



CIVIL & STRUCTURAL
CONSULTING ENGINEERS

16 Castle Hedingham

Structural Calculations

For

Daniel Hawker

Date:

08/09/2025

Project Reference: M2-3361

Document Reference: SE-01_A1

Web: m2structural.co.uk

Phone: 01225 285073



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Job Ref. M2-3361	Calc. by MC	Date 04/09/2025
Doc. Ref. SE-01_A1	Chk'd by MD	Date 08/09/2025

Document Issue History and Status

Revision	Prepared By		Checked By		Approved By	
	Name	Date	Name	Date	Name	Date
A1	Matthieu Crosnier	04.09.25	Max Day	08.09.25	Matthieu Crosnier	08.09.25

General Notes:

Calculations to be checked by Building Control Authority before work commences. Client to ensure all of contractors' works on site comply with and meet Approval of the relevant British Standards and the Local Authority including Building Control and Planning Departments. All temporary works to be the responsibility of the contractor and should be in accordance with BS 5975 to ensure temporary stability during the course of the works.

Dimensions: Note that all dimensions shown on the calculations are indicative and have been used for calculation purposes only. All dimensions should be checked prior to start of the works on site. It is the responsibility of the client to notify the Engineer of any discrepancies. The same applies to the alignment of walls and general layouts. All existing foundations and lintels to be exposed to verify suitability and to be checked for adequacy and/or replaced or surrounded in 150mm concrete cover if necessary. Prior to commencement a trial hole and /or soil report/investigation and an inspection of any trees in the areas may be required.

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Introduction:

The following design calculations are for the lintels required to punch through the timber framed house external wall to form a recess for the new wood burning stove.

Design Codes - Eurocodes:

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 1994:	Eurocode 4:	"Design of Composite Steel and Concrete 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"
BS EN 1998:	Eurocode 8:	"Design of Structures for Earthquake Resistance"
BS EN 1999:	Eurocode 9:	"Design of Aluminium Structures"



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Loadings

Roof Loading (Pitched Tiled Roof)

Roof slope;

A = 45°

Dead Load

Tiles;	Roof _{D1}	=	0.70 kN/m ²
Felt & Battens;	Roof _{D2}	=	0.05 kN/m ²
Rafters;	Roof _{D3}	=	0.12 kN/m ²
Dead Load on slope;	Roof _{DL_sroof} = sum(Roof _{D1} ,Roof _{D2} ,Roof _{D3})	=	0.87 kN/m ²
Ceiling Joists;	Roof _{D4}	=	0.05 kN/m ²
Insulation;	Roof _{D5}	=	0.05 kN/m ²
Services;	Roof _{D6}	=	0.05 kN/m ²
Plasterboard & Skim;	Roof _{D7}	=	0.15 kN/m ²
Dead Load on plan;	Roof _{DL_proof} = sum(Roof _{D4} ,Roof _{D5} ,Roof _{D6} ,Roof _{D7})	=	0.30 kN/m ²
Total Dead Load (on plan);	Roof _{DL} = Roof _{DL_sroof} / cos(A) + Roof _{DL_proof}	=	1.53 kN/m ²

Imposed Load

Roof Imposed Load (on plan);	Roof _{IL1}	=	0.60 kN/m ²
Ceiling Imposed Load (storage);	Roof _{IL2}	=	0.25 kN/m ²

Timber Floor Loading (First Floor)

Dead Load

Finishes;	Floor _{1_D1}	=	0.10 kN/m ²
Boarding;	Floor _{1_D2}	=	0.15 kN/m ²
Floor Joists;	Floor _{1_D3}	=	0.15 kN/m ²
Plasterboard & Skim;	Floor _{1_D4}	=	0.15 kN/m ²
Total Dead Load;	Floor _{1_DL} = sum(Floor _{1_D1} ,Floor _{1_D2} ,Floor _{1_D3} ,Floor _{1_D4})	=	0.55 kN/m ²

Imposed Load

Imposed Load;	Floor _{1_I1}	=	1.50 kN/m ²
Partitions;	Floor _{1_I2}	=	0.50 kN/m ²
Total Imposed Load;	Floor _{1_IL} = sum(Floor _{1_I1} ,Floor _{1_I2})	=	2.00 kN/m ²

Stud Wall Loading

Dead Load

Stud;	SW _{D1}	=	0.20 kN/m ²
Plasterboard & Skim (both sides);	SW _{D2}	=	0.30 kN/m ²
Total Dead Load;	SW _{DL} = sum(SW _{D1} ,SW _{D2})	=	0.50 kN/m ²

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Timber Lintel Design:

Loadings

UDL from Pitched Roof

Width of roof being carried;	$x_1 = 3.5\text{ m}$		
Dead Load;	$DL_1 = 1.53\text{ kN/m}^2 \times x_1$	=	5.355 kN/m
Imposed Load;	$IL_1 = 0.85\text{ kN/m}^2 \times x_1$	=	2.975 kN/m

UDL from Timber Floor

Width of floor being carried;	$x_2 = 1.6\text{ m}$		
Dead Load;	$DL_2 = 0.55\text{ kN/m}^2 \times x_2$	=	0.880 kN/m
Imposed Load;	$IL_2 = 2.00\text{ kN/m}^2 \times x_2$	=	3.200 kN/m

UDL from Stud Wall

Height of wall being carried;	$x_3 = 3.5\text{ m}$		
Dead Load;	$DL_3 = 0.50\text{ kN/m}^2 \times x_3$	=	1.750 kN/m

Total UDL

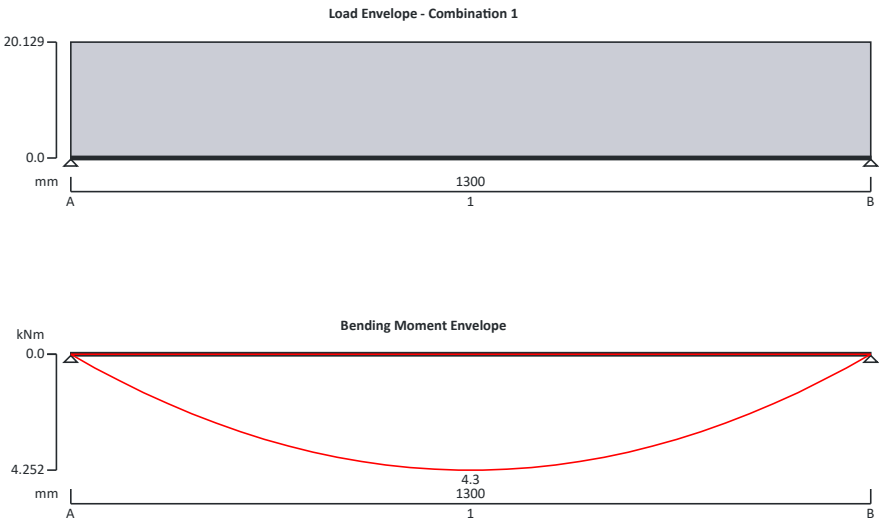
Total Dead UDL;	$DL_T = \text{sum}(DL_1, DL_2, DL_3)$	=	7.985 kN/m
Total Imposed UDL;	$IL_T = \text{sum}(IL_1, IL_2)$	=	6.175 kN/m
Total UDL;	$w_T = DL_T + IL_T$	=	14.160 kN/m

TIMBER LINTEL ANALYSIS & DESIGN (EN1995)

TIMBER BEAM ANALYSIS & DESIGN TO EN1995-1-1:2004

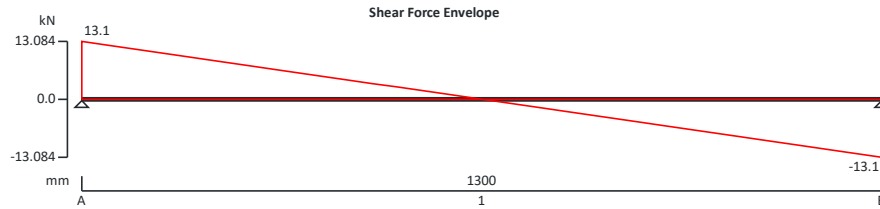
In accordance with EN1995-1-1:2004 + A2:2014 and Corrigendum No.1 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 1.7.05





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Applied loading

Beam loads

Permanent self weight of beam $\times 1$

Permanent full UDL 7.985 kN/m

Variable full UDL 6.175 kN/m

Load combinations

Load combination 1 Support A Permanent $\times 1.35$

Variable $\times 1.50$

Span 1 Permanent $\times 1.35$

Variable $\times 1.50$

Support B Permanent $\times 1.35$

Variable $\times 1.50$

Analysis results

Maximum moment; $M_{\max} = 4.252$ kNm; $M_{\min} = 0.000$ kNm

Design moment; $M = \max(\text{abs}(M_{\max}), \text{abs}(M_{\min})) = 4.252$ kNm

Maximum shear; $F_{\max} = 13.084$ kN; $F_{\min} = -13.084$ kN

Design shear; $F = \max(\text{abs}(F_{\max}), \text{abs}(F_{\min})) = 13.084$ kN

Total load on beam; $W_{\text{tot}} = 26.168$ kN

Reactions at support A; $R_{A_{\max}} = 13.084$ kN; $R_{A_{\min}} = 13.084$ kN

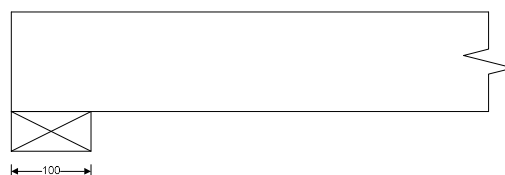
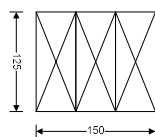
Unfactored permanent load reaction at support A; $R_{A_{\text{Permanent}}} = 5.232$ kN

Unfactored variable load reaction at support A; $R_{A_{\text{Variable}}} = 4.014$ kN

Reactions at support B; $R_{B_{\max}} = 13.084$ kN; $R_{B_{\min}} = 13.084$ kN

Unfactored permanent load reaction at support B; $R_{B_{\text{Permanent}}} = 5.232$ kN

Unfactored variable load reaction at support B; $R_{B_{\text{Variable}}} = 4.014$ kN



Timber section details

Breadth of timber sections; $b = 50$ mm

Depth of timber sections; $h = 125$ mm



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Number of timber sections in member; $N = 3$
Overall breadth of timber member; $b_b = N \times b = 150 \text{ mm}$
Timber strength class - EN 338:2016 Table 1; **C24**

Member details

Load duration - cl.2.3.1.2; **Long-term**
Service class of timber - cl.2.3.1.3; **1**
Length of span; $L_{s1} = 1300 \text{ mm}$
Length of bearing; $L_b = 100 \text{ mm}$

Section properties

Cross sectional area of member; $A = N \times b \times h = 18750 \text{ mm}^2$
Section modulus; $W_y = N \times b \times h^2 / 6 = 390625 \text{ mm}^3$
 $W_z = h \times (N \times b)^2 / 6 = 468750 \text{ mm}^3$
Second moment of area; $I_y = N \times b \times h^3 / 12 = 24414063 \text{ mm}^4$
 $I_z = h \times (N \times b)^3 / 12 = 35156250 \text{ mm}^4$
Radius of gyration; $r_y = \sqrt{I_y / A} = 36.1 \text{ mm}$
 $r_z = \sqrt{I_z / A} = 43.3 \text{ mm}$

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; $\gamma_M = 1.300$

Modification factors

Modification factor for load duration and moisture content - Table 3.1
 $k_{mod} = 0.700$
Deformation factor for service classes - Table 3.2; $k_{def} = 0.600$
Depth factor for bending - exp.3.1; $k_{h,m} = \min((150 \text{ mm} / h)^{0.2}, 1.3) = 1.037$
Depth factor for tension - exp.3.1; $k_{h,t} = \min((150 \text{ mm} / \max(b, h))^{0.2}, 1.3) = 1.037$
Bending stress re-distribution factor - cl.6.1.6(2); $k_m = 0.700$
Crack factor for shear resistance - cl.6.1.7(2); $k_{cr} = 0.670$
Load configuration factor - exp.6.4; $k_{c,90} = 1.000$
System strength factor - cl.6.6; $k_{sys} = 1.000$
Lateral buckling factor - cl.6.3.3(5); $k_{crit} = 1.000$

Compression perpendicular to the grain - cl.6.1.5

Design compressive stress; $\sigma_{c,90,d} = R_{A,max} / (N \times b \times L_b) = 0.872 \text{ N/mm}^2$
Design compressive strength; $f_{c,90,d} = k_{mod} \times k_{sys} \times k_{c,90} \times f_{c,90,k} / \gamma_M = 1.346 \text{ N/mm}^2$
 $\sigma_{c,90,d} / f_{c,90,d} = 0.648$

PASS - Design compressive strength exceeds design compressive stress at bearing

Bending - cl 6.1.6

Design bending stress; $\sigma_{m,d} = M / W_y = 10.886 \text{ N/mm}^2$
Design bending strength; $f_{m,d} = k_{h,m} \times k_{mod} \times k_{sys} \times k_{crit} \times f_{m,k} / \gamma_M = 13.403 \text{ N/mm}^2$
 $\sigma_{m,d} / f_{m,d} = 0.812$



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PASS - Design bending strength exceeds design bending stress

Shear - cl.6.1.7

Applied shear stress; $\tau_d = 3 \times F / (2 \times k_{cr} \times A) = \mathbf{1.562 \text{ N/mm}^2}$

Permissible shear stress; $f_{v,d} = k_{mod} \times k_{sys} \times f_{v,k} / \gamma_M = \mathbf{2.154 \text{ N/mm}^2}$

$\tau_d / f_{v,d} = \mathbf{0.725}$

PASS - Design shear strength exceeds design shear stress

Deflection - cl.7.2

Deflection limit; $\delta_{lim} = \min(14 \text{ mm}, 0.004 \times L_{s1}) = \mathbf{5.200 \text{ mm}}$

Instantaneous deflection due to permanent load; $\delta_{instG} = \mathbf{1.272 \text{ mm}}$

Final deflection due to permanent load; $\delta_{finG} = \delta_{instG} \times (1 + k_{def}) = \mathbf{2.036 \text{ mm}}$

Instantaneous deflection due to variable load; $\delta_{instQ} = \mathbf{0.976 \text{ mm}}$

Factor for quasi-permanent variable action; $\psi_2 = \mathbf{0.3}$

Final deflection due to variable load; $\delta_{finQ} = \delta_{instQ} \times (1 + \psi_2 \times k_{def}) = \mathbf{1.152 \text{ mm}}$

Total final deflection; $\delta_{fin} = \delta_{finG} + \delta_{finQ} = \mathbf{3.188 \text{ mm}}$

$\delta_{fin} / \delta_{lim} = \mathbf{0.613}$

PASS - Total final deflection is less than the deflection limit

Provide 3No. 50x125 C24 bolted together with M12 at 400c/c.



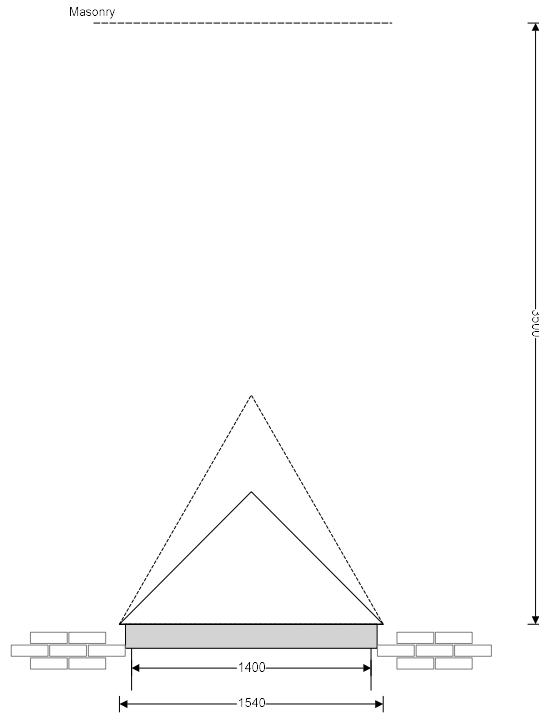
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LINTEL ANALYSIS (BS5977)

LINTEL ANALYSIS

In accordance with BS5977-1:1981 incorporating Amendment No. 1

Tedds calculation version 1.1.00



Basic lintel dimensions;

Lintel clear span;

$$L_{c1} = 1400 \text{ mm}$$

Lintel load application length;

$$L = L_{c1} \times 1.1 = 1540 \text{ mm}$$

Load zone height;

$$h_{LZ} = \tan(45) \times L / 2 = 770 \text{ mm}$$

Interaction zone height;

$$h_{IZ} = \tan(60) \times L / 2 = 1334 \text{ mm}$$

Load factors

Dead load factor;

$$LF_d = 1.40$$

Imposed load factor;

$$LF_i = 1.60$$

Masonry

Masonry height;

$$h_m = 3500 \text{ mm}$$

Leaf 1;

Masonry density;

$$\gamma_{mi} = 20.00 \text{ kN/m}^3$$

Masonry thickness;

$$t_{wi} = 100 \text{ mm}$$

Load at midspan;

$$w_{mi} = h_{LZ} \times t_{wi} \times \gamma_{mi} = 1.54 \text{ kN/m}$$

Lintel self weight

Self weight of lintel;

$$w_{lsw} = 0.000 \text{ kN/m}$$



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Masonry load zone

Height of load zone;

$$h_{LZ} = L / 2 = 770 \text{ mm}$$

Total masonry area;

$$A_{LZ} = h_{LZ} \times L / 2 = 0.593 \text{ m}^2$$

Total masonry load;

$$W_{LZ} = A_{LZ} \times t_{wi} \times \gamma_{mi} = 1.186 \text{ kN}$$

Equivalent UDL;

$$w_{Equiv_LZ} = W_{LZ} \times 1.33 / L = 1.024 \text{ kN/m}$$

Load application summary;

Load Description	UDL total length (mm)	Start of UDL on lintel (mm)	End of UDL on lintel (mm)	Equiv. dead load on lintel (kN/m)	Equiv. imposed load on lintel (kN/m)
Masonry from load triangle	1540	0	1540	1.024	0.000

Analysis results at ULS

Maximum moment;

$$M_{max} = 0.426 \text{ kNm}$$

Maximum shear;

$$V_{max} = 0.830 \text{ kN}$$

Maximum reaction at support A;

$$R_{A_max} = 0.830 \text{ kN}$$

Maximum reaction at support B;

$$R_{B_max} = 0.830 \text{ kN}$$

Support reactions at SLS

Dead loads

Reaction at support A;

$$R_{A_DL} = 0.593 \text{ kN}$$

Reaction at support B;

$$R_{B_DL} = 0.593 \text{ kN}$$

Imposed loads

Reaction at support A;

$$R_{A_IL} = 0.000 \text{ kN}$$

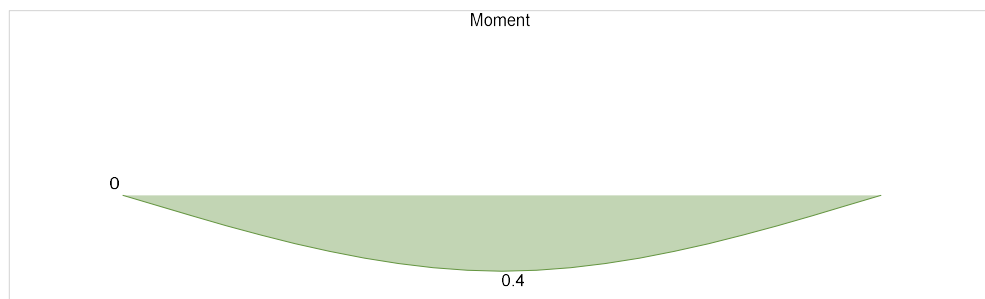
Reaction at support B;

$$R_{B_IL} = 0.000 \text{ kN}$$

Equivalent UDL at SLS

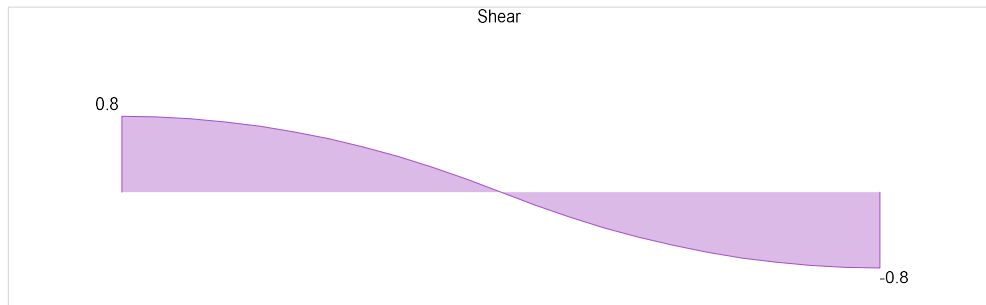
Total equivalent UDL;

$$w_e = 1.024 \text{ kN/m}$$





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Economy Range		ER1	ER2	ER3	ER4	ER6	ER7	ER8
Load Table								
Suitable for Foundation Use		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Available Range Finish		Standard	Standard	Standard	Standard	Standard	Standard	Standard
		UNFACTORED LOADS IN kN/m						
Length	Clear Span	100x65	100x140	140x65	215x70	140x140	100x215	140x215
900mm	700mm	8.31	30.04	10.08	17.73	36.87	59.38	75.93
1100mm	900mm	5.07	18.80	6.13	10.81	23.06	47.40	56.61
1200mm	1000mm	4.10	15.39	4.96	8.76	18.87	40.95	46.66
1500mm	1200mm	2.83	10.83	3.42	6.04	13.25	28.83	32.81
1800mm	1500mm	1.78	6.97	2.13	3.79	8.51	18.90	21.46
2100mm	1800mm	1.19	4.81	1.42	2.55	5.86	13.27	15.03
2400mm	2100mm	0.84	3.49	0.99	1.79	4.23	9.78	11.04
2700mm	2400mm	n/a	2.61	0.71	1.30	3.15	7.46	8.39
3000mm	2700mm	n/a	2.01	0.52	0.96	2.41	5.85	6.55
Lintel Weight kg/m		16	34	22	34	47	51.6	72

Provide 100wd x 140dp PCC lintel.