Elamin Design Consultancy

Structural Calculations

For

Paradise Nursery, Lower Hartlip Road

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November 2022

1. GENERAL NOTES

Timber

1. All structural timber is to be strength class C16 unless noted otherwise on the drawing. Timber to be tanalised. Where timbers are cut, exposed ends are to be re-treated with preservative prior to installation.
2. Unless design provided, use triple joists under dormer cheeks and double joists under partitions parallel to spans. Provide double floor joists under baths.
3. Provide external stud walls (including dormers) with 12mm plywood cladding nailed at 150mm centres with 3mm diameter galvanised nails a minimum of 50mm long.
4. All double / triple joists are to be well spiked together at 300mm c/c with 4mm diameter nails, 90mm long for 50mm wide joists and 5mm diameter nails x 125mm long for 63/75mm wide joists.
5. All notches should be pre-drilled with a 3mm dia. drill to reduce the risk of overcutting and splitting etc.
6. Provide 30 x 5mm thick galvanised horizontal wall restraint straps at 1200mm ctrs. perpendicular to span and at every third joist parallel to span.
7. Provide 30 x 5mm thick galvanised vertical twisted roof restraint straps at 1200mm ctrs. perpendicular to span and at every third joist.
8. Noggins – where floor or roof joists shown on drawings have maximum depth to breadth ratio of six or more, the contractor is to allow/provide for solid noggins/blockings at intervals not exceeding six times the depth as set out in BS5268 part 1 table 19, unless shown otherwise.
9. Herringbone strutting or blocking shall be provided at the ends of joists where they bear onto steelwork, intermediate walls or are supported on joist hangers. Additionally for spans over 2.5 metres a central row of strutting shall be provided and for spans over 4.5 metres two rows -one at each third span.
10. Notches shall not exceed 0.125 of the depth of the joist and shall be located within a zone, 0.1 to 0.2 x the span, from the support.
11. Holes shall be drilled at mid-depth of the joist at no greater diameter than 0.25 of the depth and not less than three diameters apart centre to centre. They shall be located between 0.25 and 0.4 of the span from the support.
12. When undertaking alteration to a trussed rafter roof structure all new beams, rafters, floor joists etc. are to be installed prior to the removal of any trussed rafter members unless an alternative method of support to the roof is provided.

2. CODES

EC1: Eurocode for Actions/loads
EC2: Eurocode for Concrete Design
EC3: Eurocode for Steel Design
EC5: Eurocode for Timber Design
EC6: Eurocode for Masonry design
BS 5950: Steelwork Design_reference
BS 5268: Timber Design_reference
BS 5628: Masonry Design_reference

3. DIMENSIONS

Dimensions shown in the calculation are approximate and so must **not** be used for construction. Please refer to the appropriate drawings and/or check at Site.

	Job Barn Conversion Address: Paradise Nursery, Lower Hartlip Road

Designed By	Date	Job No.	Sheet No.
HEA	November-22	49/22	

STANDARD LOADINGS

Roofs and Floors

Sloping Roofs (on plan)		
Tiles	0.80 kN/m^2	DL 1.00 kN/m^2
Battens and felt	0.10 kN/m^2	LL 0.60 kN/m^2
Rafters	0.10 kN/m^2	**WL 1.60 kN/m^2**
Live Load	0.60 kN/m^2	UL 2.36 kN/m^2
Roof Space		
Joists and Insulation	0.10 kN/m^2	DL 0.25 kN/m^2
Soffit	0.15 kN/m^2	LL 0.25 kN/m^2
Live Load	0.25 kN/m^2	**WL 0.50 kN/m^2**
		UL 0.75 kN/m^2
Flat Timber Roofs		
Chippings and Felt	0.34 kN/m^2	DL 1.00 kN/m^2
Boards Joists and Firings	0.33 kN/m^2	LL 0.60 kN/m^2
Soffit and Insulation	0.33 kN/m^2	**WL 1.60 kN/m^2**
Live Load	0.60 kN/m^2	UL 2.36 kN/m^2
Metal decking roof		
Composite profiled steel deck	0.22 kN/m^2	DL 0.80 kN/m^2
Purlin s/w	0.16 kN/m^2	LL 0.60 kN/m^2
Soffit and Insulation	0.16 kN/m^2	**WL 1.40 kN/m^2**
Services	0.26 kN/m^2	UL 2.08 kN/m^2
Live Load	0.60 kN/m^2	
Timber Floors		
Boards and Joists	0.35 kN/m^2	DL 0.50 kN/m^2
Ceiling Panels	0.15 kN/m^2	LL 1.50 kN/m^2
Live Load	1.50 kN/m^2	**WL 2.00 kN/m^2**
Partitions	1.00 kN/m^2	UL 3.10 kN/m^2
Standard PCC Floors - Private		
150 PCC Slab (200)	2.40 kN/m^2 (2.90kN/m^2)	DL 4.40 kN/m^2
Finishes	1.80 kN/m^2	LL 1.50 kN/m^2
Soffit	0.20 kN/m^2	**WL 5.90 kN/m^2**
Live Load	1.50 kN/m^2	UL 8.56 kN/m^2
Partitions	1.00 kN/m^2	
Standard PCC Floors - Common		
150 PCC Slab (200)	2.40 kN/m^2 (2.90kN/m^2)	DL 4.40 kN/m^2
Finishes	1.80 kN/m^2	LL 3.00 kN/m^2
Soffit	0.20 kN/m^2	**WL 7.50 kN/m^2**
Live Load	3.00 kN/m^2	UL 8.56 kN/m^2
Partitions	1.00 kN/m^2	
Beam & block floors		
150 flooring (225)	2.30 kN/m^2 (2.80kN/m^2)	DL 4.30 kN/m^2
Finishes	1.80 kN/m^2	LL 1.50 kN/m^2
Soffit	0.20 kN/m^2	**WL 5.80 kN/m^2**
Live Load	1.50 kN/m^2	UL 8.42 kN/m^2
Partitions	1.00 kN/m^2	
Metal profiled decking floor		
Profiled deck	0.10 kN/m^2	DL 3.90 kN/m^2
Soffit/ceiling	0.30 kN/m^2	LL 1.50 kN/m^2
Self weight of 140 deep floor	2.50 kN/m^2	**WL 5.40 kN/m^2**
Live Load	1.50 kN/m^2	UL 7.86 kN/m^2
Partitions	1.00 kN/m^2	

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STANDARD LOADINGS

Walls

Internal Stud Wall		
Studding	0.10 kN/m^2	**WL 0.40 kN/m^2**
2 * Plasterboard	0.30 kN/m^2	UL 0.56 kN/m^2
External Tile/Stud Wall		
Studding	0.10 kN/m^2	**WL 1.00 kN/m^2**
Plasterboard	0.15 kN/m^2	UL 1.40 kN/m^2
Battens, Felt and Insulation	0.15 kN/m^2	
Tile Hanging	0.60 kN/m^2	
External Brick/Block cavity Wall		
Brick	2.10 kN/m^2	**WL 3.35 kN/m^2**
100 Lightweight Block	1.00 kN/m^2	UL 5.03 kN/m^2
Plaster	0.25 kN/m^2	
100 Lightweight Block Wall (Internal)		
Blockwork	1.00 kN/m^2	**WL 1.50 kN/m^2**
2 x Plaster	0.50 kN/m^2	UL 2.10 kN/m^2
140 Lightweight Block Wall (Internal)		
Blockwork	1.40 kN/m^2	**WL 1.90 kN/m^2**
2 x Plaster	0.50 kN/m^2	UL 2.66 kN/m^2
215 Dense Block/Brick Wall		
Blockwork	4.30 kN/m^2	**WL 4.60 kN/m^2**
2 x Plasterboard	0.30 kN/m^2	UL 6.44 kN/m^2
275 Lightweight Block Cavity Wall		
2 x 100 Blockwork	2.20 kN/m^2	**WL 2.50 kN/m^2**
2 x Plasterboard	0.30 kN/m^2	UL 3.50 kN/m^2
Party walls (Dense block)		
2 x 100 dense Blockwork	4.00 kN/m^2	**WL 4.50 kN/m^2**
2 x Plaster	0.50 kN/m^2	UL 6.30 kN/m^2
Party walls (Timber per leaf)		
Timber frame	0.10 kN/m^2	**WL 0.60 kN/m^2**
Plywood sheathing x 2	0.25 kN/m^2	UL 0.84 kN/m^2
Plasterboard lining x 2	0.25 kN/m^2	
External timber clad		
Block 150mm	1.50 kN/m^2	**WL 2.00 kN/m^2**
Plaster	0.25 kN/m^2	UL 2.80 kN/m^2
Insulation	0.05 kN/m^2	
Battens & weatherboarding	0.20 kN/m^2	
External weathered boarded block		
Block 100mm	1.30 kN/m^2	**WL 3.05 kN/m^2**
Block 100mm	1.30 kN/m^2	UL 4.27 kN/m^2
Plaster	0.25 kN/m^2	
Battens & weatherboarding	0.20 kN/m^2	

Loading: Based on worst case scenario for structural elements

<u>Roof</u>

-Truss (See TEDDS Calcs for sections sizes, truss model, analysis & design)

Roof DL: = 0.8 KN/m2

Roof LL: 0.7 KN/m2

Span @ 900mm

Purlins loading:

Roof DL: 1.8 mx0.5 x 0.8 KN/m2 = 0.7 KN/m

Roof LL: 1.8mx0.5 x 0.7 KN/m2 = 0.6 KN/m

Purlins L=900mm

Point load from Purlins

DL: 0.7KN/m x 0.9m = 0.6KN

LL: 0.6KN/m x 0.9m = 0.5KN

TIMBER MEMBER ANALYSIS & DESIGN (EN1995-1-1:2004)

In accordance with EN1995-1-1:2004 + A2:2014 incorporating corrigendum June 2006 and the UK national annex

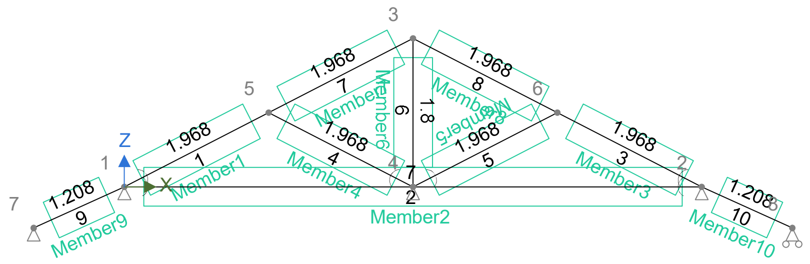
Tedds calculation version 2.2.14

ANALYSIS

Tedds calculation version 1.0.37

Geometry

Geometry (m)



Materials

Name	Density (kg/m³)	Youngs Modulus kN/mm²	Shear Modulus kN/mm²	Thermal Coefficient °C⁻¹
C24 (EC5)	420	11	0.69	0
C16 (EC5)	370	8	0.5	0

Sections

Name	Area	Moment of inertia		Shear area parallel to	
		Major	Minor	Minor	Major
	(cm²)	(cm⁴)	(cm⁴)	(cm²)	(cm²)
40x100 1	40	333.3	53.3	33.3	33.3
50x225	112.5	4746.1	234.4	93.8	93.8
2/48x97	93.1	730.1	715.2	77.6	77.6

Nodes

Node	Co-ordinates		Freedom			Coordinate system		Spring		
	X (m)	Z (m)	X	Z	Rot.	Name	Angle (°)	X (kN/m)	Z (kN/m)	Rot. kNm/°
1	0	0	Fixed	Fixed	Free		0	0	0	0
2	7	0	Fixed	Fixed	Free		0	0	0	0
3	3.5	1.8	Free	Free	Free		0	0	0	0
4	3.5	0	Fixed	Fixed	Free		0	0	0	0
5	1.75	0.9	Free	Free	Free		0	0	0	0
6	5.25	0.9	Free	Free	Free		0	0	0	0
7	-1.1	-0.5	Fixed	Fixed	Free		0	0	0	0
8	8.1	-0.5	Free	Fixed	Free		0	0	0	0

Timber Truss

Elements

Element	Length (m)	Nodes		Section	Material	Releases			Rotated
		Start	End			Start moment	End moment	Axial	
1	1.968	1	5	2/48x97	C16 (EC5)	Free	Fixed	Fixed	
2	7	1	2	50x225	C24 (EC5)	Free	Free	Fixed	
3	1.968	6	2	2/48x97	C16 (EC5)	Fixed	Free	Fixed	
4	1.968	5	4	2/48x97	C16 (EC5)	Fixed	Free	Fixed	
5	1.968	6	4	2/48x97	C16 (EC5)	Fixed	Free	Fixed	
6	1.8	3	4	2/48x97	C16 (EC5)	Fixed	Fixed	Fixed	
7	1.968	5	3	2/48x97	C16 (EC5)	Fixed	Fixed	Fixed	
8	1.968	3	6	2/48x97	C16 (EC5)	Fixed	Fixed	Fixed	
9	1.208	7	1	2/48x97	C16 (EC5)	Fixed	Fixed	Fixed	
10	1.208	2	8	2/48x97	C16 (EC5)	Fixed	Fixed	Fixed	

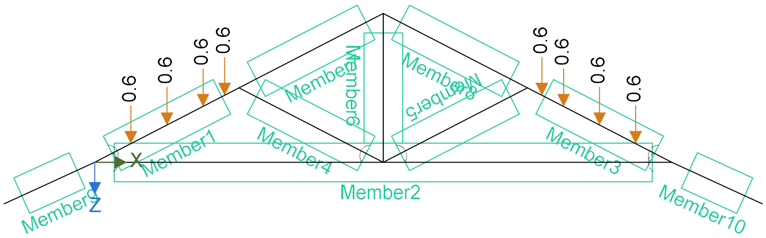
Members

Name	Elements	
	Start	End
Member1	1	1
Member2	2	2
Member3	3	3
Member4	4	4
Member5	5	5
Member6	6	6
Member7	7	7
Member8	8	8
Member9	9	9
Member10	10	10

Loading

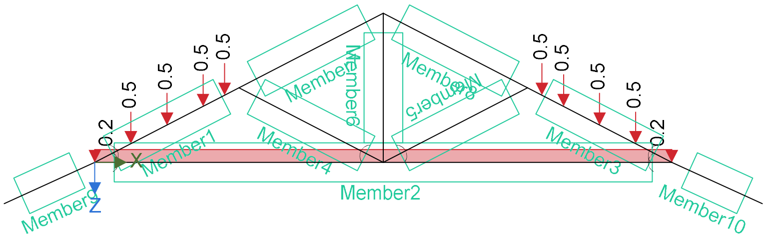
Self weight included

Permanent - Loading (kN)



Timber Truss

Imposed - Loading (kN/m,kN)



Load combination factors

Load combination	Self Weight	Permanent	Imposed
1.35G + 1.5Q + 1.5RQ (Strength)	1.35	1.35	1.50
1.0G + 1.0Q + 1.0RQ (Service)	1.00	1.00	1.00

Member Loads

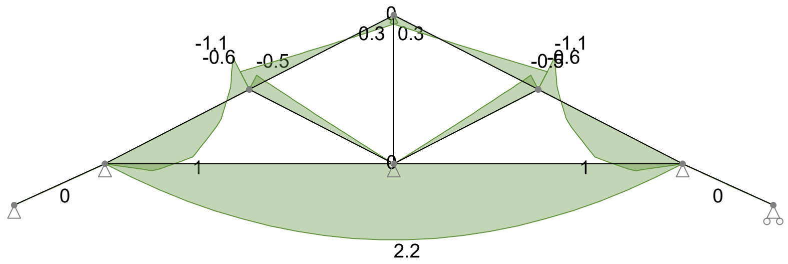
Member	Load case	Load Type	Orientation	Description
Member1	Permanent	Point load	GlobalZ	0.6 kN at 0.492 m
Member1	Permanent	Point load	GlobalZ	0.6 kN at 0.984 m
Member1	Permanent	Point load	GlobalZ	0.6 kN at 1.476 m
Member1	Permanent	Point load	GlobalZ	0.6 kN at 1.771 m
Member3	Permanent	Point load	GlobalZ	0.6 kN at 0.197 m
Member3	Permanent	Point load	GlobalZ	0.6 kN at 0.492 m
Member3	Permanent	Point load	GlobalZ	0.6 kN at 0.984 m
Member3	Permanent	Point load	GlobalZ	0.6 kN at 1.476 m
Member1	Imposed	Point load	GlobalZ	0.5 kN at 1.771 m
Member1	Imposed	Point load	GlobalZ	0.5 kN at 0.492 m
Member1	Imposed	Point load	GlobalZ	0.5 kN at 0.984 m
Member1	Imposed	Point load	GlobalZ	0.5 kN at 1.476 m
Member3	Imposed	Point load	GlobalZ	0.5 kN at 0.197 m
Member3	Imposed	Point load	GlobalZ	0.5 kN at 0.492 m
Member3	Imposed	Point load	GlobalZ	0.5 kN at 0.984 m
Member3	Imposed	Point load	GlobalZ	0.5 kN at 1.476 m
Member2	Imposed	UDL	GlobalZ	0.2 kN/m

Timber Truss

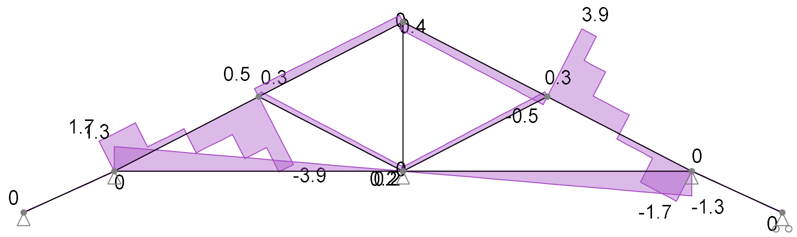
<u>Results</u>

Forces

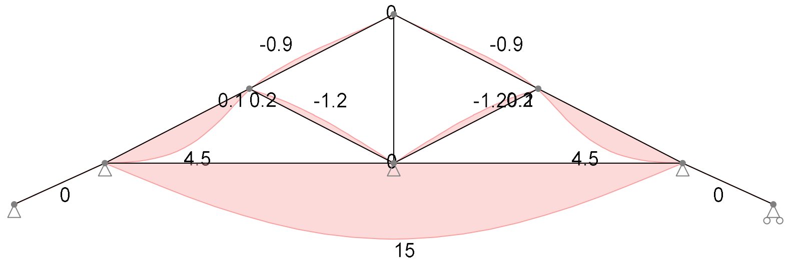
Strength combinations - Moment envelope (kNm)



Strength combinations - Shear envelope (kN)



Service combinations - Deflection envelope (mm)



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<u>Member1 - Span 1</u>

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

Timber section details

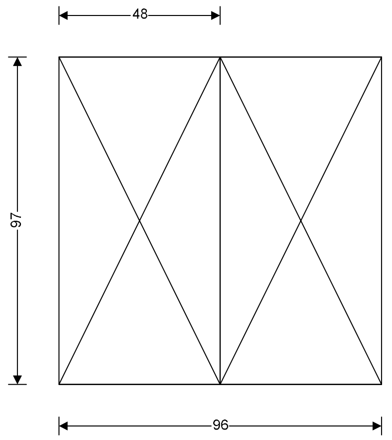
Number of timber sections in member; N = **2**

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**

Timber Truss



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member1 results summary	Unit	Capacity	Maximum	Utilisation	Result
Compressive stress	N/mm^2	10.1	0.4	0.044	PASS
Bending stress	N/mm^2	10.3	7.0	0.675	PASS
Shear stress	N/mm^2	1.9	0.9	0.495	PASS
Bending and axial force				0.675	PASS
Column stability check				0.700	PASS
Beam stability check				0.468	PASS
Deflection	mm	7.9	7.2	0.915	PASS

<u>Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)</u>

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**
Deformation factor - Table 3.2; k_{def} = **0.6**
Depth factor for bending - Major axis - exp.3.1; $k_{h,m,y} = \min((150 \text{ mm} / h)^{0.2}, 1.3)$ = **1.091**
Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**
Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**
System strength factor - cl.6.6; k_{sys} = **1.1**

Check compression parallel to the grain - cl.6.1.4

Design axial compression; P_d = **4.079** kN
Design compressive stress; $\sigma_{c,0,d} = P_d / A$ = **0.438** N/mm^2
Design compressive strength; $f_{c,0,d} = k_{mod} \times k_{sys} \times f_{c.0.k} / \gamma_M$ = **10.069** N/mm^2
$\sigma_{c,0,d} / f_{c,0,d}$ = **0.044**

PASS - Design parallel compression strength exceeds design parallel compression stress

<u>Check design at start of span</u>

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **1.726** kN
Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.415** N/mm^2

Timber Truss

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M =$ **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d} =$ **0.219**

PASS - Design shear strength exceeds design shear stress

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1968$ mm = **1771** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y =$ **63.254**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **1.13**

Effective length for z-axis bending; $L_{e,z} =$ **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z =$ **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; $\beta_c =$ **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2) =$ **1.221**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2) =$ **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) =$ **0.594**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) =$ **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) =$ **0.073**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) =$ **0.041**

PASS - Column stability is acceptable

Check design 984 mm along span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d} =$ **1.089** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h) =$ **0.262** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M =$ **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d} =$ **0.138**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d} =$ **0.996** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y =$ **6.614** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M =$ **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d} =$ **0.64**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.19 & 6.20; $(\sigma_{c,0,d} / f_{c,0,d})^2 + \sigma_{m,y,d} / f_{m,y,d} =$ **0.642**

$(\sigma_{c,0,d} / f_{c,0,d})^2 + k_m \times \sigma_{m,y,d} / f_{m,y,d} =$ **0.450**

PASS - Combined bending and axial compression utilisation is acceptable

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1968$ mm = **1771** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y =$ **63.254**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **1.13**

Effective length for z-axis bending; $L_{e,z} =$ **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z =$ **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **1.221**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.594**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) + \sigma_{m,y,d} / f_{m,y,d}$ = **0.713**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.489**

PASS - Column stability is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.35; $(\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d}))^2 + \sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d})$ = **0.45**

PASS - Beam stability is acceptable

<u>Check design at end of span</u>

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **3.903** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.938** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.495**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **1.051** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **6.98** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.675**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.19 & 6.20; $(\sigma_{c,0,d} / f_{c,0,d})^2 + \sigma_{m,y,d} / f_{m,y,d}$ = **0.677**

$(\sigma_{c,0,d} / f_{c,0,d})^2 + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.474**

PASS - Combined bending and axial compression utilisation is acceptable

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1968$ mm = **1771** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y$ = **63.254**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **1.13**

Effective length for z-axis bending; $L_{e,z}$ = **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z$ = **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **1.221**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.594**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d}$ / ($k_{c,y} \times f_{c,0,d}$) + $\sigma_{m,y,d}$ / $f_{m,y,d}$ = **0.748**

$\sigma_{c,0,d}$ / ($k_{c,z} \times f_{c,0,d}$) + $k_m \times \sigma_{m,y,d}$ / $f_{m,y,d}$ = **0.513**

PASS - Column stability is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.35; ($\sigma_{m,y,d}$ / ($k_{crit} \times f_{m,y,d}$))^2 + $\sigma_{c,0,d}$ / ($k_{c,z} \times f_{c,0,d}$) = **0.497**

PASS - Beam stability is acceptable

<u>Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)</u>

<u>Check design 938 mm along span</u>

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **4.5** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **7.2** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m1\_s1} / 250$ = **7.9** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.915**

PASS - Allowable deflection exceeds final deflection

<u>Member2 - Span 1</u>

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

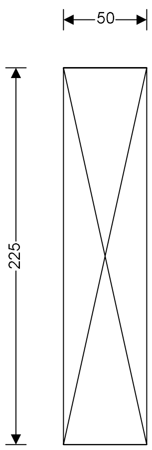
Timber section details

Number of timber sections in member; N = **1**

Breadth of sections; b = **50** mm

Depth of sections; h = **225** mm

Timber strength class - EN 338:2016 Table 1; **C24**



50x225 timber section

Cross-sectional area, A, 11250 mm^2

Section modulus, W_y, 421875 mm^3

Section modulus, W_z, 93750 mm^3

Second moment of area, I_y, 47460937 mm^4

Second moment of area, I_z, 2343750 mm^4

Radius of gyration, i_y, 65 mm

Radius of gyration, i_z, 14.4 mm

Timber strength class C24

Characteristic bending strength, $f_{m.k}$, 24 N/mm^2

Characteristic shear strength, $f_{v.k}$, 4 N/mm^2

Characteristic compression strength parallel to grain, $f_{c.0.k}$, 21 N/mm^2

Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.5 N/mm^2

Characteristic tension strength parallel to grain, $f_{t.0.k}$, 14.5 N/mm^2

Mean modulus of elasticity, $E_{0.mean}$, 11000 N/mm^2

Fifth percentile modulus of elasticity, $E_{0.05}$, 7400 N/mm^2

Shear modulus of elasticity, G_{mean}, 690 N/mm^2

Characteristic density, ρ_k, 350 kg/m^3

Mean density, ρ_{mean}, 420 kg/m^3

Timber Truss

Span details

Bearing length; L_b = **100** mm

Member2 results summary	Unit	Capacity	Maximum	Utilisation	Result
Bearing stress	N/mm^2	1.3	0.9	0.698	PASS
Bending stress	N/mm^2	12.9	5.3	0.407	PASS
Shear stress	N/mm^2	2.2	0.3	0.117	PASS
Beam stability check				0.407	PASS
Deflection	mm	28	24.0	0.856	PASS

<u>Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)</u>

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Deformation factor - Table 3.2; k_{def} = **0.6**

Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**

Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**

<u>Check design at start of span</u>

Check compression perpendicular to the grain - cl.6.1.5

Design perpendicular compression - major axis; $F_{c,y,90,d}$ = **4.697** kN

Effective contact length; $L_{b,ef} = L_b$ = **100** mm

Design perpendicular compressive stress - exp.6.4; $\sigma_{c,y,90,d} = F_{c,y,90,d} / (b \times L_{b,ef})$ = **0.939** N/mm^2

Design perpendicular compressive strength; $f_{c,y,90,d} = k_{mod} \times f_{c.90.k} / \gamma_M$ = **1.346** N/mm^2

$\sigma_{c,y,90,d} / (k_{c,90} \times f_{c,y,90,d})$ = **0.698**

PASS - Design perpendicular compression strength exceeds design perpendicular compression stress

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **1.269** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times b \times h)$ = **0.253** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times f_{v.k} / \gamma_M$ = **2.154** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.117**

PASS - Design shear strength exceeds design shear stress

<u>Check design 3500 mm along span</u>

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **2.221** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **5.264** N/mm^2

Design bending strength; $f_{m,y,d} = k_{mod} \times f_{m.k} / \gamma_M$ = **12.923** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.407**

PASS - Design bending strength exceeds design bending stress

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.33; $\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d})$ = **0.407**

PASS - Beam stability is acceptable

Timber Truss

Check design at end of span

Check compression perpendicular to the grain - cl.6.1.5

Design perpendicular compression - major axis; $F_{c,y,90,d}$ = **4.697** kN

Effective contact length; $L_{b,ef} = L_b$ = **100** mm

Design perpendicular compressive stress - exp.6.4; $\sigma_{c,y,90,d} = F_{c,y,90,d} / (b \times L_{b,ef})$ = **0.939** N/mm^2

Design perpendicular compressive strength; $f_{c,y,90,d} = k_{mod} \times f_{c.90.k} / \gamma_M$ = **1.346** N/mm^2

$\sigma_{c,y,90,d} / (k_{c,90} \times f_{c,y,90,d})$ = **0.698**

PASS - Design perpendicular compression strength exceeds design perpendicular compression stress

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **1.269** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times b \times h)$ = **0.253** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times f_{v.k} / \gamma_M$ = **2.154** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.117**

PASS - Design shear strength exceeds design shear stress

Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)

Check design 3500 mm along span

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **15** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **24** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m2\_s1} / 250$ = **28** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.856**

PASS - Allowable deflection exceeds final deflection

Member3 - Span 1

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

Timber section details

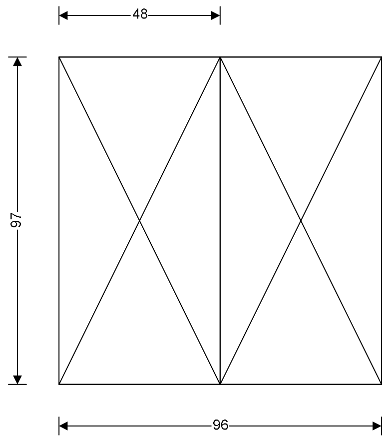
Number of timber sections in member; N = **2**

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**

Timber Truss



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member3 results summary	Unit	Capacity	Maximum	Utilisation	Result
Compressive stress	N/mm^2	10.1	0.4	0.044	PASS
Bending stress	N/mm^2	10.3	7.0	0.675	PASS
Shear stress	N/mm^2	1.9	0.9	0.495	PASS
Bending and axial force				0.675	PASS
Column stability check				0.700	PASS
Beam stability check				0.468	PASS
Deflection	mm	7.9	7.2	0.915	PASS

Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Deformation factor - Table 3.2; k_{def} = **0.6**

Depth factor for bending - Major axis - exp.3.1; $k_{h,m,y}$ = min((150 mm / h)$^{0.2}$, 1.3) = **1.091**

Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**

Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**

System strength factor - cl.6.6; k_{sys} = **1.1**

Check compression parallel to the grain - cl.6.1.4

Design axial compression; P_d = **1.185** kN

Design compressive stress; $\sigma_{c,0,d} = P_d / A$ = **0.127** N/mm^2

Design compressive strength; $f_{c,0,d} = k_{mod} \times k_{sys} \times f_{c.0.k} / \gamma_M$ = **10.069** N/mm^2

$\sigma_{c,0,d} / f_{c,0,d}$ = **0.013**

PASS - Design parallel compression strength exceeds design parallel compression stress

Check design at start of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **3.903** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.938** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M =$ **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d} =$ **0.495**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d} =$ **1.051** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y =$ **6.98** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M =$ **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d} =$ **0.675**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.19 & 6.20; $(\sigma_{c,0,d} / f_{c,0,d})^2 + \sigma_{m,y,d} / f_{m,y,d} =$ **0.675**

$(\sigma_{c,0,d} / f_{c,0,d})^2 + k_m \times \sigma_{m,y,d} / f_{m,y,d} =$ **0.473**

PASS - Combined bending and axial compression utilisation is acceptable

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1968$ mm = **1771** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y =$ **63.254**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **1.13**

Effective length for z-axis bending; $L_{e,z} =$ **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z =$ **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; $\beta_c =$ **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2) =$ **1.221**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2) =$ **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) =$ **0.594**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) =$ **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) + \sigma_{m,y,d} / f_{m,y,d} =$ **0.696**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) + k_m \times \sigma_{m,y,d} / f_{m,y,d} =$ **0.484**

PASS - Column stability is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; $k_{crit} =$ **1.000**

Beam stability check - exp.6.35; $(\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d}))^2 + \sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) =$ **0.468**

PASS - Beam stability is acceptable

<u>Check design 984 mm along span</u>

Check shear force - Section 6.1.7

Design shear force; $F_{y,d} =$ **1.089** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h) =$ **0.262** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M =$ **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d} =$ **0.138**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d} =$ **0.996** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y =$ **6.614** N/mm^2

Timber Truss

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.64**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.19 & 6.20; $(\sigma_{c,0,d} / f_{c,0,d})^2 + \sigma_{m,y,d} / f_{m,y,d}$ = **0.640**

$(\sigma_{c,0,d} / f_{c,0,d})^2 + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.448**

PASS - Combined bending and axial compression utilisation is acceptable

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1968$ mm = **1771** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y$ = **63.254**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **1.13**

Effective length for z-axis bending; $L_{e,z}$ = **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z$ = **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **1.221**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.594**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) + \sigma_{m,y,d} / f_{m,y,d}$ = **0.661**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.460**

PASS - Column stability is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.35; $(\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d}))^2 + \sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d})$ = **0.421**

PASS - Beam stability is acceptable

Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)

Check design 1030 mm along span

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **4.5** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **7.2** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m3\_s1} / 250$ = **7.9** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.915**

PASS - Allowable deflection exceeds final deflection

Member4 - Span 1

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

Timber Truss

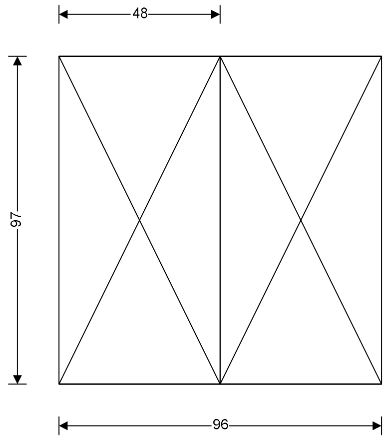
Timber section details

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

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member4 results summary	Unit	Capacity	Maximum	Utilisation	Result
Compressive stress	N/mm^2	10.1	0.6	0.060	PASS
Bending stress	N/mm^2	10.3	3.1	0.298	PASS
Shear stress	N/mm^2	1.9	0.1	0.035	PASS
Bending and axial force				0.302	PASS
Column stability check				0.398	PASS
Beam stability check				0.145	PASS
Deflection	mm	7.9	1.9	0.246	PASS

<u>Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)</u>

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Deformation factor - Table 3.2; k_{def} = **0.6**

Depth factor for bending - Major axis - exp.3.1; $k_{h,m,y}$ = min((150 mm / h)$^{0.2}$, 1.3) = **1.091**

Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**

Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**

System strength factor - cl.6.6; k_{sys} = **1.1**

Check compression parallel to the grain - cl.6.1.4

Design axial compression; P_d = **5.571** kN

Design compressive stress; $\sigma_{c,0,d} = P_d / A$ = **0.598** N/mm^2

Design compressive strength; $f_{c,0,d} = k_{mod} \times k_{sys} \times f_{c.0.k} / \gamma_M$ = **10.069** N/mm^2

$\sigma_{c,0,d} / f_{c,0,d}$ = **0.059**

PASS - Design parallel compression strength exceeds design parallel compression stress

Check design at start of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **0.276** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.066** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.035**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **0.464** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **3.083** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.298**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.19 & 6.20; $(\sigma_{c,0,d} / f_{c,0,d})^2 + \sigma_{m,y,d} / f_{m,y,d}$ = **0.302**

$(\sigma_{c,0,d} / f_{c,0,d})^2 + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.212**

PASS - Combined bending and axial compression utilisation is acceptable

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1968$ mm = **1771** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y$ = **63.254**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **1.13**

Effective length for z-axis bending; $L_{e,z}$ = **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z$ = **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **1.221**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.594**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) + \sigma_{m,y,d} / f_{m,y,d}$ = **0.398**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.265**

PASS - Column stability is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.35; $(\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d}))^2 + \sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d})$ = **0.145**

PASS - Beam stability is acceptable

Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)

Check design 843 mm along span

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **1.2** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **1.9** mm
Allowable deflection; $\delta_{y,Allowable} = L_{m4\_s1} / 250$ = **7.9** mm
$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.246**

PASS - Allowable deflection exceeds final deflection

Member5 - Span 1

Partial factor for material properties and resistances

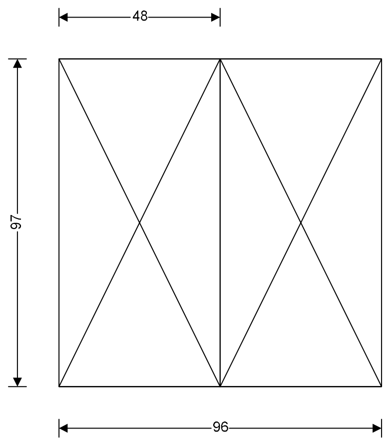
Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term
Service class - cl.2.3.1.3; 1

Timber section details

Number of timber sections in member; N = **2**
Breadth of sections; b = **48** mm
Depth of sections; h = **97** mm
Timber strength class - EN 338:2016 Table 1; **C16**



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member5 results summary	**Unit**	**Capacity**	**Maximum**	**Utilisation**	**Result**
Compressive stress	N/mm^2	10.1	0.6	0.060	PASS
Bending stress	N/mm^2	10.3	3.1	0.298	PASS
Shear stress	N/mm^2	1.9	0.1	0.035	PASS
Bending and axial force				0.302	PASS
Column stability check				0.398	PASS
Beam stability check				0.145	PASS
Deflection	mm	7.9	1.9	0.246	PASS

Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Timber Truss

Deformation factor - Table 3.2;	k_{def} = **0.6**
Depth factor for bending - Major axis - exp.3.1;	$k_{h,m,y} = \min((150\text{ mm} / h)^{0.2}, 1.3)$ = **1.091**
Bending stress re-distribution factor - cl.6.1.6(2);	k_m = **0.7**
Crack factor for shear resistance - cl.6.1.7(2);	k_{cr} = **0.67**
System strength factor - cl.6.6;	k_{sys} = **1.1**

Check compression parallel to the grain - cl.6.1.4

Design axial compression;	P_d = **5.571** kN
Design compressive stress;	$\sigma_{c,0,d} = P_d / A$ = **0.598** N/mm^2
Design compressive strength;	$f_{c,0,d} = k_{mod} \times k_{sys} \times f_{c.0.k} / \gamma_M$ = **10.069** N/mm^2
	$\sigma_{c,0,d} / f_{c,0,d}$ = **0.059**

PASS - Design parallel compression strength exceeds design parallel compression stress

<u>Check design at start of span</u>

Check shear force - Section 6.1.7

Design shear force;	$F_{y,d}$ = **0.276** kN
Design shear stress - exp.6.60;	$\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.066** N/mm^2
Design shear strength;	$f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2
	$\tau_{y,d} / f_{v,y,d}$ = **0.035**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment;	$M_{y,d}$ = **0.464** kNm
Design bending stress;	$\sigma_{m,y,d} = M_{y,d} / W_y$ = **3.083** N/mm^2
Design bending strength;	$f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2
	$\sigma_{m,y,d} / f_{m,y,d}$ = **0.298**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.19 & 6.20;	$(\sigma_{c,0,d} / f_{c,0,d})^2 + \sigma_{m,y,d} / f_{m,y,d}$ = **0.302**
	$(\sigma_{c,0,d} / f_{c,0,d})^2 + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.212**

PASS - Combined bending and axial compression utilisation is acceptable

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending;	$L_{e,y} = 0.9 \times 1968$ mm = **1771** mm
Slenderness ratio;	$\lambda_y = L_{e,y} / i_y$ = **63.254**
Relative slenderness ratio - exp. 6.21;	$\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **1.13**
Effective length for z-axis bending;	$L_{e,z}$ = **0** mm
Slenderness ratio;	$\lambda_z = L_{e,z} / i_z$ = **0**
Relative slenderness ratio - exp. 6.22;	$\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor;	β_c = **0.2**
Instability factors - exp.6.25, 6.26, 6.27 & 6.28;	$k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **1.221**
	$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**
	$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.594**
	$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**
Column stability checks - exp.6.23 & 6.24;	$\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) + \sigma_{m,y,d} / f_{m,y,d}$ = **0.398**
	$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.265**

PASS - Column stability is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.35; $(\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d}))^2 + \sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d})$ = **0.145**

PASS - Beam stability is acceptable

<u>Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)</u>

<u>Check design 843 mm along span</u>

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **1.2** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **1.9** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m5\_s1} / 250$ = **7.9** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.246**

PASS - Allowable deflection exceeds final deflection

<u>Member6 - Span 1</u>

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

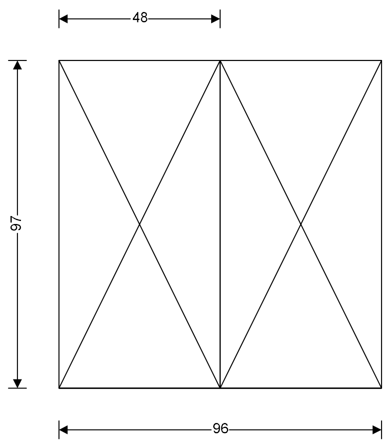
Timber section details

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

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Timber Truss

Member6 results summary	Unit	Capacity	Maximum	Utilisation	Result
Compressive stress	N/mm^2	10.1	0.2	0.016	PASS
Column stability check				0.024	PASS

Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Deformation factor - Table 3.2; k_{def} = **0.6**

System strength factor - cl.6.6; k_{sys} = **1.1**

Check compression parallel to the grain - cl.6.1.4

Design axial compression; P_d = **1.434** kN

Design compressive stress; $\sigma_{c,0,d} = P_d / A$ = **0.154** N/mm^2

Design compressive strength; $f_{c,0,d} = k_{mod} \times k_{sys} \times f_{c.0.k} / \gamma_M$ = **10.069** N/mm^2

$\sigma_{c,0,d} / f_{c,0,d}$ = **0.015**

PASS - Design parallel compression strength exceeds design parallel compression stress

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1800$ mm = **1620** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y$ = **57.854**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **1.033**

Effective length for z-axis bending; $L_{e,z}$ = **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z$ = **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **1.107**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.665**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d})$ = **0.023**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d})$ = **0.014**

PASS - Column stability is acceptable

Check design at end of span

Check compression perpendicular to the grain - cl.6.1.5

Design perpendicular compression - major axis; $F_{c,y,90,d}$ = **0** kN

Effective contact length; $L_{b,ef}$ = min(1800 mm / 2, L_b, 30 mm) + L_b = **130** mm

Design perpendicular compressive stress - exp.6.4; $\sigma_{c,y,90,d} = F_{c,y,90,d} / (N \times b \times L_{b,ef})$ = **0.000** N/mm^2

Design perpendicular compressive strength; $f_{c,y,90,d} = k_{mod} \times k_{sys} \times f_{c.90.k} / \gamma_M$ = **1.303** N/mm^2

$\sigma_{c,y,90,d} / (k_{c,90} \times f_{c,y,90,d})$ = **0.000**

PASS - Design perpendicular compression strength exceeds design perpendicular compression stress

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1800$ mm = **1620** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y$ = **57.854**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **1.033**

Timber Truss

Effective length for z-axis bending; $L_{e,z}$ = **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z$ = **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **1.107**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.665**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d})$ = **0.023**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d})$ = **0.014**

PASS - Column stability is acceptable

<u>Member7 - Span 1</u>

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

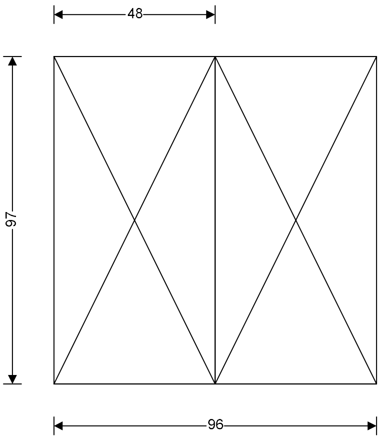
Timber section details

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

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member7 results summary	**Unit**	**Capacity**	**Maximum**	**Utilisation**	**Result**
Tensile stress	N/mm^2	5.5	0.1	0.023	PASS
Bending stress	N/mm^2	10.3	3.9	0.377	PASS
Shear stress	N/mm^2	1.9	0.1	0.059	PASS

Timber Truss

Bending and axial force				0.399	PASS
Beam stability check				0.377	PASS
Deflection	mm	7.9	1.4	0.183	PASS

Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Deformation factor - Table 3.2; k_{def} = **0.6**

Depth factor for bending - Major axis - exp.3.1; $k_{h,m,y} = \min((150\text{ mm} / h)^{0.2}, 1.3)$ = **1.091**

Depth factor for tension - exp.3.1; $k_{h,t} = \min((150\text{ mm} / \max(b, h))^{0.2}, 1.3)$ = **1.091**

Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**

Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**

System strength factor - cl.6.6; k_{sys} = **1.1**

Check tension parallel to the grain - Section 6.1.2

Axial tension; P_d = **2.28** kN

Design tensile stress; $\sigma_{t,0,d} = P_d / (N \times b \times \min(h_{ef\_e1}, h_{ef\_e2}))$ = **0.122** N/mm^2

Design tensile strength; $f_{t,0,d} = k_{h,t} \times k_{mod} \times k_{sys} \times f_{t.0.k} / \gamma_M$ = **5.493** N/mm^2

$\sigma_{t,0,d} / f_{t,0,d}$ = **0.022**

PASS - Design tensile strength exceeds design tensile stress

Check design at start of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **0.468** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.112** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.059**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **0.587** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **3.898** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.377**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.17 & 6.18; $\sigma_{t,0,d} / f_{t,0,d} + \sigma_{m,y,d} / f_{m,y,d}$ = **0.399**

$\sigma_{t,0,d} / f_{t,0,d} + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.286**

PASS - Combined bending and axial tension utilisation is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.33; $\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d})$ = **0.377**

PASS - Beam stability is acceptable

<u>Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)</u>

<u>Check design 685 mm along span</u>

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **0.9** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **1.4** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m7\_s1} / 250$ = **7.9** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.183**

PASS - Allowable deflection exceeds final deflection

<u>Member8 - Span 1</u>

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

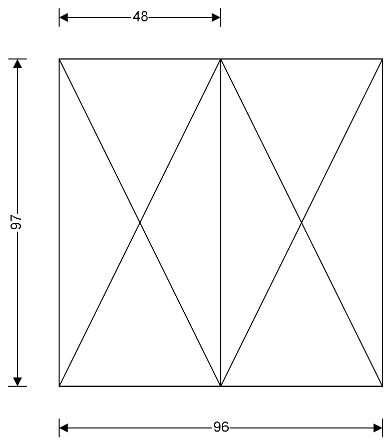
Timber section details

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

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member8 results summary	**Unit**	**Capacity**	**Maximum**	**Utilisation**	**Result**
Tensile stress	N/mm^2	5.5	0.1	0.023	PASS
Bending stress	N/mm^2	10.3	3.9	0.377	PASS
Shear stress	N/mm^2	1.9	0.1	0.059	PASS
Bending and axial force				0.399	PASS
Beam stability check				0.377	PASS

Deflection	mm	7.9	1.4	0.183	PASS

Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Deformation factor - Table 3.2; k_{def} = **0.6**

Depth factor for bending - Major axis - exp.3.1; $k_{h,m,y} = \min((150 \text{ mm} / h)^{0.2}, 1.3)$ = **1.091**

Depth factor for tension - exp.3.1; $k_{h,t} = \min((150 \text{ mm} / \max(b, h))^{0.2}, 1.3)$ = **1.091**

Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**

Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**

System strength factor - cl.6.6; k_{sys} = **1.1**

Check tension parallel to the grain - Section 6.1.2

Axial tension; P_d = **2.321** kN

Design tensile stress; $\sigma_{t,0,d} = P_d / (N \times b \times \min(h_{ef\_e1}, h_{ef\_e2}))$ = **0.124** N/mm^2

Design tensile strength; $f_{t,0,d} = k_{h,t} \times k_{mod} \times k_{sys} \times f_{t.0.k} / \gamma_M$ = **5.493** N/mm^2

$\sigma_{t,0,d} / f_{t,0,d}$ = **0.023**

PASS - Design tensile strength exceeds design tensile stress

Check design at start of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **0.388** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.093** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.049**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **0.255** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **1.692** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.164**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.17 & 6.18; $\sigma_{t,0,d} / f_{t,0,d} + \sigma_{m,y,d} / f_{m,y,d}$ = **0.186**

$\sigma_{t,0,d} / f_{t,0,d} + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.137**

PASS - Combined bending and axial tension utilisation is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.33; $\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d})$ = **0.164**

PASS - Beam stability is acceptable

Check design at end of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **0.468** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.112** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.059**

PASS - Design shear strength exceeds design shear stress

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **0.587** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **3.898** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.377**

PASS - Design bending strength exceeds design bending stress

Check combined bending and axial tension - Section 6.2.3

Combined loading checks - exp.6.17 & 6.18; $\sigma_{t,0,d} / f_{t,0,d} + \sigma_{m,y,d} / f_{m,y,d}$ = **0.400**

$\sigma_{t,0,d} / f_{t,0,d} + k_m \times \sigma_{m,y,d} / f_{m,y,d}$ = **0.286**

PASS - Combined bending and axial tension utilisation is acceptable

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.33; $\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d})$ = **0.377**

PASS - Beam stability is acceptable

Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)

Check design 1283 mm along span

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **0.9** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **1.4** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m8\_s1} / 250$ = **7.9** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.183**

PASS - Allowable deflection exceeds final deflection

Member9 - Span 1

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

Timber section details

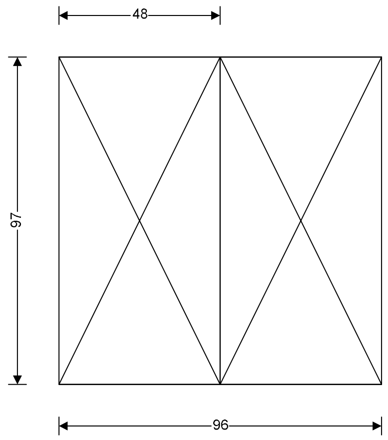
Number of timber sections in member; N = **2**

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**

Timber Truss



2/48x97 timber sections
Cross-sectional area, A, 9312 mm^2
Section modulus, W_y, 150544 mm^3
Section modulus, W_z, 74496 mm^3
Second moment of area, I_y, 7301384 mm^4
Second moment of area, I_z, 1787904 mm^4
Radius of gyration, i_y, 28 mm
Radius of gyration, i_z, 13.9 mm
Timber strength class C16
Characteristic bending strength, $f_{m.k}$, 16 N/mm^2
Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member9 results summary	**Unit**	**Capacity**	**Maximum**	**Utilisation**	**Result**
Tensile stress	N/mm^2	5.5	0.0	0.000	PASS
Compressive stress	N/mm^2	10.1	0.0	0.000	PASS
Bending stress	N/mm^2	10.3	0.1	0.005	PASS
Shear stress	N/mm^2	1.9	0.0	0.003	PASS
Column stability check				0.000	PASS
Beam stability check				0.005	PASS
Deflection	mm	4.8	0.0	0.005	PASS

Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**
Deformation factor - Table 3.2; k_{def} = **0.6**
Depth factor for bending - Major axis - exp.3.1; $k_{h,m,y} = \min((150 \text{ mm} / h)^{0.2}, 1.3)$ = **1.091**
Depth factor for tension - exp.3.1; $k_{h,t} = \min((150 \text{ mm} / \max(b, h))^{0.2}, 1.3)$ = **1.091**
Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**
Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**
System strength factor - cl.6.6; k_{sys} = **1.1**

Check compression parallel to the grain - cl.6.1.4

Design axial compression; P_d = **0.011** kN
Design compressive stress; $\sigma_{c,0,d} = P_d / A$ = **0.001** N/mm^2
Design compressive strength; $f_{c,0,d} = k_{mod} \times k_{sys} \times f_{c.0.k} / \gamma_M$ = **10.069** N/mm^2
$\sigma_{c,0,d} / f_{c,0,d}$ = **0.000**

PASS - Design parallel compression strength exceeds design parallel compression stress

Check design at start of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **0.025** kN

Timber Truss

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.006** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.003**

PASS - Design shear strength exceeds design shear stress

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1208$ mm = **1087** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y$ = **38.827**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0.693**

Effective length for z-axis bending; $L_{e,z}$ = **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z$ = **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **0.780**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2)$ = **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)})$ = **0.880**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)})$ = **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d})$ = **0.000**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d})$ = **0.000**

PASS - Column stability is acceptable

<u>Check design 604 mm along span</u>

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **0.008** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **0.05** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.005**

PASS - Design bending strength exceeds design bending stress

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.33; $\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d})$ = **0.005**

PASS - Beam stability is acceptable

<u>Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)</u>

<u>Check design 604 mm along span</u>

Check y-y axis deflection - Section 7.2

Instantaneous deflection; δ_y = **0** mm

Quasi-permanent variable load factor; ψ_2 = **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def})$ = **0** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m9\_s1} / 250$ = **4.8** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.005**

PASS - Allowable deflection exceeds final deflection

Timber Truss

Member10 - Span 1

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3; γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2; Long-term

Service class - cl.2.3.1.3; 1

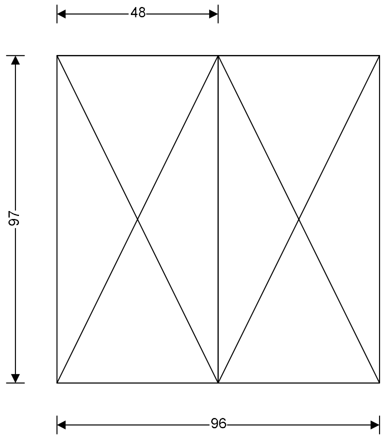
Timber section details

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

Breadth of sections; b = **48** mm

Depth of sections; h = **97** mm

Timber strength class - EN 338:2016 Table 1; **C16**



2/48x97 timber sections

Cross-sectional area, A, 9312 mm^2

Section modulus, W_y, 150544 mm^3

Section modulus, W_z, 74496 mm^3

Second moment of area, I_y, 7301384 mm^4

Second moment of area, I_z, 1787904 mm^4

Radius of gyration, i_y, 28 mm

Radius of gyration, i_z, 13.9 mm

Timber strength class C16

Characteristic bending strength, $f_{m.k}$, 16 N/mm^2

Characteristic shear strength, $f_{v.k}$, 3.2 N/mm^2

Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2

Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2

Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2

Mean modulus of elasticity, $E_{0.mean}$, 8000 N/mm^2

Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2

Shear modulus of elasticity, G_{mean}, 500 N/mm^2

Characteristic density, ρ_k, 310 kg/m^3

Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length; L_b = **100** mm

Member10 results summary	**Unit**	**Capacity**	**Maximum**	**Utilisation**	**Result**
Tensile stress	N/mm^2	5.5	0.0	0.000	PASS
Compressive stress	N/mm^2	10.1	0.0	0.000	PASS
Bending stress	N/mm^2	10.3	0.1	0.005	PASS
Shear stress	N/mm^2	1.9	0.0	0.003	PASS
Column stability check				0.000	PASS
Beam stability check				0.005	PASS
Deflection	mm	4.8	0.0	0.005	PASS

Consider Combination 1 - 1.35G + 1.5Q + 1.5RQ (Strength)

Modification factors

Duration of load and moisture content - Table 3.1; k_{mod} = **0.7**

Deformation factor - Table 3.2; k_{def} = **0.6**

Depth factor for bending - Major axis - exp.3.1; $k_{h,m,y}$ = min((150 mm / h)$^{0.2}$, 1.3) = **1.091**

Bending stress re-distribution factor - cl.6.1.6(2); k_m = **0.7**

Crack factor for shear resistance - cl.6.1.7(2); k_{cr} = **0.67**

Timber Truss

System strength factor - cl.6.6; k_{sys} = **1.1**

Check tension parallel to the grain - Section 6.1.2

Axial tension; P_d = **0.011** kN

Design tensile stress; $\sigma_{t,0,d} = P_d / (N \times b \times min(h_{ef\_e1}, h_{ef\_e2}))$ = **0.001** N/mm^2

Design tensile strength; $f_{t,0,d} = k_{h,t} \times k_{mod} \times k_{sys} \times f_{t.0.k} / \gamma_M$ = **5.493** N/mm^2

$\sigma_{t,0,d} / f_{t,0,d}$ = **0.000**

PASS - Design tensile strength exceeds design tensile stress

Check design at start of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **0.025** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.006** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.003**

PASS - Design shear strength exceeds design shear stress

Check design 604 mm along span

Check bending moment - Section 6.1.6

Design bending moment; $M_{y,d}$ = **0.008** kNm

Design bending stress; $\sigma_{m,y,d} = M_{y,d} / W_y$ = **0.05** N/mm^2

Design bending strength; $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **10.34** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.005**

PASS - Design bending strength exceeds design bending stress

Check beams subjected to either bending or combined bending and compression - cl.6.3.3

Lateral buckling factor - exp.6.34; k_{crit} = **1.000**

Beam stability check - exp.6.33; $\sigma_{m,y,d} / (k_{crit} \times f_{m,y,d})$ = **0.005**

PASS - Beam stability is acceptable

Check design at end of span

Check shear force - Section 6.1.7

Design shear force; $F_{y,d}$ = **0.025** kN

Design shear stress - exp.6.60; $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times N \times b \times h)$ = **0.006** N/mm^2

Design shear strength; $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **1.895** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.003**

PASS - Design shear strength exceeds design shear stress

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending; $L_{e,y} = 0.9 \times 1208$ mm = **1087** mm

Slenderness ratio; $\lambda_y = L_{e,y} / i_y$ = **38.827**

Relative slenderness ratio - exp. 6.21; $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0.693**

Effective length for z-axis bending; $L_{e,z}$ = **0** mm

Slenderness ratio; $\lambda_z = L_{e,z} / i_z$ = **0**

Relative slenderness ratio - exp. 6.22; $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})}$ = **0**

$\lambda_{rel,y}$ > 0.3 column stability check is required

Straightness factor; β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28; $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2)$ = **0.780**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2) =$ **0.470**

$k_{c,y} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) =$ **0.880**

$k_{c,z} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) =$ **1.064**

Column stability checks - exp.6.23 & 6.24; $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) =$ **0.000**

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) =$ **0.000**

PASS - Column stability is acceptable

<u>Consider Combination 2 - 1.0G + 1.0Q + 1.0RQ (Service)</u>

<u>Check design 604 mm along span</u>

Check y-y axis deflection - Section 7.2

Instantaneous deflection; $\delta_y =$ **0** mm

Quasi-permanent variable load factor; $\psi_2 =$ **0.3**

Final deflection with creep; $\delta_{y,Final} = \delta_y \times (1 + k_{def}) =$ **0** mm

Allowable deflection; $\delta_{y,Allowable} = L_{m10\_s1} / 250 =$ **4.8** mm

$\delta_{y,Final} / \delta_{y,Allowable} =$ **0.005**

PASS - Allowable deflection exceeds final deflection