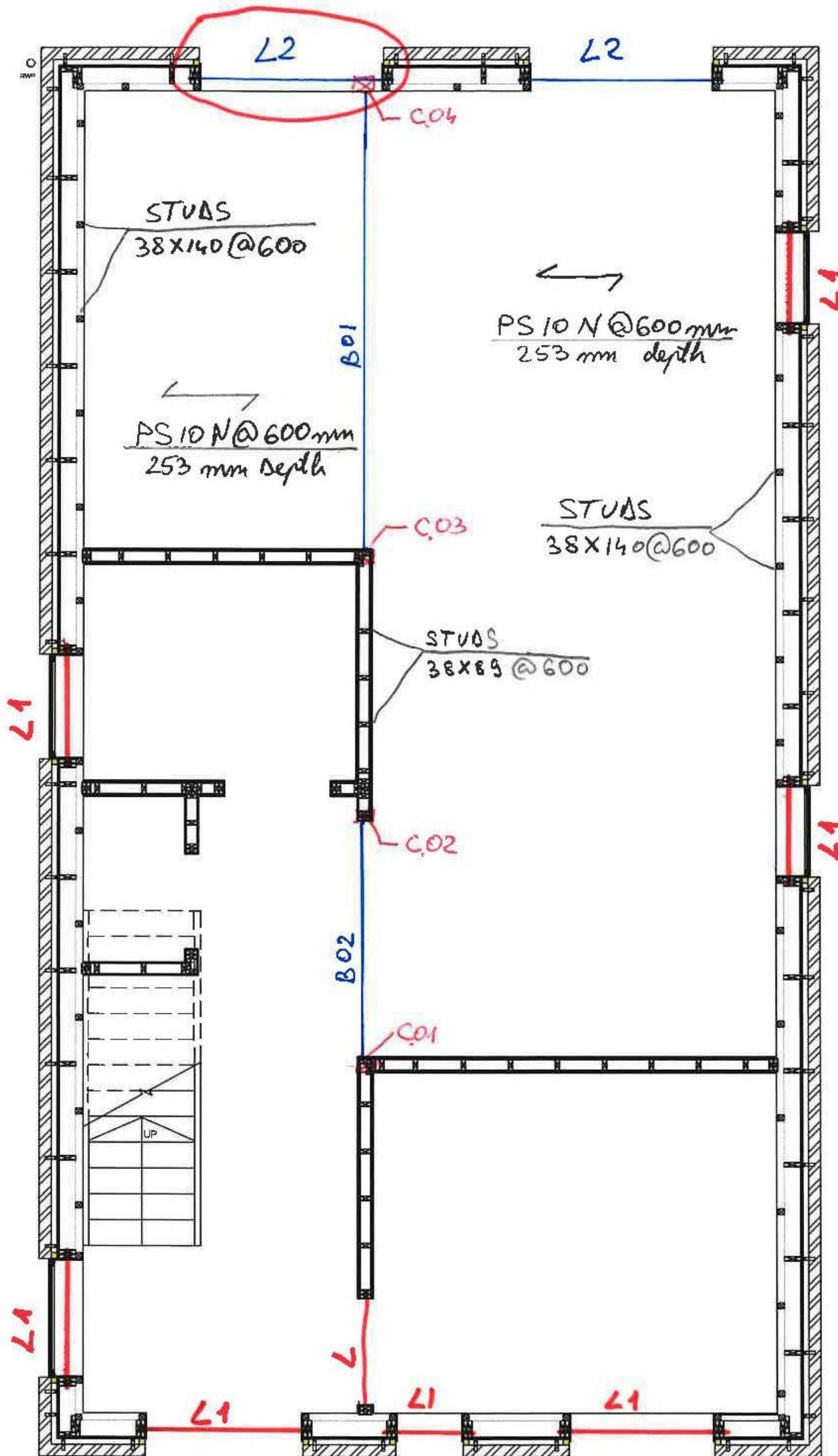
4(3) x
38x140 C24

Lintel Sketch

Sec. 1/10



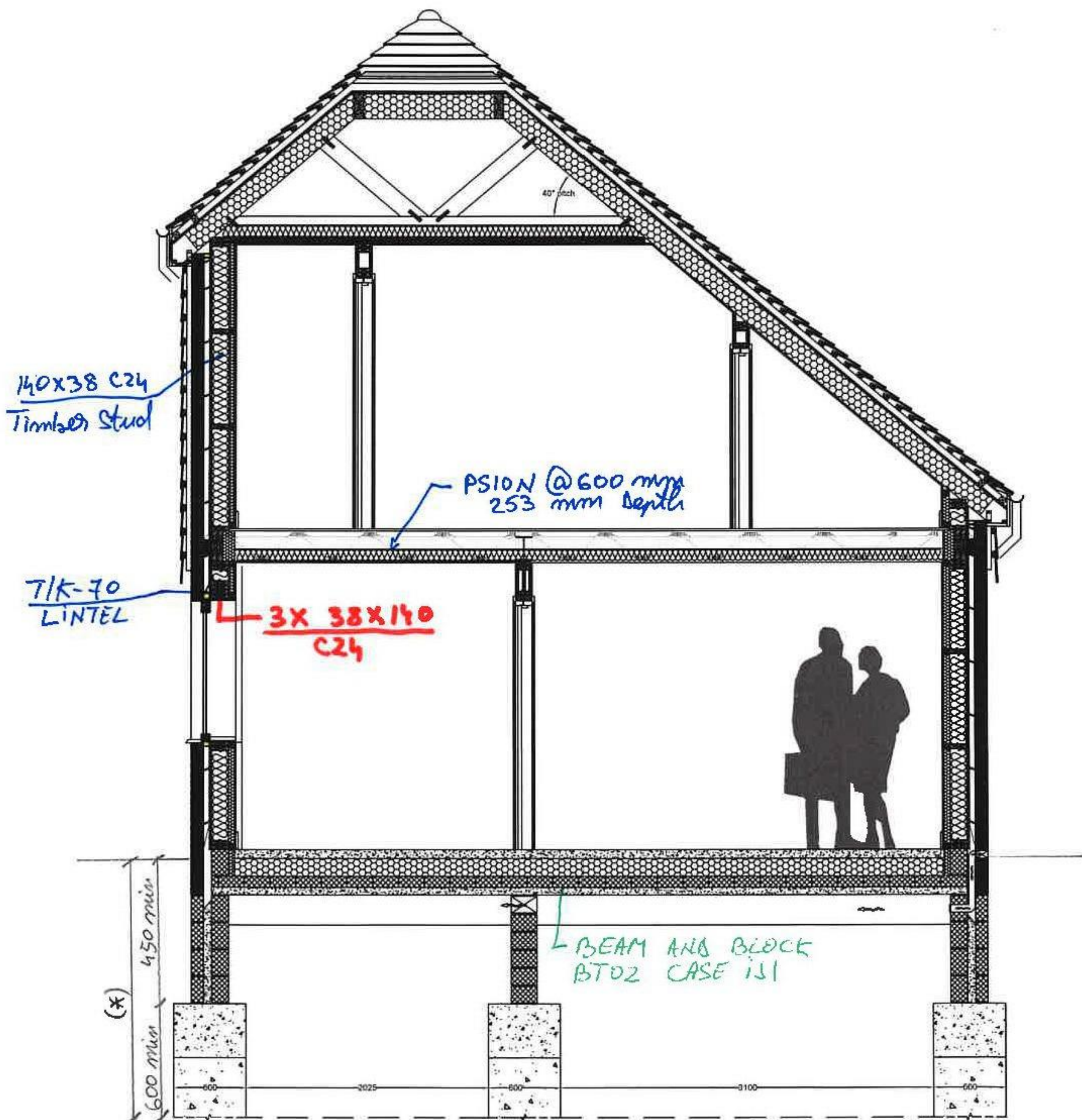
TO BE MOVED



Second Proposal
16-4656 LONGWOOD AV.
FIRST FLOOR
06/07/2017 | Sc 1/50

B.01, B.02 - 203X133 UB25
C.01-04 - 80X80 SHS 3
L1 - T/K70 Lintel on 3X 38X140, C24
L2 - T/K70 Lintel on 4X 38X140, C24

Note: Truss and Rafter subject of Specialist Design



(*): Footings to be founded at a min 1000 mm below existing ground level and/or 150 mm into the underlaying.

Natural ground to be inspected and confirmed on site by building control.

16-465 G Longwood Ave
SECTION
13/07/2017 Sc 1/50