VISUAL STRUCTURAL INSPECTION
STRUCTURAL ASSESSMENT & DESIGN CHECK

UPON

EXISTING AGRICULTURAL BARN

BROADWATER FARMYARD

BROADWATER LANE

MOULTON

SPALDING

DOCUMENT REF:

SW24-198-REP-01

Client: Mr James Kirk

Prepared By: Mark Shields IEngAMIStructE

1. INTRODUCTION

This brief preliminary report and/or opinion has been prepared for the specific purpose stated herein. It has been prepared for the exclusive use of our client Mr James Kirk.
This document, or any part of its contents shall not be disclosed to any other persons except these specifically mentioned below.

- Local Authority Planning Department
- Local Authority Building Control
- Oglesby & Limb Ltd
- Any other party with written permission of Mr James Kirk.

This document is issued only to the persons stated above and on the understanding that Shields Wilson Ltd is not held responsible for the actions of others who obtain any unauthorised disclosure of its contents, or place reliance on any parts of its findings, facts or opinions be they specifically stated or implied.

Shields Wilson Ltd have been requested to carry out a visual inspection and assessment of the existing agricultural building situated off Broadwater Lane, adjacent to Engine Bank, Moulton, Spalding, Lincolnshire. National Grid Reference: TF309210.
This is in connection with a proposed conversion under PART Q to dwellings.
We confirm that the visual inspection took place Friday 26th April 2024.

2. RESULTS OF VISUAL STRUCTURAL INSPECTION AND STRUCTURAL ASSESSMENT

In principle this is a traditional timber framed, agricultural detached building with a corrugated asbestos cement duo pitched roof covering.
The external elevations are clad with corrugated galvanized steel sheets.
The roof cladding is supported off 65 x 165 timber purlins at 1.375m c/c. The purlins span between the main timber trusses spaced at 4.572m bay centres.
The wall cladding is supported off 65 x 100 timber rails, spaced at 1.565m vertical centres, spanning between the main posts spaced at 4.572 bay centres.

The main structural frames consist of 145 x 220 timber posts, supporting the timber scissor trusses formed with 75 x 225 timbers to top and bottom chords.
Stability of the timber structure is provided in both directions by timber ‘knee braces’ at eaves level, fixed to the main posts from the eaves members for longitudinal direction and underside of the main trusses, for transverse direction.
Full details of the timber frame structural are shown on Oglesby and Limb drawing A1531-03 and 04.

The floor of the building remains as compacted soil and not a concrete slab.

We would confirm that during our structural inspection we saw no signs of any structural deformation, deflection or misalignment of the timber framed structure.
This would therefore indicate the existing structural framework are performing satisfactorily.
For the age and use of the building, the structural members remained in a good serviceable condition, with minimal signs of decay and is a good example of a traditional farm building constructed by Messers English Brothers, of Wisbech.

3. CONCLUSIONS & RECOMMENDATIONS

Following our visual structural inspection and subsequent consideration and design checks, it is our opinion that this particular barn has survived several decades of usage.

This has included withstanding significant storm periods, particularly the peak of storms which occurred in the 1990's and the late 1980's. It has easily withstood significant snow loads that occurred over its life without any undue deformation or distortion.

Design check calculations are provided within the appendix, showing that the main posts and scissor trusses are suitable and satisfactory for the proposed new residential loadings. The purlin and side rail members will need some remedial strengthening or additional members adding, to meet the deflection limitations of the proposed internal finishes.

From the above, it is our conclusion that the existing barn is structurally stable and suitable for conversion/change of use to residential.

Therefore it would structurally comply with and satisfy the requirement of Class Q for change of use of an existing agricultural building to a dwelling.

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

M Shields IEng AMIStructE **MAY 2024**

4. APPENDIX

SHIELDS WILSON

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STRUCTURAL AND CIVIL ENGINEERING

Structural Calculations	Project:	Date: May '24	Designer: MAS
Project No: 24-198	Subject:	Sheet No: 1	Rev:

STRUCTURAL DESIGN CHECK

UPON EXISTING AGRICULTURAL BUILDING

BROADWATER FARMYARD

BROADWATER LANE

MOULTON

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STRUCTURAL AND CIVIL ENGINEERING

Structural Calculations	Project:	Date: MAY '24	Designer: MAS
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LOADINGS

ROOF IMPOSED = 0.60 kN/m²

COMPOSITE ROOF SHEETING	=	0.12 kN/m²
PURLINS	=	0.03 kN/m²
INSULATION, CEILING & SERVICES	=	0.16 kN/m²
		0.31 kN/m²

WIND LOADING

BASIC WIND SPEED, V_b = 43 m/s

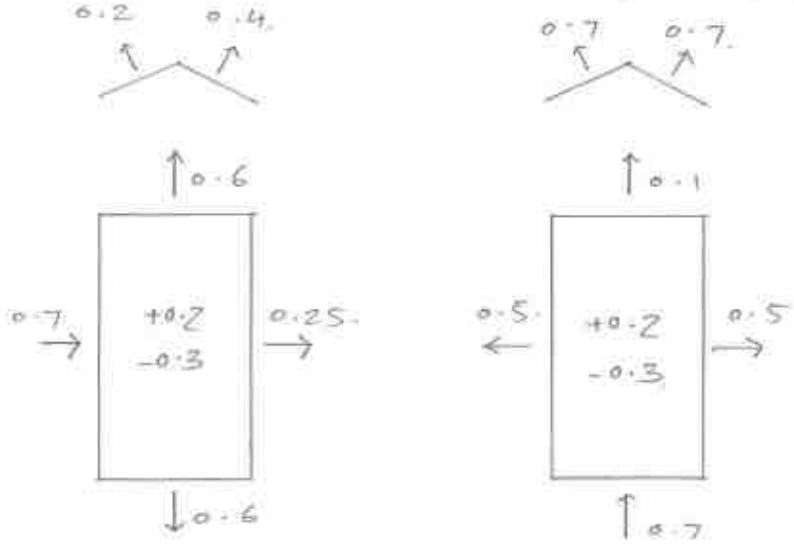
S_1 = 1.0

H = 7.0m S_2 = 0.796 CAT 2 CLASS B

S_3 = 1.0

V_s = 34.23

q = 0.718 kN/m²



q_p EAVES = $(0.719 \times .43)^2 \times 0.613$ = 0.586 kN/m²

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STRUCTURAL AND CIVIL ENGINEERING

Structural Calculations	Project:	Date: MAY '24	Designer: MAS
Project No: 24-198	Subject:	Sheet No: 3	Rev:

SIDE RAILS

SPAN = 4.572 m. 1.565 m c/c.

LOAD/m = $\frac{1.565 \times 0.586 \times 4.572^2}{8.}$ = 2.090 kN/m

CHECK. 65 × 100 $Z = \frac{65 \times 100^2}{6}$ = 108333 mm³

STRESS = $\frac{2.090 \times 10^6}{108333}$ = 19.29 N/mm²

K_3 = 1.75 $k_7 = \left(\frac{300}{100.}\right)^{0.11}$ = 1.128.

∴ ALLOWABLE STRESS = 1.75 × 1.128 × 7.5 = 14.81 N/mm²

∴ RAILS ARE OVERSTRESSED DUE TO CURRENT WIND LOAD CALCULATIONS

∴ WE RECOMMEND THAT ADDITIONAL RAILS ARE INSTALLED BETWEEN EXISTING MEMBERS ie: 0.783m c/c.

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Structural Calculations	Project:	Date: MAY '24	Designer: MAS
Project No: 24-198	Subject:	Sheet No: 4	Rev:

ROOF PURLINS

SPAN = 4.572 m. 1.375 m c/c

LOAD/m = (0.6 + 0.31) × 1.375 = 1.251 kN/m

∴ MOMENT = $\frac{1.251 \times 4.572^2}{8}$ = 3.269 kNm

CHECK 65 × 165 PURLINS

$Z = \frac{65 \times 165^2}{6}$ = 294938 mm³

STRESS = $\frac{3.269 \times 10^6}{294938}$ = 11.08 N/mm².

k_3 = 1.25 $k_7 = \left(\frac{300}{165}\right)^{0.11}$ = 1.07.

∴ ALLOWABLE STRESS = 1.25 × 1.07 × 7.5 = 10.03 N/mm²

∴ PURLIN IS SLIGHTLY OVERSTRESSED WITH ADDITIONAL LOADS FROM PROPOSED CEILING.

∴ WE RECOMMEND THAT ADDITIONAL PURLINS ARE INSTALLED BETWEEN EXISTING MEMBERS @ 0.688 m c/c.

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Frame Geometry - (Full Frame) - Front View

Not to Scale

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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 Group W1	Wind Load
Load Group W2	Wind Load
Load Group W3	Wind Load

Load Case 001 : Dead plus Live

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

Load Case 002 : Live (Serviceability)

Load Combination	+ 1.00 UT + 1.00 L1
Load Duration	Short Term

Load Case 003 : Dead (Serviceability)

Load Combination	+ 1.00 UT + 1.00 D1
Load Duration	Short Term

Load Case 004 : Dead Plus Wind Case 1

Load Combination	+ 1.00 UT + 1.00 D1 + 0.85 W1
Load Duration	Short Term

Load Case 005 : Dead Plus Wind Case 2

Load Combination	+ 1.00 UT + 1.00 D1 + 0.85 W2
Load Duration	Short Term

Load Case 006 : Dead Plus Wind Case 3

Load Combination	+ 1.00 UT + 1.00 D1 + 0.85 W3
Load Duration	Short 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	0.000	3.300	0.000
3	0.000	4.500	0.000	4	1.487	4.698	0.000
5	12.000	0.000	0.000	6	3.439	4.957	0.000
7	3.000	5.899	0.000	8	6.000	5.298	0.000
9	12.000	3.300	0.000	10	6.000	7.298	0.000
11	8.561	4.957	0.000	12	10.513	4.698	0.000
13	9.000	5.899	0.000	14	12.000	4.500	0.000

Member Properties

Members 1-4, 10-12, 14, 16-18 & 20

```
M  ...  ...        75x225 TR26 E 11.00E6 G .688E6 TG TR26 1000000
A 168.8E-4          Ix 7119E-8          Iy 791.0E-8         J 3164E-8
```

Members 5-8

```
M  ...  ...        145x215 TR26 E 11.00E6 G .688E6 TG TR26 1000000
A 311.8E-4          Ix 12009E-8         Iy 5462E-8          J 21848E-8
```

Member 9

```
M  ...  ...        16 Square Bar [Grade 43]
A 2.56E-4           Ix 0.546E-8         Iy 0.546E-8         J 2.18E-8
E 205.0E6           G 78.85E6
```

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Members 13, 15, 19 & 21

```
M  ...  ...          75x150 TR26 E 11.00E6 G .688E6 TG TR26 1000000
 A 112.5E-4          Ix 2109E-8          Iy 527.3E-8         J 2109E-8
```

Member Loading

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

E kN/mm²	Density kN/m³
>= 200.00	77.01
>= 20.00	24.00
>= 2.00	10.00

Members 1-2

```
D1 UDLY -001.417              ( kN/m )
L1 UDLY -002.743              ( kN/m )
W1 UDLN +001.313              ( kN/m )
W2 UDLN -000.328              ( kN/m )
W3 UDLN +002.954              ( kN/m )
```

Members 1-8 & 10-21 - MasterFrame Pro Loads

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

Members 3-4

```
D1 UDLY -001.417              ( kN/m )
L1 UDLY -002.743              ( kN/m )
W1 UDLN +001.970              ( kN/m )
W2 UDLN +000.000              ( kN/m )
W3 UDLN +000.000              ( kN/m )
```

Members 5-6

```
W1 UDLX +001.641              ( kN/m )
W2 UDLX +003.283              ( kN/m )
W3 UDLX -002.298              ( kN/m )
```

Members 7-8

```
W1 UDLX +001.477              ( kN/m )
W2 UDLX -000.164              ( kN/m )
W3 UDLX +002.298              ( kN/m )
```

Member 9 - MasterFrame Pro Loads

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

Member Orientation

Member 9 ß +180.00

Member End Releases

Symbols End 1 torsion-minor-major End 2 torsion-minor-major O Released ® Fixed

1 ®OO ®®®	2 ®®® ®OO	9 ®OO ®OO	10 ®OO ®®®
13 ®OO ®OO	14 ®OO ®®®	15 ®OO ®OO	18 ®®® ®OO
19 ®OO ®OO	20 ®®® ®OO	21 ®OO ®OO	

Nodal Loading and Support Conditions

NODES 1 & 5

```
UT Rs 1 1 1 1 1 1 (Fixed)
```

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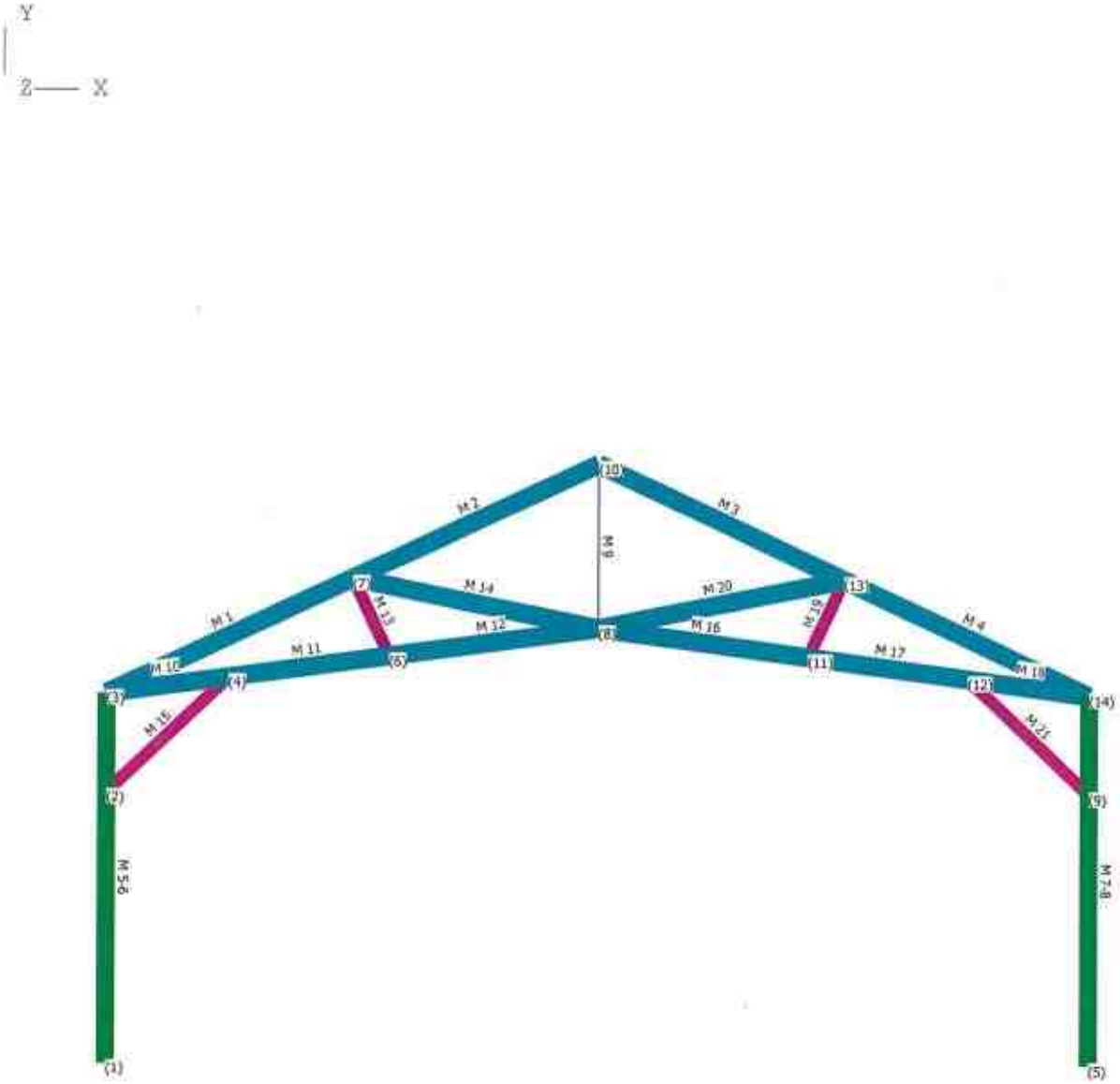

Frame Geometry - (Full Frame) - Front View

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Nodal Deflections Serviceability (001 : Dead plus Live)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	δ X →	δ Y ↑	ΦZ ↗	δ XY		δ X →	δ Y ↑	ΦZ ↗	δ XY
1	0.00	0.00	0.00	0.00	2	-6.18	-0.28	0.00	6.18
3	-4.50	-0.35	-0.12	4.51	4	-3.63	-3.21	-0.21	4.84
5	0.00	0.00	0.00	0.00	6	-1.85	-12.25	-0.18	12.39
7	-0.44	-11.63	-0.11	11.64	8	-1.01	-13.07	0.01	13.11
9	5.35	-0.28	0.03	5.36	10	-1.03	-12.15	-0.27	12.19
11	-0.17	-12.22	0.14	12.22	12	1.40	-4.61	0.22	4.82
13	-1.59	-11.59	0.17	11.70	14	2.44	-0.36	0.23	2.46

Nodal Deflections Serviceability (002 : Live (Serviceability))

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	δ X →	δ Y ↑	ΦZ ↗	δ XY		δ X →	δ Y ↑	ΦZ ↗	δ XY
1	0.00	0.00	0.00	0.00	2	-3.60	-0.16	0.00	3.60
3	-2.69	-0.20	-0.07	2.70	4	-2.19	-1.78	-0.12	2.82
5	0.00	0.00	0.00	0.00	6	-1.13	-7.21	-0.11	7.30
7	-0.30	-6.86	-0.06	6.86	8	-0.64	-7.68	0.00	7.71
9	3.08	-0.16	0.02	3.09	10	-0.65	-7.16	-0.17	7.19
11	-0.14	-7.20	0.09	7.20	12	0.80	-2.66	0.13	2.78
13	-0.98	-6.83	0.10	6.90	14	1.40	-0.21	0.14	1.41

Nodal Deflections Serviceability (003 : Dead (Serviceability))

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	δ X →	δ Y ↑	ΦZ ↗	δ XY		δ X →	δ Y ↑	ΦZ ↗	δ XY
1	0.00	0.00	0.00	0.00	2	-2.58	-0.12	0.00	2.58
3	-1.81	-0.15	-0.05	1.81	4	-1.44	-1.42	-0.09	2.02
5	0.00	0.00	0.00	0.00	6	-0.72	-5.03	-0.07	5.09
7	-0.14	-4.78	-0.04	4.78	8	-0.38	-5.39	0.00	5.40
9	2.27	-0.12	0.01	2.27	10	-0.38	-4.99	-0.10	5.00
11	-0.03	-5.02	0.06	5.02	12	0.61	-1.95	0.09	2.04
13	-0.62	-4.76	0.07	4.80	14	1.04	-0.15	0.10	1.05

Nodal Deflections Serviceability (004 : Dead Plus Wind Case 1)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	δ X →	δ Y ↑	ΦZ ↗	δ XY		δ X →	δ Y ↑	ΦZ ↗	δ XY
1	0.00	0.00	0.00	0.00	2	16.23	-0.03	-0.23	16.23
3	19.55	-0.06	-0.12	19.55	4	20.13	-4.04	-0.05	20.54
5	0.00	0.00	0.00	0.00	6	19.98	-1.93	0.07	20.08
7	20.14	-1.83	-0.01	20.22	8	20.10	-1.46	-0.01	20.15
9	17.73	-0.04	-0.23	17.73	10	19.84	-1.35	0.02	19.88
11	20.19	-0.71	0.10	20.21	12	20.68	2.90	0.00	20.88
13	20.06	-0.67	0.03	20.07	14	20.34	-0.04	-0.06	20.34

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Nodal Deflections Serviceability (005 : Dead Plus Wind Case 2)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	δ X →	δ Y ↑	ΦZ ↗	δ XY		δ X →	δ Y ↑	ΦZ ↗	δ XY
1	0.00	0.00	0.00	0.00	2	13.81	-0.12	-0.17	13.81
3	16.06	-0.16	-0.07	16.06	4	16.62	-3.10	-0.09	16.90
5	0.00	0.00	0.00	0.00	6	17.07	-4.80	-0.02	17.73
7	17.57	-4.57	-0.04	18.15	8	17.35	-4.69	-0.01	17.98
9	16.26	-0.13	-0.22	16.26	10	17.15	-4.34	-0.10	17.69
11	17.62	-3.86	0.15	18.03	12	18.53	2.04	0.05	18.64
13	17.14	-3.67	0.08	17.53	14	18.40	-0.15	-0.01	18.40

Nodal Deflections Serviceability (006 : Dead Plus Wind Case 3)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	δ X →	δ Y ↑	ΦZ ↗	δ XY		δ X →	δ Y ↑	ΦZ ↗	δ XY
1	0.00	0.00	0.00	0.00	2	-18.25	-0.03	0.21	18.25
3	-20.41	-0.02	0.05	20.41	4	-20.65	2.32	-0.02	20.78
5	0.00	0.00	0.00	0.00	6	-20.06	-1.83	-0.12	20.14
7	-19.68	-1.67	-0.03	19.76	8	-19.82	-3.35	0.00	20.10
9	-12.72	-0.06	0.31	12.72	10	-19.21	-3.11	-0.11	19.46
11	-19.53	-4.51	-0.11	20.04	12	-19.55	-7.09	0.11	20.80
13	-19.92	-4.29	0.01	20.38	14	-18.44	-0.11	0.24	18.44

Member Forces (001 : Dead plus Live)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	3	63.985C	4.811	0.000	3.241	3.999
	7	58.475C	-7.006	-3.633	@ 1.357	@ 1.490
2	7	44.722C	7.006	-3.633	3.241	3.999
	10	39.211C	-4.811	0.000	@ 1.953	@ 1.821
3	10	39.104C	5.042	0.000	3.560	4.644
	13	44.614C	-6.775	-2.870	@ 1.423	@ 1.556
4	13	58.350C	5.838	-2.870	1.904	1.903
	14	63.860C	-5.979	-3.102	@ 1.622	@ 1.622
5	1	29.367C	-2.742	4.515	-4.535	3.041
	2	28.339C	-2.742	-4.535	@ 3.300	@ 2.970
6	2	22.093C	3.779	-4.535		
	3	21.719C	3.779	0.000		
7	5	29.401C	2.742	-4.315	4.735	3.733
	9	28.372C	2.742	4.735	@ 3.300	@ 2.970
8	9	24.400C	-1.361	4.735		
	14	24.026C	-1.361	3.102		
9	8	24.130T	0.000	0.000	0.000	0.000
	10	24.170T	0.000	0.000	@ 0.000	@ 0.000

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Member Forces (001 : Dead plus Live)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
10	3	60.491T	-1.722	0.000		0.497
	4	60.524T	-1.973	-2.771		@ 0.870
11	4	53.267T	3.128	-2.771		0.324
	6	53.310T	2.798	3.065		@ 1.477
12	6	52.002T	-1.452	3.065		1.203
	8	52.059T	-1.884	-1.245		@ 0.956
13	6	4.448C	-0.025	0.000	-0.006	0.000
	7	4.342C	0.025	0.000	@ 0.509	@ 0.000
14	7	16.788C	0.343	0.000	0.355	0.448
	8	16.890C	-0.163	0.274	@ 2.019	@ 1.622
15	2	9.029C	0.084	0.000	0.042	0.080
	4	8.872C	-0.084	0.000	@ 0.939	@ 1.020
16	8	52.021T	1.543	-1.082		0.889
	11	51.963T	1.111	2.345		@ 1.653
17	11	52.837T	-1.755	2.345		0.403
	12	52.793T	-2.084	-1.435		@ 0.630
18	12	57.354T	1.082	-1.435		0.251
	14	57.320T	0.831	0.000		@ 0.630
19	11	2.996C	0.025	0.000	0.006	0.000
	13	2.890C	-0.025	0.000	@ 0.509	@ 0.000
20	8	16.907C	0.217	0.112	0.253	0.325
	13	16.806C	-0.290	0.000	@ 1.285	@ 1.469
21	9	5.710C	-0.084	0.000	-0.042	0.080
	12	5.553C	0.084	0.000	@ 0.939	@ 1.020

Members ordered by parts of physical members. Member numbers in Italic are part of the preceeding regular member number.

Member Forces (002 : Live (Serviceability))

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	3	37.989C	3.021	0.000	2.025	2.481
	7	34.511C	-4.437	-2.345	@ 1.324	@ 1.490
2	7	26.357C	4.437	-2.345	2.025	2.481
	10	22.879C	-3.021	0.000	@ 1.953	@ 1.821
3	10	22.812C	3.166	0.000	2.224	2.885
	13	26.290C	-4.292	-1.865	@ 1.390	@ 1.523
4	13	34.433C	3.704	-1.865	1.179	1.162
	14	37.911C	-3.754	-1.948	@ 1.622	@ 1.655

Shields Wilson
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Member Forces (002 : Live (Serviceability))

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
5	1	16.448C	-1.571	2.601	-2.582	1.717
	2	16.448C	-1.571	-2.582	@ 3.300	@ 2.970
6	2	12.949C	2.151	-2.582		
	3	12.949C	2.151	0.000		
7	5	16.468C	1.571	-2.476	2.707	2.151
	9	16.468C	1.571	2.707	@ 3.300	@ 2.970
8	9	14.397C	-0.632	2.707		
	14	14.397C	-0.632	1.948		
9	8	13.704T	0.000	0.000	0.000	0.000
	10	13.704T	0.000	0.000	@ 0.000	@ 0.000
10	3	35.767T	-1.138	0.000		0.315
	4	35.767T	-1.138	-1.707		@ 0.870
11	4	31.616T	1.838	-1.707		0.188
	6	31.616T	1.838	1.913		@ 1.497
12	6	30.720T	-1.014	1.913		0.712
	8	30.720T	-1.014	-0.706		@ 0.930
13	6	2.990C	0.000	0.000	0.000	0.000
	7	2.990C	0.000	0.000	@ 0.000	@ 0.000
14	7	10.056C	0.089	0.000		0.210
	8	10.056C	0.089	0.274		@ 1.775
15	2	5.108C	0.000	0.000		0.000
	4	5.108C	0.000	0.000		@ 0.000
16	8	30.696T	0.799	-0.604		0.515
	11	30.696T	0.799	1.461		@ 1.679
17	11	31.319T	-1.182	1.461		0.235
	12	31.319T	-1.182	-0.868		@ 0.611
18	12	33.775T	0.579	-0.868		0.160
	14	33.775T	0.579	0.000		@ 0.630
19	11	2.078C	0.000	0.000	0.000	0.000
	13	2.078C	0.000	0.000	@ 0.000	@ 0.000
20	8	10.067C	-0.056	0.172		0.132
	13	10.067C	-0.056	0.000		@ 1.285
21	9	3.024C	0.000	0.000	0.000	0.000
	12	3.024C	0.000	0.000	@ 0.000	@ 0.000

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Member Forces (003 : Dead (Serviceability))

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	3	25.996C	1.790	0.000	1.217	1.519
	7	23.963C	-2.569	-1.288	@ 1.357	@ 1.490
2	7	18.365C	2.569	-1.288	1.217	1.519
	10	16.332C	-1.790	0.000	@ 1.953	@ 1.821
3	10	16.292C	1.876	0.000	1.336	1.759
	13	18.325C	-2.483	-1.004	@ 1.423	@ 1.556
4	13	23.917C	2.134	-1.004	0.725	0.741
	14	25.950C	-2.225	-1.154	@ 1.622	@ 1.622
5	1	12.920C	-1.172	1.914	-1.953	1.324
	2	11.891C	-1.172	-1.953	@ 3.300	@ 2.970
6	2	9.145C	1.628	-1.953		
	3	8.770C	1.628	0.000		
7	5	12.932C	1.172	-1.839	2.028	1.582
	9	11.903C	1.172	2.028	@ 3.300	@ 2.970
8	9	10.003C	-0.728	2.028		
	14	9.628C	-0.728	1.154		
9	8	10.426T	0.000	0.000	0.000	0.000
	10	10.465T	0.000	0.000	@ 0.000	@ 0.000
10	3	24.724T	-0.584	0.000		0.182
	4	24.758T	-0.835	-1.064		@ 0.870
11	4	21.651T	1.290	-1.064		0.136
	6	21.695T	0.960	1.152		@ 1.457
12	6	21.281T	-0.438	1.152		0.491
	8	21.339T	-0.870	-0.538		@ 0.956
13	6	1.459C	-0.025	0.000	-0.006	0.000
	7	1.353C	0.025	0.000	@ 0.509	@ 0.000
14	7	6.733C	0.253	0.000	0.194	0.242
	8	6.834C	-0.253	0.001	@ 1.499	@ 1.530
15	2	3.921C	0.084	0.000	0.042	0.080
	4	3.764C	-0.084	0.000	@ 0.939	@ 1.020
16	8	21.324T	0.743	-0.478		0.375
	11	21.267T	0.311	0.884		@ 1.628
17	11	21.519T	-0.572	0.884		0.168
	12	21.475T	-0.902	-0.567		@ 0.650
18	12	23.578T	0.503	-0.567		0.091
	14	23.545T	0.252	0.000		@ 0.615

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Member Forces (003 : Dead (Serviceability))

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
19	11	0.919C	0.025	0.000	0.006	0.000
	13	0.813C	-0.025	0.000	@ 0.509	@ 0.000
20	8	6.841C	0.273	-0.060	0.165	0.197
	13	6.739C	-0.234	0.000	@ 1.622	@ 1.591
21	9	2.686C	-0.084	0.000	-0.042	0.080
	12	2.529C	0.084	0.000	@ 0.939	@ 1.020

Members ordered by parts of physical members. Member numbers in Italic are part of the preceeding regular member number.

Member Forces (004 : Dead Plus Wind Case 1)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	3	12.745C	0.328	0.000	0.267	0.387
	7	10.713C	-0.337	-0.016	@ 1.622	@ 1.655
2	7	5.193C	0.337	-0.016	0.267	0.387
	10	3.160C	-0.328	0.000	@ 1.655	@ 1.655
3	10	3.493C	-0.388	0.000	-0.210	0.154
	13	5.526C	0.796	0.676	@ 1.092	@ 1.159
4	13	0.058T	-1.024	0.676	-0.789	0.825
	14	1.974C	0.160	-0.754	@ 2.814	@ 1.986
5	1	4.110C	6.501	-9.822	4.036	1.906
	2	3.081C	1.898	4.036	@ 3.300	@ 3.201
6	2	7.126C	-2.527	4.036		
	3	6.752C	-4.201	0.000		
7	5	4.998C	6.988	-10.848	5.376	2.846
	9	3.970C	2.845	5.376	@ 3.300	@ 3.168
8	9	1.732T	-3.098	5.376		
	14	2.106T	-4.605	0.754		
9	8	2.827T	0.000	0.000	0.000	0.000
	10	2.866T	0.000	0.000	@ 0.000	@ 0.000
10	3	7.008T	2.010	0.000		0.535
	4	7.041T	1.759	2.827		@ 0.870
11	4	11.991T	-1.895	2.827		0.602
	6	12.035T	-2.224	-1.229		@ 0.709
12	6	12.993T	0.746	-1.229		0.485
	8	13.051T	0.314	0.141		@ 0.982
13	6	3.121T	-0.025	0.000	-0.006	0.000
	7	3.227T	0.025	0.000	@ 0.509	@ 0.000

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Member Forces (004 : Dead Plus Wind Case 1)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
14	7	6.738C	0.113	0.000	0.038	0.110
	8	6.840C	-0.393	-0.429	@ 0.643	@ 2.203
15	2	5.994T	0.084	0.000	0.042	0.080
	4	6.152T	-0.084	0.000	@ 0.939	@ 1.020
16	8	0.515C	0.956	-0.436		0.714
	11	0.572C	0.523	1.474		@ 1.576
17	11	0.238T	-2.141	1.474		0.541
	12	0.195T	-2.471	-3.067		@ 1.319
18	12	6.807T	2.170	-3.067		0.552
	14	6.774T	1.919	0.000		@ 0.630
19	11	2.785C	0.025	0.000	0.006	0.000
	13	2.679C	-0.025	0.000	@ 0.509	@ 0.000
20	8	7.083T	0.205	0.148	0.275	0.353
	13	7.185T	-0.302	0.000	@ 1.193	@ 1.469
21	9	8.236C	-0.084	0.000	-0.042	0.080
	12	8.078C	0.084	0.000	@ 0.939	@ 1.020

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Member Forces (005 : Dead Plus Wind Case 2)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	3	28.465C	2.143	0.000	1.439	1.767
	7	26.432C	-3.139	-1.648	@ 1.324	@ 1.490
2	7	17.192C	3.139	-1.648	1.439	1.767
	10	15.159C	-2.143	0.000	@ 1.953	@ 1.821
3	10	15.267C	1.911	0.000	1.386	1.857
	13	17.300C	-2.448	-0.889	@ 1.423	@ 1.556
4	13	18.040C	1.748	-0.889	0.271	0.394
	14	20.072C	-2.611	-2.317	@ 1.324	@ 2.615
5	1	13.133C	8.590	-10.267	2.953	2.140
	2	12.104C	-0.619	2.885	@ 3.069	@ 3.003
6	2	12.093C	-0.730	2.885		
	3	11.719C	-4.078	0.000		
7	5	14.392C	4.120	-8.603	5.753	2.765
	9	13.363C	4.580	5.753	@ 3.300	@ 3.234
8	9	6.172C	-2.947	5.753		
	14	5.798C	-2.780	2.317		

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Member Forces (005 : Dead Plus Wind Case 2)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
9	8	9.146T	0.000	0.000	0.000	0.000
	10	9.185T	0.000	0.000	@ 0.000	@ 0.000
10	3	20.929T	0.511	0.000		0.120
	4	20.962T	0.260	0.578		@ 0.855
11	4	21.101T	0.057	0.578	0.588	0.334
	6	21.145T	-0.273	0.365	@ 0.315	@ 0.945
12	6	21.223T	-0.106	0.365		0.105
	8	21.280T	-0.538	-0.467		@ 0.749
13	6	0.182T	-0.025	0.000	-0.006	0.000
	7	0.288T	0.025	0.000	@ 0.509	@ 0.000
14	7	11.314C	0.170	0.000	0.087	0.060
	8	11.415C	-0.336	-0.253	@ 0.979	@ 1.132
15	2	0.073T	0.084	0.000	0.042	0.080
	4	0.231T	-0.084	0.000	@ 0.939	@ 1.020
16	8	10.894T	1.468	-0.889		0.976
	11	10.836T	1.036	2.344		@ 1.628
17	11	12.058T	-2.940	2.344		0.549
	12	12.015T	-3.269	-3.770		@ 1.379
18	12	20.394T	2.639	-3.770		0.681
	14	20.361T	2.388	0.000		@ 0.630
19	11	4.159C	0.025	0.000	0.006	0.000
	13	4.053C	-0.025	0.000	@ 0.509	@ 0.000
20	8	0.762C	0.198	0.169	0.287	0.368
	13	0.661C	-0.308	0.000	@ 1.163	@ 1.438
21	9	10.411C	-0.084	0.000	-0.042	0.080
	12	10.253C	0.084	0.000	@ 0.939	@ 1.020

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Member Forces (006 : Dead Plus Wind Case 3)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	3	3.159C	-1.472	0.000	-0.908	0.965
	7	1.127C	2.480	1.668	@ 1.225	@ 1.390
2	7	10.726C	-2.480	1.668	-0.907	0.965
	10	8.694C	1.472	0.000	@ 2.052	@ 1.920
3	10	7.192C	1.749	0.000	1.161	1.403
	13	9.224C	-2.610	-1.426	@ 1.324	@ 1.490

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Member Forces (006 : Dead Plus Wind Case 3)

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
4	13	23.104C	2.904	-1.426	1.775	2.274
	14	25.137C	-1.455	0.972	@ 2.185	@ 1.854
5	1	3.810C	-8.630	12.149	-5.696	3.380
	2	2.782C	-2.185	-5.696	@ 3.300	@ 3.069
6	2	2.747T	3.574	-5.696		
	3	3.121T	5.918	0.000		
7	5	6.976C	1.605	3.094	3.753	3.141
	9	5.947C	-4.841	-2.246	@ 0.825	@ 1.518
8	9	12.484C	2.234	-2.246		
	14	12.109C	-0.110	-0.972		
9	8	6.424T	0.000	0.000	0.000	0.000
	10	6.463T	0.000	0.000	@ 0.000	@ 0.000
10	3	9.734T	-1.855	0.000		0.534
	4	9.767T	-2.106	-2.970		@ 0.870
11	4	3.360T	2.387	-2.970		0.528
	6	3.404T	2.058	1.407		@ 0.650
12	6	2.642T	-0.451	1.407		0.734
	8	2.699T	-0.883	-0.317		@ 1.059
13	6	2.622C	-0.025	0.000	-0.006	0.000
	7	2.516C	0.025	0.000	@ 0.509	@ 0.000
14	7	12.183T	0.322	0.000	0.313	0.400
	8	12.082T	-0.184	0.210	@ 1.897	@ 1.622
15	2	7.983C	0.084	0.000	0.042	0.080
	4	7.826C	-0.084	0.000	@ 0.939	@ 1.020
16	8	31.446T	-0.523	0.296		0.623
	11	31.389T	-0.956	-1.614		@ 1.602
17	11	30.042T	3.252	-1.614		1.014
	12	29.998T	2.923	4.466		@ 1.241
18	12	22.093T	-2.852	4.466		0.837
	14	22.060T	-3.103	0.000		@ 0.630
19	11	4.417T	0.025	0.000	0.006	0.000
	13	4.523T	-0.025	0.000	@ 0.509	@ 0.000
20	8	17.210C	0.385	-0.403	0.045	0.092
	13	17.108C	-0.122	0.000	@ 2.295	@ 0.795
21	9	9.631T	-0.084	0.000	-0.042	0.080
	12	9.789T	0.084	0.000	@ 0.939	@ 1.020

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Support Reactions Serviceability (001 : Dead plus Live)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)
1	2.742	29.367	-4.515	5	-2.742	29.401	4.315
Total	0.000	58.768	-0.200				

Support Reactions Serviceability (002 : Live (Serviceability))

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)
1	1.571	16.448	-2.601	5	-1.571	16.468	2.476
Total	0.000	32.916	-0.126				

Support Reactions Serviceability (003 : Dead (Serviceability))

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)
1	1.172	12.920	-1.914	5	-1.172	12.932	1.839
Total	0.000	25.852	-0.074				

Support Reactions Serviceability (004 : Dead Plus Wind Case 1)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)
1	-6.501	4.110	9.822	5	-6.988	4.998	10.848
Total	-13.489	9.109	20.670				

Support Reactions Serviceability (005 : Dead Plus Wind Case 2)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)
1	-8.590	13.133	10.267	5	-4.120	14.392	8.603
Total	-12.710	27.525	18.870				

Support Reactions Serviceability (006 : Dead Plus Wind Case 3)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)
1	8.630	3.810	-12.149	5	-1.605	6.976	-3.094
Total	7.025	10.787	-15.243				

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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	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = 63.985 kN, L = 3.31 m, Lx = 3.31 m, Ly = 1.375 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{z.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(331/6.495, 138/2.165)≤ 180	63.5	OK
$K_{12} = fn(\lambda, K_3.\sigma_c, E)$	63.51, 12.30, 7400	0.569	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.569 x 12.30	7.00 N/mm²	
$\sigma_{c.a} = F/Area$	63.985 / 168.8≤ 7.00	3.79 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 3.310		
$\sigma_{mx.a} = Mx/Zx$	3.633 / 632.81≤ 15.48	5.74 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	15.48 (1-1.5x0.569x3.79/18.11)	12.71 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	3.79/7.00+5.74/12.71	0.993	OK

Shear and Bearing Check

Critical Design Location	X = 3.310		
τ_a = 1.5 Fv / Area	1.5 x 7.006 / 168.75≤ 1.65	0.62 N/mm²	OK
$\sigma_{cax} = Fvx / (b.Bx)$	7.006 / (75 x 75)≤ 3.42	1.25 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 001 : Dead plus Live			
$\delta = \delta_m$	In-span 4.00≤ L/333	4.00 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 15 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm⁴,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = 44.722 kN, L = 3.31 m, Lx = 3.31 m, Ly = 1.375 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_7.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_7.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(331/6.495, 138/2.165)≤ 180	63.5	OK
$K_{12} = fn(\lambda, K_3.\sigma_c, E)$	63.51, 12.30, 7400	0.569	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.569 x 12.30	7.00 N/mm²	
$\sigma_{c.a}$ = F/Area	44.722 / 168.8≤ 7.00	2.65 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a} = Mx/Zx$	3.633 / 632.81≤ 15.48	5.74 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	15.48 (1-1.5x0.569x2.65/18.11)	13.55 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	2.65/7.00+5.74/13.55	0.802	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_a = 1.5\ Fv / Area$	1.5 x 7.006 / 168.75≤ 1.65	0.62 N/mm²	OK
$\sigma_{cax} = Fvx / (b.Bx)$	7.006 / (75 x 75)≤ 3.42	1.25 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 001 : Dead plus Live

$\delta = \delta_m$	In-span 4.00≤ L/333	4.00 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 5 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = 44.614 kN, L = 3.31 m, Lx = 3.31 m, Ly = 1.375 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_7.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(331/6.495, 138/2.165)≤ 180	63.5	OK
$K_{12} = fn(\lambda, K_3.\sigma_c, E)$	63.51, 12.30, 7400	0.569	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.569 x 12.30	7.00 N/mm²	
$\sigma_{c.a}$ = F/Area	44.614 / 168.8≤ 7.00	2.64 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 1.423		
$\sigma_{mx.a} = Mx/Zx$	3.556 / 632.81≤ 15.48	5.62 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	15.48 (1-1.5x0.569x2.64/18.11)	13.55 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	2.64/7.00+5.62/13.55	0.792	OK

Shear and Bearing Check

Critical Design Location	X = 3.310		
τ_x= 1.5 Fv / Area	1.5 x 6.775 / 168.75≤ 1.65	0.60 N/mm²	OK
σ_{cax} = Fvx / (b.Bx)	6.775 / (75 x 75)≤ 3.42	1.20 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 001 : Dead plus Live

$\delta = \delta_m$	In-span 4.64≤ L/333	4.64 mm	OK

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Axial Load With Moment Design to BS 5268 : Part 2
Member TBL11d 24 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = 63.86 kN, L = 3.31 m, Lx = 3.31 m, Ly = 1.375 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(331/6.495, 138/2.165)≤ 180	63.5	OK
$K_{12} = fn(\lambda, K_3.\sigma_c, E)$	63.51, 12.30, 7400	0.569	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.569 x 12.30	7.00 N/mm²	
$\sigma_{c.a} = F/Area$	63.86 / 168.8≤ 7.00	3.78 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 3.310		
$\sigma_{mx.a} = Mx/Zx$	3.102 / 632.81≤ 15.48	4.90 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	15.48 (1-1.5x0.569x3.78/18.11)	12.72 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	3.78/7.00+4.90/12.72	0.926	OK

Shear and Bearing Check

Critical Design Location	X = 3.310		
$\tau_a = 1.5\ Fv / Area$	1.5 x 5.979 / 168.75≤ 1.65	0.53 N/mm²	OK
$\sigma_{cax} = Fvx / (b.Bx)$	5.979 / (75 x 75)≤ 3.42	1.06 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 006 : Dead Plus Wind Case 3

$\delta = \delta_m$	In-span 2.27≤ L/333	2.27 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TCL1Id 1 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 145, h = 215, 215x145 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 311.8, Zx 1117.1, Zy 753.4, rx 6.21, ry 4.19
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead Plus Wind Case 3
Member Details	F = 3.81 kN, L = 4.5 m, Lx = 4.5 m, Ly = 4.5 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.04 x 1.00 x 10.00	15.56 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.08 x 1.00 x 10.00	16.25 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(450/6.207, 450/4.186)≤ 180	107.5	OK
$K_{12} = fn(\lambda, K_3.\sigma_c, E)$	107.51, 12.30, 7400	0.273	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.273 x 12.30	3.36 N/mm²	
$\sigma_{c.a}$ = F/Area	3.81 / 311.8≤ 3.36	0.12 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a}$ = Mx/Zx	12.149 / 1117.1≤ 15.56	10.88 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_c)$	15.56 (1-1.5x0.273x0.12/6.32)	15.44 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	0.12/3.36+10.88/15.44	0.741	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a= 1.5 Fv / Area	1.5 x 8.63 / 311.75≤ 1.65	0.42 N/mm²	OK
σ_{cbx} = Fvx / (b.Bx)	8.63 / (145 x 75)≤ 3.42	0.79 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 006 : Dead Plus Wind Case 3

$\delta = \delta_m$	In-span 3.38≤ L/333	3.38 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TCL1Id 2 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 145, h = 215, 215x145 in Strength Class TR26
Section Properties (cm^2,cm^3,cm)	Area 311.8, Zx 1117.1, Zy 753.4, rx 6.21, ry 4.19
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead Plus Wind Case 1
Member Details	F = 4.998 kN, L = 4.5 m, Lx = 4.5 m, Ly = 4.5 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.04 x 1.00 x 10.00	15.56 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.08 x 1.00 x 10.00	16.25 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(450/6.207, 450/4.186)≤ 180	107.5	OK
$K_{12} = fn(\lambda, K_1.\sigma_c, E)$	107.51, 12.30, 7400	0.273	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.273 x 12.30	3.36 N/mm²	
$\sigma_{c.a}$ = F/Area	4.998 / 311.8≤ 3.36	0.16 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a}$ = Mx/Zx	10.848 / 1117.1≤ 15.56	9.71 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1\text{-}1.5\ K_{12}.\sigma_{c.a}/\sigma_z)$	15.56 (1-1.5x0.273x0.16/6.32)	15.40 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	0.16/3.36+9.71/15.40	0.678	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_4 = 1.5 Fv / Area	1.5 x 6.988 / 311.75≤ 1.65	0.34 N/mm²	OK
σ_{cax} = Fvx / (b.Bx)	6.988 / (145 x 75)≤ 3.42	0.64 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 001 : Dead plus Live

$\delta = \delta_m$	In-span 3.73≤ L/333	3.73 mm	OK

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Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 7 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = -60.524 kN, L = 1.5 m, Lx = 1.5 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 TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{t.adm} = K_2.K_3.K_8.K_{14}.\sigma_t$	1.00 x 1.50 x 1.00 x 1.03 x 6.00	9.29 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.E_{mean}$	1.00 x 11000	11000.0 N/mm²

Tensile Resistance

$\sigma_{t.a} = F/Area$	60.524 / 168.75≤ 9.29	3.59 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 1.500		
$\sigma_{mx.a} = Mx/Zx$	2.771 / 632.81≤ 15.48	4.38 N/mm²	OK
$\sigma_t/\sigma_{t.adm}+\sigma_{mx}/\sigma_{mx.adm}$	3.59/9.29+4.38/15.48	0.669	OK

Shear and Bearing Check

Critical Design Location	X = 1.481		
$\tau_a = 1.5\ Fv / Area$	1.5 x 1.97 / 168.75≤ 1.65	0.18 N/mm²	OK
$\sigma_{cax} = Fvx / (b.Bx)$	1.97 / (75 x 75)≤ 3.42	0.35 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead Plus Wind Case 1

$\delta = \delta_m$	In-span 0.53≤ L/333	0.53 mm	OK

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Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 17 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = -53.31 kN, L = 1.969 m, Lx = 1.969 m, Ly = 1.969 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{t.adm} = K_2.K_3.K_8.K_{14}.\sigma_t$	1.00 x 1.50 x 1.00 x 1.03 x 6.00	9.29 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.E_{mean}$	1.00 x 11000	11000.0 N/mm²

Tensile Resistance

$\sigma_{t.a}$ = F/Area	53.31 / 168.75≤ 9.29	3.16 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 1.969		
$\sigma_{mx.a}$ = Mx/Zx	3.065 / 632.81≤ 15.48	4.84 N/mm²	OK
$\sigma_t/\sigma_{t.adm}+\sigma_{mx}/\sigma_{mx.adm}$	3.16/9.29+4.84/15.48	0.653	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a= 1.5 Fv / Area	1.5 x 3.128 / 168.75≤ 1.65	0.28 N/mm²	OK
σ_{cax} = Fvx / (b.Bx)	3.128 / (75 x 75)≤ 3.42	0.56 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead Plus Wind Case 1

$\delta = \delta_m$	In-span 0.60≤ L/333	0.60 mm	OK

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Cloud 98e51

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1ld 19 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = -52.059 kN, L = 2.583 m, Lx = 2.583 m, Ly = 2.583 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{t.adm} = K_2.K_3.K_8.K_{14}.\sigma_t$	1.00 x 1.50 x 1.00 x 1.03 x 6.00	9.29 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.E_{mean}$	1.00 x 11000	11000.0 N/mm²

Tensile Resistance

$\sigma_{t.a} = F/Area$	52.059 / 168.75≤ 9.29	3.08 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx.a} = Mx/Zx$	3.065 / 632.81≤ 15.48	4.84 N/mm²	OK
$\sigma_t/\sigma_{t.adm}+\sigma_{mx}/\sigma_{mx.adm}$	3.08/9.29+4.84/15.48	0.645	OK

Shear and Bearing Check

Critical Design Location	X = 2.422		
$\tau_a = 1.5\ Fv / Area$	1.5 x 1.857 / 168.75≤ 1.65	0.17 N/mm²	OK
$\sigma_{cax} = Fvx / (b.Bx)$	1.857 / (75 x 75)≤ 3.42	0.33 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 001 : Dead plus Live

$\delta = \delta_m$	In-span 1.20≤ L/333	1.20 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 8 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	h = 75, h = 150, 150x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 112.5, Zx 281.3, Zy 140.6, rx 4.33, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = 4.448 kN, L = 1.039 m, Lx = 1.039 m, Ly = 1.039 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.08 x 1.00 x 10.00	16.19 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(104/4.330, 104/2.165)≤ 180	48.0	OK
$K_{12} = fn(\lambda, K_3.\sigma_c, E)$	47.99, 12.30, 7400	0.710	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.710 x 12.30	8.73 N/mm²	
$\sigma_{c.a}$ = F/Area	4.448 / 112.5≤ 8.73	0.40 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.545		
$\sigma_{mx.a} = Mx/Zx$	0.007 / 281.25≤ 16.19	0.02 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	16.19 (1-1.5x0.710x0.40/31.71)	15.97 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	0.40/8.73+0.02/15.97	0.047	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 0.025 / 112.5≤ 1.65	0.00 N/mm²	OK
$\sigma_{bx} = Fvx / (b.Bx)$	0.025 / (75 x 75)≤ 3.42	0.00 N/mm²	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 11 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = 16.89 kN, L = 3.06 m, Lx = 3.06 m, Ly = 3.06 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{26}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(306/6.495, 306/2.165)≤ 180	141.3	OK
$K_{12} = fn(\lambda, K_1.\sigma_c, E)$	141.34, 12.30, 7400	0.170	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.170 x 12.30	2.09 N/mm²	
$\sigma_{c.a}$ = F/Area	16.89 / 168.8≤ 2.09	1.00 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 2.027		
$\sigma_{mx.a}$ = Mx/Zx	0.355 / 632.81≤ 15.48	0.56 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	15.48 (1-1.5x0.170x1.00/3.66)	14.40 N/mm²	
$\sigma_c/\sigma_{c.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.00/2.09+0.56/14.40	0.519	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a= 1.5 Fv / Area	1.5 x 0.343 / 168.75≤ 1.65	0.03 N/mm²	OK
σ_{cax} = Fvx / (b.Bx)	0.343 / (75 x 75)≤ 3.42	0.06 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 001 : Dead plus Live

$\delta = \delta_m$	In-span 0.45≤ L/333	0.45 mm	OK

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Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 13 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 150, 150x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 112.5, Zx 281.3, Zy 140.6, rx 4.33, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = 9.029 kN, L = 2.041 m, Lx = 2.041 m, Ly = 2.041 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.08 x 1.00 x 10.00	16.19 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ_e = Max(Lex/rx, Ley/ry)	Max(204/4.330, 204/2.165)≤ 180	94.3	OK
$K_{12} = fn(\lambda_e, K_3.\sigma_c, E)$	94.27, 12.30, 7400	0.338	
$\sigma_{c.adm} = K_{12}.\sigma_{c.adm}$	0.338 x 12.30	4.16 N/mm²	
$\sigma_{c.a}$ = F/Area	9.029 / 112.5≤ 4.16	0.80 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 1.097		
$\sigma_{mx.a} = Mx/Zx$	0.042 / 281.25≤ 16.19	0.15 N/mm²	OK
$\sigma_{mx.adm} = \sigma_{mx.adm}(1-1.5\ K_{12}.\sigma_{c.a}/\sigma_e)$	16.19 (1-1.5x0.338x0.80/8.22)	15.39 N/mm²	
$\sigma_c/\sigma_{c.adm} + \sigma_{mx}/\sigma_{mx.adm}$	0.80/4.16+0.15/15.39	0.203	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_x = 1.5 Fv / Area	1.5 x 0.084 / 112.5≤ 1.65	0.01 N/mm²	OK
$\sigma_{cen} = Fvx / (b.Bx)$	0.084 / (75 x 75)≤ 3.42	0.01 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 005 : Dead Plus Wind Case 2

$\delta = \delta_m$	In-span 0.08≤ L/333	0.08 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 20 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead plus Live
Member Details	F = -52.021 kN, L = 2.583 m, Lx = 2.583 m, Ly = 2.583 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{t.adm} = K_2.K_3.K_8.K_{14}.\sigma_t$	1.00 x 1.50 x 1.00 x 1.03 x 6.00	9.29 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.E_{mean}$	1.00 x 11000	11000.0 N/mm²

Tensile Resistance

$\sigma_{t.0} = F/Area$	52.021 / 168.75≤ 9.29	3.08 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 2.583		
$\sigma_{mx.a} = Mx/Zx$	2.345 / 632.81≤ 15.48	3.71 N/mm²	OK
$\sigma_t/\sigma_{t.adm}+\sigma_{mx}/\sigma_{mx.adm}$	3.08/9.29+3.71/15.48	0.571	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_v = 1.5\ Fv / Area$	1.5 x 1.543 / 168.75≤ 1.65	0.14 N/mm²	OK
$\sigma_{cex} = Fvx / (b.Bx)$	1.543 / (75 x 75)≤ 3.42	0.27 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 005 : Dead Plus Wind Case 2			
$\delta = \delta_m$	In-span 0.98≤ L/333	0.98 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 25 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead Plus Wind Case 3
Member Details	F = -30.042 kN, L = 1.969 m, Lx = 1.969 m, Ly = 1.969 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{t.adm} = K_2.K_3.K_8.K_{14}.\sigma_t$	1.00 x 1.50 x 1.00 x 1.03 x 6.00	9.29 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.E_{mean}$	1.00 x 11000	11000.0 N/mm²

Tensile Resistance

$\sigma_{t,g} = F/Area$	30.042 / 168.75≤ 9.29	1.78 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 1.969		
$\sigma_{mx,d} = Mx/Zx$	4.466 / 632.81≤ 15.48	7.06 N/mm²	OK
$\sigma_t/\sigma_{t.adm}+\sigma_{mx}/\sigma_{mx.adm}$	1.78/9.29+7.06/15.48	0.648	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_a = 1.5\ Fv / Area$	1.5 x 3.252 / 168.75≤ 1.65	0.29 N/mm²	OK
$\sigma_{cax} = Fvx / (b.Bx)$	3.252 / (75 x 75)≤ 3.42	0.58 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 006 : Dead Plus Wind Case 3

$\delta = \delta_m$	In-span 1.01≤ L/333	1.01 mm	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 26 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead Plus Wind Case 3
Member Details	F = 0.0 kN, L = 1.5 m, Lx = 1.5 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 TR26)

$\sigma_{mx,adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my,adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c,adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.E_{mean}$	1.00 x 11000	11000.0 N/mm²

Axial Load with Moments Check

Critical Design Location	X = 0.000		
		0.000	OK
$\sigma_{cax} = Fvx / (b.Bx)$	3.094 / (75 x 75) ≤ 3.42	0.55 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 006 : Dead Plus Wind Case 3

$\delta = \delta_m$	In-span 0.84 ≤ L/333	0.84 mm	OK

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Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 21 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 150, 150x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 112.5, Zx 281.3, Zy 140.6, rx 4.33, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead Plus Wind Case 3
Member Details	F = 0.0 kN, L = 1.039 m, Lx = 1.039 m, Ly = 1.039 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx.adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.08 x 1.00 x 10.00	16.19 N/mm²
$\sigma_{my.adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c.adm} = K_2.K_3.K_8.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.E_{mean}$	1.00 x 11000	11000.0 N/mm²

Axial Load with Moments Check

Critical Design Location	X = 0.545		
		0.000	OK
$\sigma_{cax} = Fvx / (b.Bx)$	0.025 / (75 x 75)≤ 3.42	0.00 N/mm²	OK

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MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 22 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 225, 225x75 in Strength Class TR26
Section Properties (cm²,cm³,cm)	Area 168.8, Zx 632.8, Zy 210.9, rx 6.5, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead Plus Wind Case 3
Member Details	F = 17.21 kN, L = 3.06 m, Lx = 3.06 m, Ly = 3.06 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx,adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.03 x 1.00 x 10.00	15.48 N/mm²
$\sigma_{my,adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c,adm} = K_2.K_3.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c,adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(306/6.495, 306/2.165)≤ 180	141.3	OK
$K_{12} = fn(\lambda, K_3.\sigma_c, E)$	141.34, 12.30, 7400	0.170	
$\sigma_{c,adm} = K_{12}.\sigma_{c,adm}$	0.170 x 12.30	2.09 N/mm²	
$\sigma_{c,a} = F/Area$	17.21 / 168.8≤ 2.09	1.02 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 0.000		
$\sigma_{mx,a} = Mx/Zx$	0.403 / 632.81≤ 15.48	0.64 N/mm²	OK
$\sigma_{mx,adm} = \sigma_{mx,adm}(1-1.5\ K_{12}.\sigma_{c,a}/\sigma_e)$	15.48 (1-1.5x0.170x1.02/3.66)	14.38 N/mm²	
$\sigma_c/\sigma_{c,adm}+\sigma_{mx}/\sigma_{mx,adm}$	1.02/2.09+0.64/14.38	0.533	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 0.385 / 168.75≤ 1.65	0.03 N/mm²	OK
σ_{cas} = Fvx / (b.Bx)	0.385 / (75 x 75)≤ 3.42	0.07 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 005 : Dead Plus Wind Case 2

$\delta = \delta_m$	In-span 0.37≤ L/333	0.37 mm	OK

Shields Wilson
Bank House
Broad Street
Spalding, PE11 1TB
Tel: 01775 729252

Cloud 98e51

Job Ref	: 24-198
Sheet	: 36
Made by	: MAS
Date	: 17 May 2024 / Ver. 2023.09.15
Checked	:
Approved	:

MasterKey : Timber Design
Axial Load With Moment Design to BS 5268 : Part 2
Member TBL1Id 23 @ Level 1

Summary Design Data

Design Cases Covered	1-6
Deflection Cases Covered	1-6
Section Size	b = 75, h = 150, 150x75 in Strength Class TR26
Section Properties (cm^2,cm^3,cm)	Area 112.5, Zx 281.3, Zy 140.6, rx 4.33, ry 2.17
Specification	1 : Internal use in continuously heated building Short term loading
Integrated Design Critical Case	: Dead Plus Wind Case 2
Member Details	F = 10.411 kN, L = 2.041 m, Lx = 2.041 m, Ly = 2.041 m, Lex = 1.0 Lx, Ley = 1.0 Ly Bearing length B 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class TR26)

$\sigma_{mx\,adm} = K_2.K_3.K_{7x}.K_8.\sigma_m$	1.00 x 1.50 x 1.08 x 1.00 x 10.00	16.19 N/mm²
$\sigma_{my\,adm} = K_2.K_3.K_{7y}.K_8.\sigma_m$	1.00 x 1.50 x 1.16 x 1.00 x 10.00	17.47 N/mm²
$\sigma_{c\,adm} = K_2.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.00 x 8.20	12.30 N/mm²
$\sigma_{c\,adm} = K_2.K_3.K_4.K_8.\sigma_c$	1.00 x 1.50 x 1.14 x 1.00 x 2.00	3.42 N/mm²
$\tau_{adm} = K_2.K_3.K_8.\tau$	1.00 x 1.50 x 1.00 x 1.10	1.65 N/mm²
$E = K_2.K_{20}.E_{mean}$(Compression)	1.00 x 1.00 x 11000	7400.0 N/mm²
$E = K_2.E_{mean}$(Deflection)	1.00 x 11000	11000.0 N/mm²

Compression Resistance

λ = Max(Lex/rx, Ley/ry)	Max(204/4.330, 204/2.165)≤ 180	94.3	OK
$K_{12} = fn(\lambda\ ,\ K_3.\sigma_c,\ E)$	94.27, 12.30, 7400	0.338	
$\sigma_{c\,adm} = K_{12}.\sigma_{c\,adm}$	0.338 x 12.30	4.16 N/mm²	
$\sigma_{c,a}$ = F/Area	10.411 / 112.5≤ 4.16	0.93 N/mm²	OK

Axial Load with Moments Check

Critical Design Location	X = 1.097		
$\sigma_{mx,a}$ = Mx/Zx	0.042 / 281.25≤ 16.19	0.15 N/mm²	OK
$\sigma_{mx\,adm} = \sigma_{mx\,adm}(1\text{-}1.5\ K_{12}.\sigma_{c,a}/\sigma_e)$	16.19 (1-1.5x0.338x0.93/8.22)	15.26 N/mm²	
$\sigma_c/\sigma_{c\,adm} + \sigma_{mx}/\sigma_{mx\,adm}$	0.93/4.16+0.15/15.26	0.232	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
τ_a = 1.5 Fv / Area	1.5 x 0.084 / 112.5≤ 1.65	0.01 N/mm²	OK
σ_{cax} = Fvx / (b.Bx)	0.084 / (75 x 75)≤ 3.42	0.01 N/mm²	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead Plus Wind Case 1

$\delta = \delta_m$	In-span 0.08≤ L/333	0.08 mm	OK