SHIELDS WILSON
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STRUCTURAL AND CIVIL ENGINEERING

PRELIMINARY STRUCTURAL REPORT

UPON

AGRICULTURAL BARN

92 PETERS POINT ROAD

SUTTON BRIDGE

PE12 9UX

PROJECT No: SW 21-185

DOCUMENT REF: SW 21-185-REP-01



Mr &Mrs Farley

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1. INTRODUCTION

Acting upon the instruction of Mr & Mrs Farley., we attended the site on 22nd July 2021, to undertake visual inspections and basic ground investigations including inspecting the existing foundation detail.

The object of this report is to comment upon the current structural condition and viability for conversion to domestic accommodation. It confines itself to the Basic Structural Fabric and is not intended to comment upon non-structural items.

During the course of the survey and in preparation of this report no cladding, internal features or items were moved, therefore we cannot comment upon the condition of areas which were covered or inaccessible.

Comments relating to Ground Conditions are based upon investigations undertaken on site at the time and previous experience in the Fenland area, and publicly available British Geological Society records.

This report has been prepared for the named client above and should not be relied upon by any other parties, expect the client and their specialist third party advisors, without the express written permission of Shields Wilson Limited.

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2. PROPERTY LOCATION & DESCRIPTION

The barn building sits to the South East of the dwelling located to the frontage of the plot, 92 Peters Point Road, Sutton Bridge PE12 9UX.

The building is an agricultural barn which has been erected to the South of the road frontage. It is likely the barn dates from the 1940s or 50s.

The timber structure of the barn takes the form of main frames consisting of timber columns and scissor trusses at regular centres along the length of the building with purlins spanning between these truss frames. The 4 No. frames are spaced at approximately 4.5m.

The width of the structure is just over 10m which the scissor trusses clear span over.

The roof cladding takes the form of asbestos cement roof sheets. These are not likely to be original but do appear to be fixed off what are likely to be the original timber purlins.

The walls are clad using single skin metal corrugated cladding sheets fixed to timber rails spanning between the main frame posts.

There does not appear to have been a floor structure placed within the barn.

3. OBSERVATIONS

A visual inspection of the building was undertaken, including an inspection of the existing foundation detail and a basic ground investigation. Our observations are described below.

The Location of the barn and its form are illustrated on Swann Edwards drawing SE1589/PP1000, a copy of which is located within Appendix A.

There is a general photographic record of our survey contained in Appendix B.

3.1. Ground Investigations

Publicly available British Geological Society maps and borehole records indicate the site to be underlain with Tidal flat deposits of Clay and Silt tidal flat deposits over the Clay Formations.

Work undertaken on site included 1 no.100mmØ hand auger borehole and a small trial pit to expose the existing foundation details.

The trial pit adjacent one of the main frame timber posts found that there is no formal foundation, with no concrete embedment or surround to the post, or traditional pad type foundation. The Posts appear to have been driven to a suitable embedment within the clay.

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Immediately underlying the 0.2m of topsoil is a layer of Light brown dense clayey silt which is 0.5m thick extending to 0.7m below ground below which is a dark brown firm silty clay. Borehole was terminated at 1.5m BGL with no further changes in strata recorded.

The natural clay at 0.9m below ground will be capable of supporting a maximum SWL of 70 - 80 Kn/m², on a traditional pad or strip footing. Alternatively, the spread raft of 10m x 15m could exert a maximum of 20 kN/m².

Both styles of foundation founded onto this stratum would not be expected to experience settlements outside of normally acceptable limits

3.2. Structure

The style of structure can be seen forming a number of agricultural barns across the surrounding Fenland area. They are lightweight structures intended as storage buildings and light workshops for agricultural use.

It is typical of the style and period that the cladding is asbestos cement cladding. This is unlikely to be the original cladding. The asbestos sheets should be handled appropriately by correctly trained operatives in accordance with all asbestos related legislation.

It should be noted that the rain water goods also appear to be of asbestos construction and that some have been broken in the past.

The single skin metal cladding is generally in poor condition with noticeable gaps in the sheeting joints and surface corrosion generally to most of the sheets.

Having analysed a number of structures of this style in the past we can say from experience that the timber frame structure will not be adequate to carry the required domestic loads, of cladding, services, ceiling and minimum roof imposed loads with the desired factors of safety required by current design codes.

A simplified model analysis of the structure was undertaken in MasterSeries frame analysis software and as expected it was found that the frame is not adequate to meet current design codes loading and standards.

Calculation output is contained with Appendix C.

In addition, the timber frame post exposed at foundation was showing significant signs of decay at ground level and just above. This can be seen in a number of the timber posts

As mentioned in the general description the barn has not been used for industrial or commercial purposes and as such has never had a ground floor structure installed.

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4. Proposed Structure Conversion

The proposed conversion involves the replacement of the roof and wall cladding, with similar new materials.

The existing timber frame construction is inadequate for the proposed loads, as described above. However, the proposed layout and arrangements can be configured in such a way to provide the load bearing capacity and structural stability required for the proposed conversion to meet current design standards.

The new internal partition walls are located on the main frame lines, and as such they should be constructed as load bearing stud walls. These walls will also need to be sheathed and as such will provide significant racking stability for the proposed dwelling.

The new external walls can be designed to be suitable timber frame walls spanning from ground to head utilising the racking capacity described above to provide overall stability.

New load bearing internal walls which are proposed along the main frame lines can be built into the existing frames to provide the vertical support for the roof.

New or additional purlin members may be required to aid the existing members with the additional loads.

The new load bearing walls should be built up to the underside of the frame roof trusses and be packed tight, to ensure load transfer. This will ensure roof loads are supported by the new structure and new foundations.

As the barn has no existing floor or suitable foundation detail it is recommended that a combined floor and foundation detail be installed by way of installing a structural raft slab foundation.

The raft slab should include a suitable edge beam detail which can encapsulate and support the existing main frame posts. Once the main frame posts are suitably support by a new foundation detail the decaying ground level and below section should be cut out so that the good wood above cannot be affected in the future by spreading decay.

The raft slab foundation solution should include stiffening and thickening beams at the proposed internal wall lines, which will be load bearing at the main frame positions, roof and stability loads picked up by these lines will then be suitably founded.

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5. CONCLUSIONS & RECCOMENDATIONS

Generally, the condition of the structure is good for a building of this type and age.

The proposed conversion layout and style will provide methods for load bearing and stability and as such will ensure that the proposed conversion can accommodate domestic loads in accordance with the modern building regulations.

The deteriorated sections of underground timber posts should be cut out, and supported onto a new foundation detail as described in section 4 of this report and this will ensure the longevity of the structure which is to remain.

By implementing the recommendations contained in the report above, the property should provide suitable domestic accommodation for years to come.

For and on behalf of **SHIELDS WILSON LIMITED**

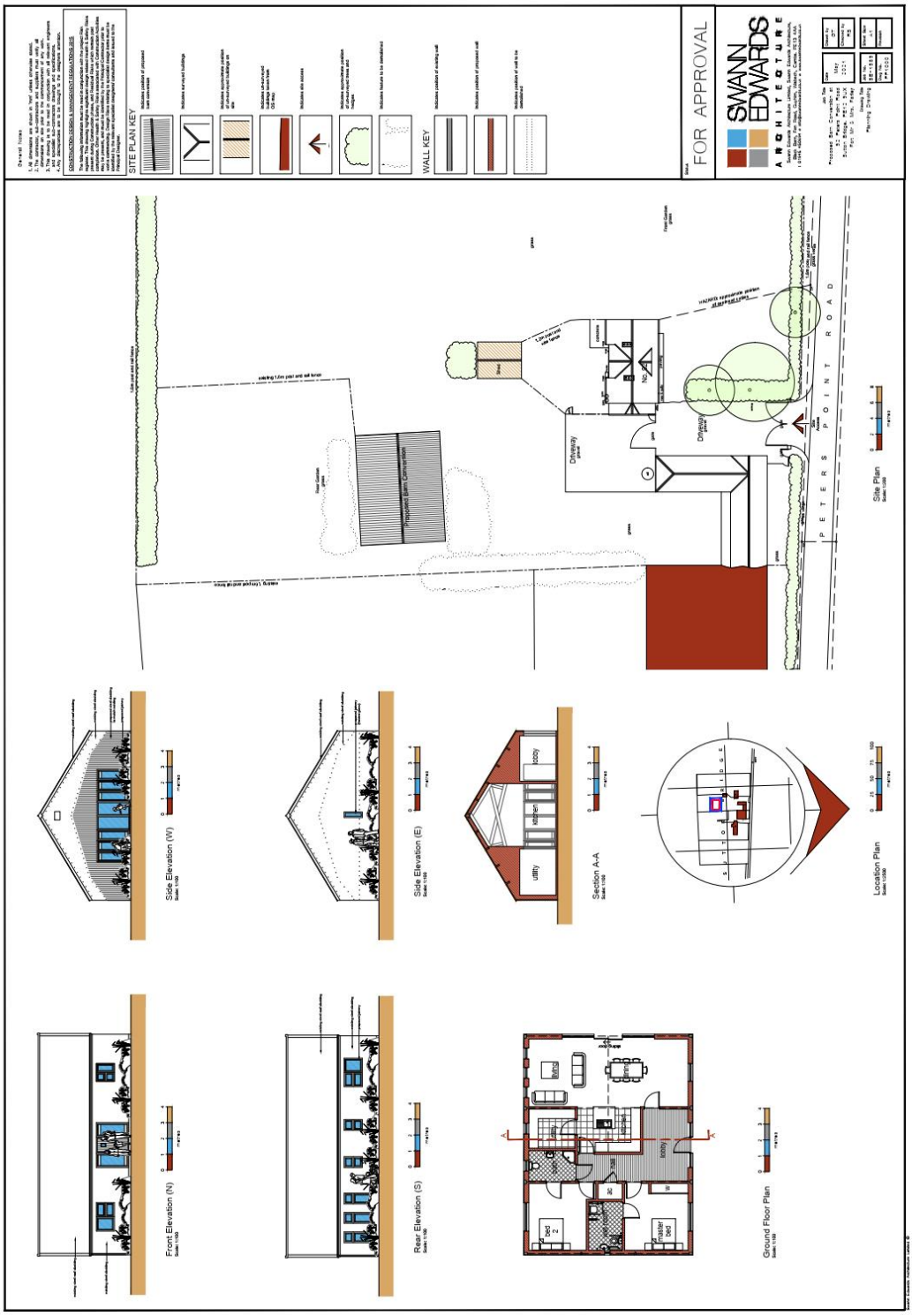
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APPENDIX A

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APPENDIX B

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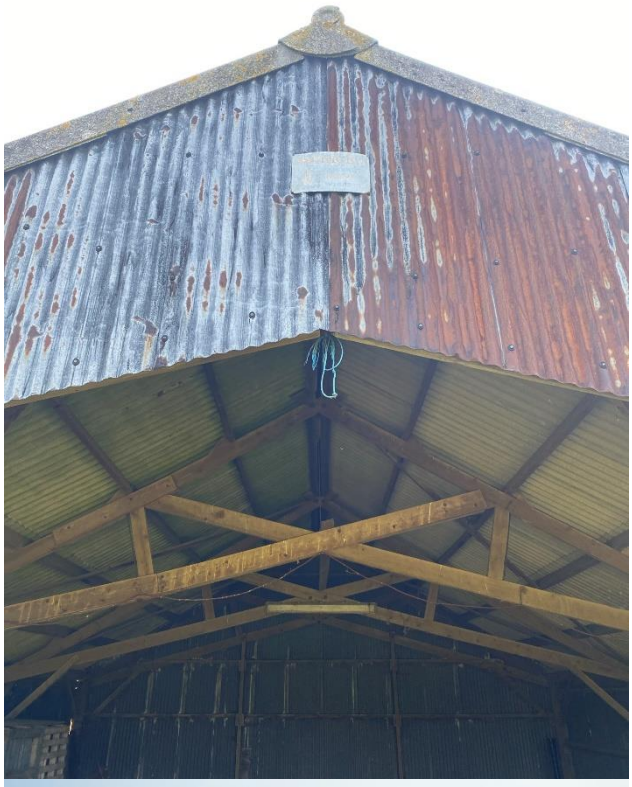


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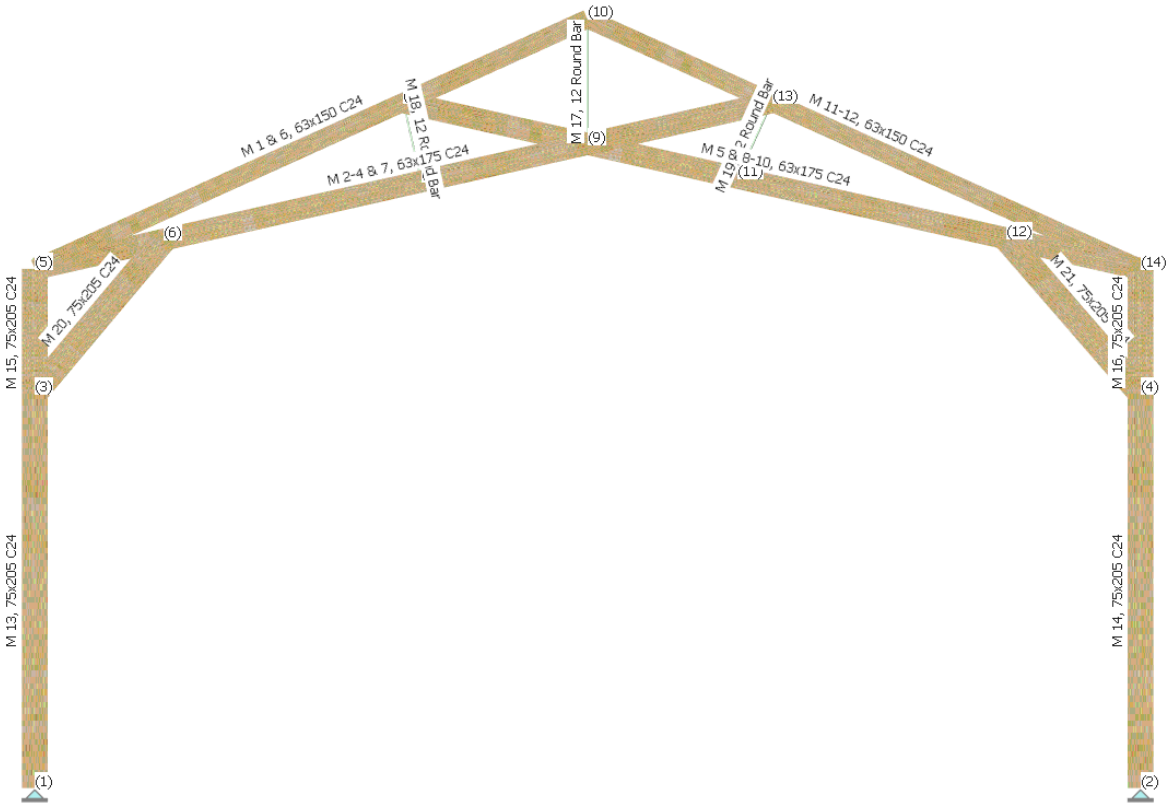




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APPENDIX C

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Frame Geometry - Full Frame - Front View

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MASTERFRAME DATA FILE

LOADING CASES AND LOAD COMBINATION

Load Group Labels

Load Group UT	Unity Load Factor (All Cases)
Load Group D1	Dead Load
Load Group L1	Live Load

Load Case 001 : Dead plus Live (Ultimate)

Load Combination	+ 1.00 UT + 1.40 D1 + 1.60 L1
Load Duration	Long Term

Load Case 002 : Live Only (Serviceability)

Load Combination	+ 1.00 UT + 1.00 L1

Load Case 003 : Dead plus Live (Serviceability)

Load Combination	+ 1.00 UT + 1.00 D1 + 1.00 L1
Load Duration	Long Term

THE NODAL CO-ORDINATES

Node	X (m)	Y (m)	Z (m)	Node	X (m)	Y (m)	Z (m)
1	0.000	0.000	0.000	2	8.774	0.000	0.000
3	0.000	3.132	0.000	4	8.774	3.132	0.000
5	0.000	4.118	0.000	6	1.022	4.349	0.000
7	3.067	4.811	0.000	8	2.925	5.439	0.000
9	4.387	5.109	0.000	10	4.387	6.100	0.000
11	5.579	4.840	0.000	12	7.709	4.359	0.000
13	5.849	5.439	0.000	14	8.774	4.118	0.000

MEMBER PROPERTIES

Members 1, 6 & 11-12

```
M  ...  ...          63x150 C24 E 10.80E6 G .675E6 TG C24  1000000
 A 94.5E-4            Ix 1772E-8          Iy 312.6E-8         J 1250E-8
```

Members 2-5 & 7-10

```
M  ...  ...          63x175 C24 E 10.80E6 G .675E6 TG C24  1000000
 A 110.2E-4           Ix 2814E-8          Iy 364.7E-8         J 1459E-8
```

Members 13-16 & 20-21

```
M  ...  ...          75x205 C24 E 10.80E6 G .675E6 TG C24  1100000
 A 153.8E-4           Ix 5384E-8          Iy 720.7E-8         J 2883E-8
```

Members 17-19

```
M  ...  ...          12 Round Bar [S 275]
 A 1.131E-4           Ix 0.102E-8         Iy 0.102E-8         J 0.2E-8
 E 205.0E6            G 78.85E6
```

MEMBER LOADING

Member Self Weight Density Load Included in Load Group D1, defined by Modulus of Elasticity

E kN/mm^2	Density kN/m^3	
>= 200.00	77.01	
>= 20.00	24.00	
>= 2.00	10.00	Members 1, 6 & 11-12

```
   UT Spacing 04.500 [Multiply AllLoads]
   D1 UDLY -000.500             [ kN/m ]
   L1 UDLY -000.600             [ kN/m ]
```

Members 1-16 & 20-21 - MasterFrame Pro Loads

```
   D1 D     010.000             ( kN/m³)
```

Members 17-19 - MasterFrame Pro Loads

```
   D1 D     077.010             ( kN/m³)
```

Members 18-19

```
   UT Tension-Only      (No Compression)
```

MEMBER ORIENTATION

Members 16-17 ß +180.00

NODAL LOADING AND SUPPORT CONDITIONS

NODES 1-2

```
     UT Rs 1 1 1 0 0 0 (Pinned)
```


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Nodal Deflections Serviceability (002 : Live Only (Serviceability))									
Node	Nodal Def. (mm and degrees)				Node	Nodal Def. (mm and degrees)			
	δX →	δY ↑	θZ ↗	δXY		δX →	δY ↑	θZ ↗	δXY
3	-7.12	-0.22	-0.12	7.13	4	7.12	-0.22	0.12	7.13
5	-4.19	-0.28	-0.23	4.20	6	-3.17	-3.57	-0.20	4.77
7	-0.88	-11.33	-0.18	11.36	8	0.30	-12.78	-0.01	12.79
9	0.00	-13.62	0.00	13.62	10	0.00	-12.98	0.00	12.98
11	0.74	-11.71	0.17	11.74	12	3.11	-3.73	0.21	4.86
13	-0.31	-12.78	0.01	12.79	14	4.18	-0.28	0.23	4.19

Nodal Deflections Serviceability (003 : Dead plus Live (Serviceability))									
Node	Nodal Def. (mm and degrees)				Node	Nodal Def. (mm and degrees)			
	δX →	δY ↑	θZ ↗	δXY		δX →	δY ↑	θZ ↗	δXY
3	-13.96	-0.44	-0.24	13.97	4	13.92	-0.44	0.24	13.93
5	-8.12	-0.55	-0.45	8.14	6	-6.10	-7.10	-0.41	9.36
7	-1.66	-22.14	-0.34	22.20	8	0.56	-24.68	-0.03	24.68
9	-0.04	-26.33	0.00	26.33	10	-0.04	-25.07	0.00	25.07
11	1.36	-22.87	0.32	22.91	12	5.93	-7.43	0.41	9.51
13	-0.63	-24.68	0.03	24.69	14	8.05	-0.55	0.46	8.07

Member Forces Ultimate (001 : Dead plus Live (Ultimate))						
Load Case No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm @m)	Maximum Deflection (mm@m)
1	5	101.272C	11.420	-6.801	3.509	21.239
	8	92.102C	-8.877	-2.720	@ 1.797	@ 1.990
2	5	89.694T	-4.819	2.911	-2.170	14.628
	6	89.730T	-4.977	-2.223	@ 1.037	@ 3.645
3	6	87.139T	1.316	-1.036	-2.170	14.628
	7	87.210T	1.001	1.393	@ 1.037	@ 3.645
4	7	87.211T	1.002	1.393	-2.170	14.628
	9	87.257T	0.798	2.611	@ 1.037	@ 3.645
5	8	26.016C	2.402	-1.607	-2.163	14.627
	9	26.067C	2.177	1.825	@ 4.905	@ 2.354
6	8	69.887C	4.871	-1.113	3.509	21.239
	10	65.302C	-5.277	-1.440	@ 1.797	@ 1.990
7	9	26.086C	-2.180	1.825	-2.170	14.628
	13	26.035C	-2.406	-1.612	@ 1.037	@ 3.645
8	9	87.277T	-0.800	2.611	-2.163	14.627
	11	87.236T	-0.984	1.521	@ 4.905	@ 2.354
9	11	87.235T	-0.984	1.521	-2.163	14.627
	12	87.161T	-1.313	-0.987	@ 4.905	@ 2.354
10	12	89.619T	4.643	-2.163	-2.163	14.627
	14	89.582T	4.478	2.817	@ 4.905	@ 2.354
11	10	65.303C	5.276	-1.440	3.513	21.270
	13	69.888C	-4.873	-1.116	@ 3.017	@ 2.824
12	13	92.120C	8.886	-2.729	3.513	21.270
	14	101.290C	-11.410	-6.780	@ 3.017	@ 2.824
13	1	35.577C	-2.301	0.000		7.798
	3	34.903C	-2.301	-7.206		@ 1.817
14	2	35.582C	2.301	0.000		7.798
	4	34.908C	2.301	7.206		@ 1.817

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Member Forces Ultimate (001 : Dead plus Live (Ultimate))						
Load Case No.	**Node End1 End2**	**Axial Force (kN)**	**Shear Force (kN)**	**Bending Moment (kNm)**	**Maximum Moment (kNm @m)**	**Maximum Deflection (mm@m)**
15	3	27.850C	-1.161	-2.746		0.694
	5	27.638C	-1.161	-3.891		@ 0.503
16	4	28.209C	-1.215	-2.765		0.703
	14	27.996C	-1.215	-3.963		@ 0.503
17	9	44.145T	0.000	0.000	0.000	0.000
	10	44.157T	0.000	0.000	@ 0.000	@ 0.000
18	7	0.000C	-0.001	0.000	0.000	0.029
	8	0.000C	0.001	0.000	@ 0.000	@ 0.322
19	11	0.000C	0.002	0.000	0.000	0.059
	13	0.000C	-0.002	0.000	@ 0.000	@ 0.329
20	3	6.134C	3.663	-4.460		0.934
	6	5.872C	3.443	1.187		@ 0.604
21	4	5.770C	-3.573	4.441		0.972
	12	5.506C	-3.343	-1.176		@ 0.617

Member Forces Ultimate (Maximum Values)						
Load Case No.	**Node End1 End2**	**Axial Force (kN)**	**Shear Force (kN)**	**Bending Moment (kNm)**	**Maximum Moment (kNm @m)**	**Maximum Deflection (mm@m)**
1	5	101.272C	11.420	-6.801	3.509	21.239
	8	92.102C	-8.877	-2.720	@ 1.797	@ 1.990
2	5	89.694T	-4.819	2.911	-2.170	14.628
	6	89.730T	-4.977	-2.223	@ 1.037	@ 3.645
3	6	87.139T	1.316	-1.036	-2.170	14.628
	7	87.210T	1.001	1.393	@ 1.037	@ 3.645
4	7	87.211T	1.002	1.393	-2.170	14.628
	9	87.257T	0.798	2.611	@ 1.037	@ 3.645
5	8	26.016C	2.402	-1.607	-2.163	14.627
	9	26.067C	2.177	1.825	@ 4.905	@ 2.354
6	8	69.887C	4.871	-1.113	3.509	21.239
	10	65.302C	-5.277	-1.440	@ 1.797	@ 1.990
7	9	26.086C	-2.180	1.825	-2.170	14.628
	13	26.035C	-2.406	-1.612	@ 1.037	@ 3.645
8	9	87.277T	-0.800	2.611	-2.163	14.627
	11	87.236T	-0.984	1.521	@ 4.905	@ 2.354
9	11	87.235T	-0.984	1.521	-2.163	14.627
	12	87.161T	-1.313	-0.987	@ 4.905	@ 2.354
10	12	89.619T	4.643	-2.163	-2.163	14.627
	14	89.582T	4.478	2.817	@ 4.905	@ 2.354
11	10	65.303C	5.276	-1.440	3.513	21.270
	13	69.888C	-4.873	-1.116	@ 3.017	@ 2.824
12	13	92.120C	8.886	-2.729	3.513	21.270

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Member Forces Ultimate (Maximum Values)						
Load Case No.	**Node End1 End2**	**Axial Force (kN)**	**Shear Force (kN)**	**Bending Moment (kNm)**	**Maximum Moment (kNm @m)**	**Maximum Deflection (mm@m)**
	14	101.290C	-11.410	-6.780	@ 3.017	@ 2.824
13	1	35.577C	-2.301	0.000		7.798
	3	34.903C	-2.301	-7.206		@ 1.817
14	2	35.582C	2.301	0.000		7.798
	4	34.908C	2.301	7.206		@ 1.817
15	3	27.850C	-1.161	-2.746		0.694
	5	27.638C	-1.161	-3.891		@ 0.503
16	4	28.209C	-1.215	-2.765		0.703
	14	27.996C	-1.215	-3.963		@ 0.503
17	9	44.145T	0.000	0.000	0.000	0.000
	10	44.157T	0.000	0.000	@ 0.000	@ 0.000
18	7	0.000C	-0.001	0.000	0.000	0.029
	8	0.000C	0.001	0.000	@ 0.000	@ 0.322
19	11	0.000C	0.002	0.000	0.000	0.059
	13	0.000C	-0.002	0.000	@ 0.000	@ 0.329
20	3	6.134C	3.663	-4.460		0.934
	6	5.872C	3.443	1.187		@ 0.604
21	4	5.770C	-3.573	4.441		0.972
	12	5.506C	-3.343	-1.176		@ 0.617

Member Forces Ultimate (Minimum Values)						
Load Case No.	**Node End1 End2**	**Axial Force (kN)**	**Shear Force (kN)**	**Bending Moment (kNm)**	**Maximum Moment (kNm @m)**	**Maximum Deflection (mm@m)**
1	5	101.272C	11.420	-6.801	3.509	21.239
	8	92.102C	-8.877	-2.720	@ 1.797	@ 1.990
2	5	89.694T	-4.819	2.911	-2.170	14.628
	6	89.730T	-4.977	-2.223	@ 1.037	@ 3.645
3	6	87.139T	1.316	-1.036	-2.170	14.628
	7	87.210T	1.001	1.393	@ 1.037	@ 3.645
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6	8	69.887C	4.871	-1.113	3.509	21.239
	10	65.302C	-5.277	-1.440	@ 1.797	@ 1.990
7	9	26.086C	-2.180	1.825	-2.170	14.628
	13	26.035C	-2.406	-1.612	@ 1.037	@ 3.645
8	9	87.277T	-0.800	2.611	-2.163	14.627
	11	87.236T	-0.984	1.521	@ 4.905	@ 2.354
9	11	87.235T	-0.984	1.521	-2.163	14.627
	12	87.161T	-1.313	-0.987	@ 4.905	@ 2.354

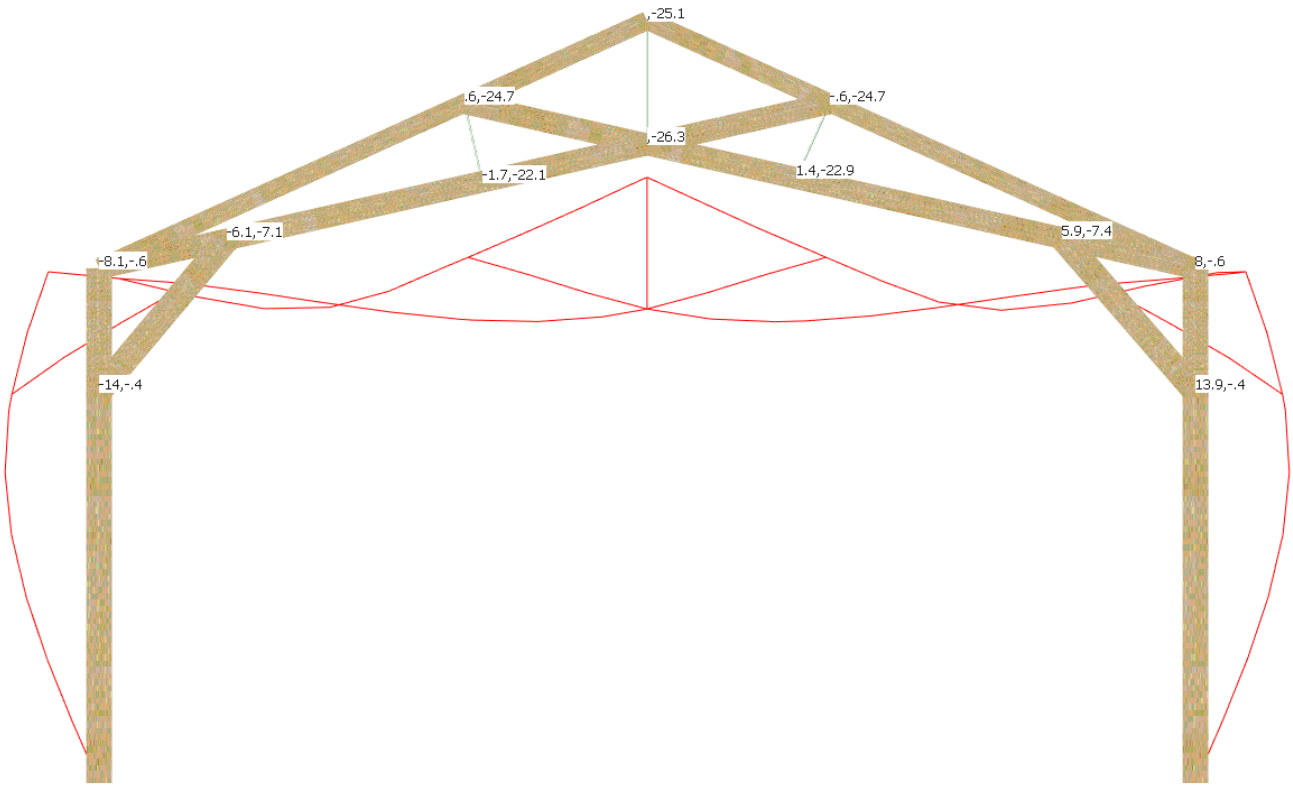
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Member Forces Ultimate (Minimum Values)						
Load Case No.	**Node End1 End2**	**Axial Force (kN)**	**Shear Force (kN)**	**Bending Moment (kNm)**	**Maximum Moment (kNm @m)**	**Maximum Deflection (mm@m)**
10	12	89.619T	4.643	-2.163	-2.163	14.627
	14	89.582T	4.478	2.817	@ 4.905	@ 2.354
11	10	65.303C	5.276	-1.440	3.513	21.270
	13	69.888C	-4.873	-1.116	@ 3.017	@ 2.824
12	13	92.120C	8.886	-2.729	3.513	21.270
	14	101.290C	-11.410	-6.780	@ 3.017	@ 2.824
13	1	35.577C	-2.301	0.000		7.798
	3	34.903C	-2.301	-7.206		@ 1.817
14	2	35.582C	2.301	0.000		7.798
	4	34.908C	2.301	7.206		@ 1.817
15	3	27.850C	-1.161	-2.746		0.694
	5	27.638C	-1.161	-3.891		@ 0.503
16	4	28.209C	-1.215	-2.765		0.703
	14	27.996C	-1.215	-3.963		@ 0.503
17	9	44.145T	0.000	0.000	0.000	0.000
	10	44.157T	0.000	0.000	@ 0.000	@ 0.000
18	7	0.000C	-0.001	0.000	0.000	0.029
	8	0.000C	0.001	0.000	@ 0.000	@ 0.322
19	11	0.000C	0.002	0.000	0.000	0.059
	13	0.000C	-0.002	0.000	@ 0.000	@ 0.329
20	3	6.134C	3.663	-4.460		0.934
	6	5.872C	3.443	1.187		@ 0.604
21	4	5.770C	-3.573	4.441		0.972
	12	5.506C	-3.343	-1.176		@ 0.617

Support Reactions Serviceability (002 : Live Only (Serviceability))							
Node	**Node0**			**Node**	**Node0**		
	Rx → (kN)	**Ry ↑ (kN)**	**Mz ↗ (kNm)**		**Rx → (kN)**	**Ry ↑ (kN)**	**Mz ↗ (kNm)**
1	0.772	11.845	0.000	2	-0.772	11.845	0.000
Total	0.000	23.690	0.000				

Support Reactions Serviceability (003 : Dead plus Live (Serviceability))							
Node	**Node0**			**Node**	**Node0**		
	Rx → (kN)	**Ry ↑ (kN)**	**Mz ↗ (kNm)**		**Rx → (kN)**	**Ry ↑ (kN)**	**Mz ↗ (kNm)**
1	1.533	23.720	0.000	2	-1.533	23.724	0.000
Total	0.000	47.444	0.000				

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Load Case 003 : Dead plus Live (Serviceability)
Deflected Shape - Full Frame - Front View
50 Magnification

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TBL1Id 1 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 63, h = 150, 150x63 in Strength Class C24
Section Properties (c,cm³,cm)	Area 94.5, Zx 236.3, Zy 99.2, rx 4.33, ry 1.82
Specification	1 : Internal use in continuously heated building Long term loading
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 67.335 kN, L = 4.814 m, Lx = 1.2 m, Ly = 1.2 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.08 x 1.00 x 7.50	8.09 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.17 x 1.00 x 7.50	8.78 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.00 x 7200	7200 N/mm²
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(120/4.330, 120/1.819) ≤ 180	66.0	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	65.98, 7.90, 7200	0.624	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.624 x 7.90	4.93 N/mm²	
$\sigma_{c.a}$ = F/Area	67.335 / 94.5 ≤ 4.93	7.13 N/mm²	Warning

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a}$ = Mx/Zx	4.512 / 236.25 ≤ 8.09	19.10 N/mm²	Warning
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	8.09 (1-1.5x0.624x7.13/16.32)	4.79 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	7.13/4.93+19.10/4.79	5.435	Warning

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 7.579 / 94.5 ≤ 0.71	1.20 N/mm²	Warning
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	7.579 / (63 x 75) ≤ 2.17	1.60 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
δ = δ_m	In-span 14.11 ≤ L/333	14.11 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TBL1Id 2 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 63, h = 175, 175x63 in Strength Class C24
Section Properties (c,cm³,cm)	Area 110.3, Zx 321.6, Zy 115.8, rx 5.05, ry 1.82
Specification	1 : Internal use in continuously heated building Long term loading
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 17.321 kN, L = 5.997 m, Lx = 5.997 m, Ly = 5.997 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.06 x 1.00 x 7.50	7.96 N/mm²	
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.17 x 1.00 x 7.50	8.78 N/mm²	
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²	
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²	
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²	
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.00 x 7200	7200 N/mm²	
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²	

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(600/5.052, 600/1.819) ≤ 180	329.7	Warning
K_{12} = fn(λ , $K_3.\sigma_c$, E)	329.75, 7.90, 7200	0.050	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.050 x 7.90	0.40 N/mm²	
$\sigma_{c.a}$ = F/Area	17.321 / 110.3 ≤ 0.40	1.57 N/mm²	Warning

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a}$ = Mx/Zx	1.932 / 321.56 ≤ 7.96	6.01 N/mm²	OK
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.96 (1-1.5x0.050x1.57/0.65)	6.51 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.57/0.40+6.01/6.51	4.874	Warning

Shear and Bearing Check

Critical Design Location	X = 0.750		
τ_a = 1.5 Fv / Area	1.5 x 3.277 / 110.25 ≤ 0.71	0.45 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	3.277 / (63 x 75) ≤ 2.17	0.69 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
$\delta = \delta_m$	In-span 9.74 ≤ L/333	9.74 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TBL1Id 3 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 63, h = 175, 175x63 in Strength Class C24
Section Properties (c,cm³,cm)	Area 110.3, Zx 321.6, Zy 115.8, rx 5.05, ry 1.82
Specification	1 : Internal use in continuously heated building Long term loading
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 17.307 kN, L = 5.997 m, Lx = 5.997 m, Ly = 5.997 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.06 x 1.00 x 7.50	7.96 N/mm²	
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.17 x 1.00 x 7.50	8.78 N/mm²	
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²	
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²	
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²	
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.00 x 7200	7200 N/mm²	
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²	

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(600/5.052, 600/1.819) ≤ 180	329.7	Warning
K_{12} = fn(λ , $K_3.\sigma_c$, E)	329.75, 7.90, 7200	0.050	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.050 x 7.90	0.40 N/mm²	
$\sigma_{c.a}$ = F/Area	17.307 / 110.3 ≤ 0.40	1.57 N/mm²	Warning

Axial Load with Moments Check

Critical Design Location	X = 5.997		
$\sigma_{mx.a}$ = Mx/Zx	1.870 / 321.56 ≤ 7.96	5.82 N/mm²	OK
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.96 (1-1.5x0.050x1.57/0.65)	6.51 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.57/0.40+5.82/6.51	4.841	Warning

Shear and Bearing Check

Critical Design Location	X = 4.905		
τ_a = 1.5 Fv / Area	1.5 x 3.087 / 110.25 ≤ 0.71	0.42 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	3.087 / (63 x 75) ≤ 2.17	0.65 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
$\delta = \delta_m$	In-span 9.74 ≤ L/333	9.74 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TBL1Id 4 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 63, h = 150, 150x63 in Strength Class C24
Section Properties (c,cm³,cm)	Area 94.5, Zx 236.3, Zy 99.2, rx 4.33, ry 1.82
Specification	1 : Internal use in continuously heated building Long term loading
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 67.348 kN, L = 4.814 m, Lx = 1.2 m, Ly = 1.2 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.08 x 1.00 x 7.50	8.09 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.17 x 1.00 x 7.50	8.78 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.00 x 7200	7200 N/mm²
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(120/4.330, 120/1.819) ≤ 180	66.0	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	65.98, 7.90, 7200	0.624	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.624 x 7.90	4.93 N/mm²	
$\sigma_{c.a}$ = F/Area	67.348 / 94.5 ≤ 4.93	7.13 N/mm²	Warning

Axial Load with Moments Check

Critical Design Location	X = 4.814		
$\sigma_{mx.a}$ = Mx/Zx	4.498 / 236.25 ≤ 8.09	19.04 N/mm²	Warning
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	8.09 (1-1.5x0.624x7.13/16.32)	4.79 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	7.13/4.93+19.04/4.79	5.423	Warning

Shear and Bearing Check

Critical Design Location	X = 4.814		
τ_a = 1.5 Fv / Area	1.5 x 7.572 / 94.5 ≤ 0.71	1.20 N/mm²	Warning
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	7.572 / (63 x 75) ≤ 2.17	1.60 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
$\delta = \delta_m$	In-span 14.13 ≤ L/333	14.13 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TCL1Id 5 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 205, 205x75 in Strength Class C24
Section Properties (c,cm³,cm)	Area 153.8, Zx 525.3, Zy 192.2, rx 5.92, ry 2.17
Specification	1 : Internal use in continuously heated building Long term loading,
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 23.72 kN, L = 3.132 m, Lx = 3.132 m, Ly = 1.5 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.04 x 1.00 x 7.50	7.82 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.16 x 1.00 x 7.50	8.74 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²
$\tau_{adm} = K_2.K_{3_}.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.14 x 7200	8208 N/mm²
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(313/5.918, 150/2.165) ≤ 180	69.3	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	69.28, 7.90, 8208	0.620	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.620 x 7.90	4.90 N/mm²	
$\sigma_{c.a}$ = F/Area	23.72 / 153.8 ≤ 4.90	1.54 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 3.132		
$\sigma_{mx.a}$ = Mx/Zx	4.802 / 525.31 ≤ 7.82	9.14 N/mm²	Warning
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.82 (1-1.5x0.620x1.54/16.88)	7.16 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.54/4.90+9.14/7.16	1.592	Warning

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 1.533 / 153.75 ≤ 0.71	0.15 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	1.533 / (75 x 75) ≤ 2.17	0.27 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
δ = δ_m	In-span 5.20 ≤ L/333	5.20 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TCL1Id 6 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 205, 205x75 in Strength Class C24
Section Properties (c,cm³,cm)	Area 153.8, Zx 525.3, Zy 192.2, rx 5.92, ry 2.17
Specification	1 : Internal use in continuously heated building Long term loading,
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 23.724 kN, L = 3.132 m, Lx = 3.132 m, Ly = 1.5 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.04 x 1.00 x 7.50	7.82 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.16 x 1.00 x 7.50	8.74 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.14 x 7200	8208 N/mm²
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(313/5.918, 150/2.165) ≤ 180	69.3	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	69.28, 7.90, 8208	0.620	
$\sigma_{c.adm} = K_{12} . \sigma_{c.adm}$	0.620 x 7.90	4.90 N/mm²	
$\sigma_{c.a}$ = F/Area	23.724 / 153.8 ≤ 4.90	1.54 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 3.132		
$\sigma_{mx.a}$ = Mx/Zx	4.802 / 525.31 ≤ 7.82	9.14 N/mm²	Warning
$\sigma_{mx.adm}=\sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.82 (1-1.5x0.620x1.54/16.88)	7.16 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.54/4.90+9.14/7.16	1.592	Warning

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 1.533 / 153.75 ≤ 0.71	0.15 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	1.533 / (75 x 75) ≤ 2.17	0.27 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
δ = δ_m	In-span 5.20 ≤ L/333	5.20 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TCL1Id 7 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 205, 205x75 in Strength Class C24
Section Properties (c,cm³,cm)	Area 153.8, Zx 525.3, Zy 192.2, rx 5.92, ry 2.17
Specification	1 : Internal use in continuously heated building Long term loading,
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 18.518 kN, L = 0.986 m, Lx = 0.986 m, Ly = 0.986 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.04 x 1.00 x 7.50	7.82 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.16 x 1.00 x 7.50	8.74 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.14 x 7200	8208 N/mm²
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(99/5.918, 99/2.165) ≤ 180	45.5	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	45.54, 7.90, 8208	0.771	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.771 x 7.90	6.09 N/mm²	
$\sigma_{c.a}$ = F/Area	18.518 / 153.8 ≤ 6.09	1.20 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.986		
$\sigma_{mx.a}$ = Mx/Zx	2.580 / 525.31 ≤ 7.82	4.91 N/mm²	OK
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.82 (1-1.5x0.771x1.20/39.06)	7.54 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.20/6.09+4.91/7.54	0.849	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 0.759 / 153.75 ≤ 0.71	0.07 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	0.759 / (75 x 75) ≤ 2.17	0.13 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
$\delta = \delta_m$	In-span 0.46 ≤ L/333	0.46 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TCL1Id 8 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 205, 205x75 in Strength Class C24
Section Properties (c,cm³,cm)	Area 153.8, Zx 525.3, Zy 192.2, rx 5.92, ry 2.17
Specification	1 : Internal use in continuously heated building Long term loading,
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 18.757 kN, L = 0.986 m, Lx = 0.986 m, Ly = 0.986 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.04 x 1.00 x 7.50	7.82 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.16 x 1.00 x 7.50	8.74 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.14 x 7200	8208 N/mm²
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(99/5.918, 99/2.165) ≤ 180	45.5	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	45.54, 7.90, 8208	0.771	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.771 x 7.90	6.09 N/mm²	
$\sigma_{c.a}$ = F/Area	18.757 / 153.8 ≤ 6.09	1.22 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.986		
$\sigma_{mx.a}$ = Mx/Zx	2.628 / 525.31 ≤ 7.82	5.00 N/mm²	OK
$\sigma_{mx.adm}=\sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.82 (1-1.5x0.771x1.22/39.06)	7.54 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.22/6.09+5.00/7.54	0.864	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 0.795 / 153.75 ≤ 0.71	0.08 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	0.795 / (75 x 75) ≤ 2.17	0.14 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
$\delta = \delta_m$	In-span 0.47 ≤ L/333	0.47 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TBL1Id 12 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 205, 205x75 in Strength Class C24
Section Properties (c,cm³,cm)	Area 153.8, Zx 525.3, Zy 192.2, rx 5.92, ry 2.17
Specification	1 : Internal use in continuously heated building Long term loading,
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 4.113 kN, L = 1.589 m, Lx = 1.589 m, Ly = 1.589 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.04 x 1.00 x 7.50	7.82 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.16 x 1.00 x 7.50	8.74 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²
E = $K_2.K_9.E_m$in (Compression)	1.00 x 1.14 x 7200	8208 N/mm²
E = $K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(159/5.918, 159/2.165) ≤ 180	73.4	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	73.39, 7.90, 8208	0.592	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.592 x 7.90	4.68 N/mm²	
$\sigma_{c.a}$ = F/Area	4.113 / 153.8 ≤ 4.68	0.27 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a}$ = Mx/Zx	2.970 / 525.31 ≤ 7.82	5.65 N/mm²	OK
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.82 (1-1.5x0.592x0.27/15.04)	7.70 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	0.27/4.68+5.65/7.70	0.791	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 2.443 / 153.75 ≤ 0.71	0.24 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	2.443 / (75 x 75) ≤ 2.17	0.43 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
δ = δ_m	In-span 0.62 ≤ L/333	0.62 mm	OK

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MASTERKEY : TIMBER DESIGN

AXIAL LOAD WITH MOMENT DESIGN TO BS 5268 : PART 2
Member TBL1Id 13 @ Level 1

Summary Design Data

Design Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Deflection Cases Covered	1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 75, h = 205, 205x75 in Strength Class C24
Section Properties (c,cm³,cm)	Area 153.8, Zx 525.3, Zy 192.2, rx 5.92, ry 2.17
Specification	1 : Internal use in continuously heated building Long term loading,
Integrated Design Critical Case	: Dead plus Live (Serviceability)
Member Details	F = 3.871 kN, L = 1.625 m, Lx = 1.625 m, Ly = 1.625 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.00 x 1.04 x 1.00 x 7.50	7.82 N/mm²	
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.00 x 1.16 x 1.00 x 7.50	8.74 N/mm²	
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.00 x 1.00 x 7.90	7.90 N/mm²	
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.00 x 1.14 x 1.00 x 1.90	2.17 N/mm²	
$\tau_{adm} = K_2.K_3_.K_8.\tau$	1.00 x 1.00 x 1.00 x 0.71	0.71 N/mm²	
$E = K_2.K_9.E_m$in (Compression)	1.00 x 1.14 x 7200	8208 N/mm²	
$E = K_2.E_m$ean (Deflection)	1.00 x 10800	10800 N/mm²	

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(163/5.918, 163/2.165) ≤ 180	75.1	OK
K_{12} = fn(λ , $K_3.\sigma_c$, E)	75.06, 7.90, 8208	0.581	
$\sigma_{c.adm} = K_{12}$. $\sigma_{c.adm}$	0.581 x 7.90	4.59 N/mm²	
$\sigma_{c.a}$ = F/Area	3.871 / 153.8 ≤ 4.59	0.25 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a}$ = Mx/Zx	2.957 / 525.31 ≤ 7.82	5.63 N/mm²	OK
$\sigma_{mx.adm}=\sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	7.82 (1-1.5x0.581x0.25/14.38)	7.70 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	0.25/4.59+5.63/7.70	0.786	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 2.383 / 153.75 ≤ 0.71	0.23 N/mm²	OK
$\sigma_{c\perp ax}$ = Fvx / (b.Bx)	2.383 / (75 x 75) ≤ 2.17	0.42 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 003 : Dead plus Live (Serviceability)			
$\delta = \delta_m$	In-span 0.65 ≤ L/333	0.65 mm	OK

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