



CIVIL & STRUCTURAL
CONSULTING ENGINEERS

75 Bath Road

Structural Calculations

For

Arlene Caddow

Date:

10/09/2024

Project Reference: M2-3039

Document Reference: SE-01-A1



Project 75 Bath Road		Sheet no./rev. 1
Job Ref. M2-3039	Calc. by SW	Date Sep-24
Doc. Ref SE-01-A1	Chk'd by MD	Date Sep-24

Document Issue History and Status

Revision	Prepared By		Checked By		Approved By	
	Name	Date	Name	Date	Name	Date
A1	Scott Williams	10.09.2024	Max Day	10.09.24	Max Day	10.09.24

General Notes:

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

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

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Introduction:

The following design calculations are for the proposed steel frame and roof structure to replace the existing conservatory at the above property.

Design Codes - British Standards:

BS 5268:2002 "The Structural Use of Timber"
BS 5950:2000 "The Structural Use of Steel in Building"
BS 6399:1997 "Loadings for Buildings"



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Loadings

Roof Loading (Flat Timber Roof)

Dead Load

Sedum roof ;	Roof _{D1}	=	1.00 kN/m ²
Firrings;	Roof _{D2}	=	0.05 kN/m ²
Insulation & Vapour Barrier;	Roof _{D3}	=	0.05 kN/m ²
Boarding;	Roof _{D4}	=	0.12 kN/m ²
Joists;	Roof _{D5}	=	0.12 kN/m ²
Services;	Roof _{D6}	=	0.05 kN/m ²
Plasterboard & Skim;	Roof _{D7}	=	0.15 kN/m ²
Total Dead Load (on plan);	Roof _{DL} = sum(Roof _{D1} ,Roof _{D2} ,Roof _{D3} ,Roof _{D4} ,Roof _{D5} ,Roof _{D6} ,Roof _{D7})		
		=	1.54 kN/m ²

Imposed Load

;Roof Imposed Load (on plan);	Roof _{IL1}	=	0.75 kN/m ²
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Beam Design: B1

Loadings

UDL from Flat Roof

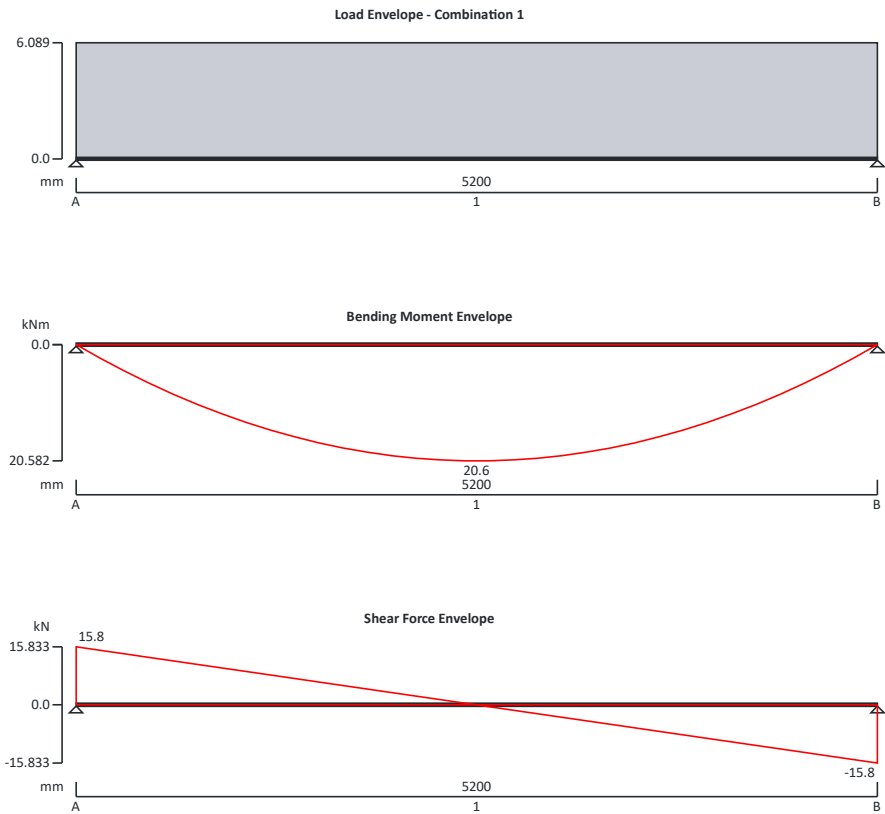
Width of roof being carried;	$x_1 = 1.72\text{ m}$		
Dead Load;	$DL_1 = 1.54\text{ kN/m}^2 \times x_1$	=	2.649 kN/m
Imposed Load;	$IL_1 = 0.75\text{ kN/m}^2 \times x_1$	=	1.290 kN/m

STEEL BEAM ANALYSIS & DESIGN (BS5950)

STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.08



Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

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Applied loading

Beam loads

Dead self weight of beam $\times 1$

Dead full UDL 2.649 kN/m

Imposed full UDL 1.29 kN/m

Load combinations

Load combination 1

Support A

Dead $\times 1.40$

Imposed $\times 1.60$

Dead $\times 1.40$

Imposed $\times 1.60$

Support B

Dead $\times 1.40$

Imposed $\times 1.60$

Analysis results

Maximum moment; $M_{\max} = 20.6 \text{ kNm}$; $M_{\min} = 0 \text{ kNm}$

Maximum shear; $V_{\max} = 15.8 \text{ kN}$; $V_{\min} = -15.8 \text{ kN}$

Deflection; $\delta_{\max} = 9.2 \text{ mm}$; $\delta_{\min} = 0 \text{ mm}$

Maximum reaction at support A; $R_{A_{\max}} = 15.8 \text{ kN}$; $R_{A_{\min}} = 15.8 \text{ kN}$

Unfactored dead load reaction at support A; $R_{A_{\text{Dead}}} = 7.5 \text{ kN}$

Unfactored imposed load reaction at support A; $R_{A_{\text{Imposed}}} = 3.4 \text{ kN}$

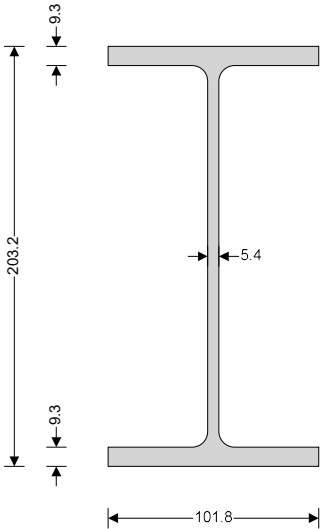
Maximum reaction at support B; $R_{B_{\max}} = 15.8 \text{ kN}$; $R_{B_{\min}} = 15.8 \text{ kN}$

Unfactored dead load reaction at support B; $R_{B_{\text{Dead}}} = 7.5 \text{ kN}$

Unfactored imposed load reaction at support B; $R_{B_{\text{Imposed}}} = 3.4 \text{ kN}$

Section details

Section type; **UB 203x102x23 (British Steel Section Range 2022 (BS4-1)); Steel grade; S275**



Classification of cross sections - Section 3.5

Tensile strain coefficient; $\epsilon = 1.00$; Section classification; **Plastic**

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Shear capacity - Section 4.2.3

Design shear force; $F_v = 15.8$ kN;

Design shear resistance; $P_v = 181.1$ kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment; $M = 20.6$ kNm;

Moment capacity low shear; $M_c = 64.4$ kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment; $M_b = 20.7$ kNm;

$M_b / m_{LT} = 22.4$ kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

Limiting deflection $\delta_{lim} = 14.444$ mm;

Maximum deflection; $\delta = 9.19$ mm

PASS - Maximum deflection does not exceed deflection limit

STEEL MEMBER DESIGN (BS5950)

STEEL MEMBER DESIGN (BS5950)

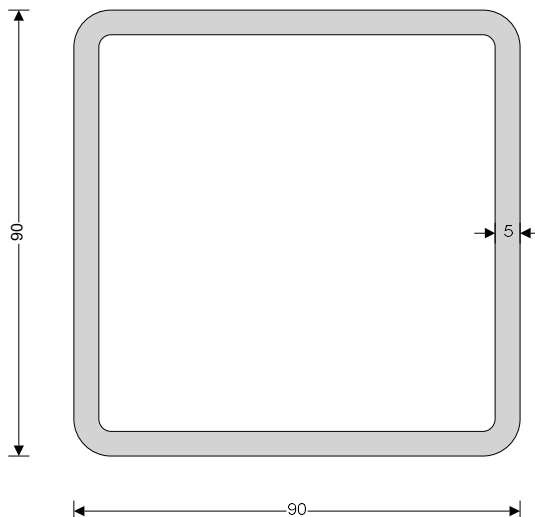
In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.08

Section details

Section type; **SHS 90x90x5.0 (Tata Steel Celsius (Gr355 Gr420 Gr460));**

Steel grade; **S275**





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Classification of cross sections - Section 3.5

Tensile strain coefficient; $\varepsilon = 1.00$; Section classification; **Semi-compact**

Moment capacity - Section 4.2.5

Design bending moment; $M_x = 2.4$ kNm; Moment capacity low shear; $M_{cx} = 14.6$ kNm

Buckling resistance moment - Section 4.3.6.4

Bending strength; $p_b = 275$ N/mm²; Buckling resistance moment; $M_b = 14.6$ kNm

PASS - Moment capacity exceeds design bending moment

Moment capacity - Section 4.2.5

Design bending moment; $M_y = 1.2$ kNm; Moment capacity low shear; $M_{cy} = 14.6$ kNm

PASS - Moment capacity exceeds design bending moment

Compression members - Section 4.7

Design compression force; $F_c = 23.7$ kN; Compression resistance; $P_{cx} = 383.8$ kN

PASS - Compression resistance exceeds design compression force

Design compression force; $F_c = 23.7$ kN; Compression resistance; $P_{cy} = 383.8$ kN

PASS - Compression resistance exceeds design compression force

Compression members with moments - Section 4.8.3

Comp.and bending check; $F_c / (A \times p_y) + M_x / M_{cx} + M_y / M_{cy} = 0.295$

PASS - Combined bending and compression check is satisfied

Member buckling resistance - cl.4.8.3.3.3

Buckling resistance checks; $F_c / P_{cx} + m_x \times M_x / M_{cx} \times (1 + 0.5 \times F_c / P_{cx}) + 0.5 \times m_{yx} \times M_y / M_{cy} = 0.270$

$F_c / P_{cy} + 0.5 \times m_{LT} \times M_{LT} / M_{cx} + m_y \times M_y / M_{cy} \times (1 + 0.5 \times F_c / P_{cy}) = 0.227$

Interactive buckling;

$m_x \times M_x \times (1 + 0.5 \times (F_c / P_{cx})) / (M_{cx} \times (1 - F_c / P_{cx})) + m_y \times M_y \times (1 + 0.5 \times (F_c / P_{cy})) / (M_{cy} \times (1 - F_c / P_{cy})) = 0.268$

PASS - Member buckling resistance checks are satisfied

Provide 203x102x23 UB S.275 - By inspection beam 2 is similar.

Provide 90x90x5.0 SHS S.275 posts.

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TIMBER JOIST DESIGN (BS5268)

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

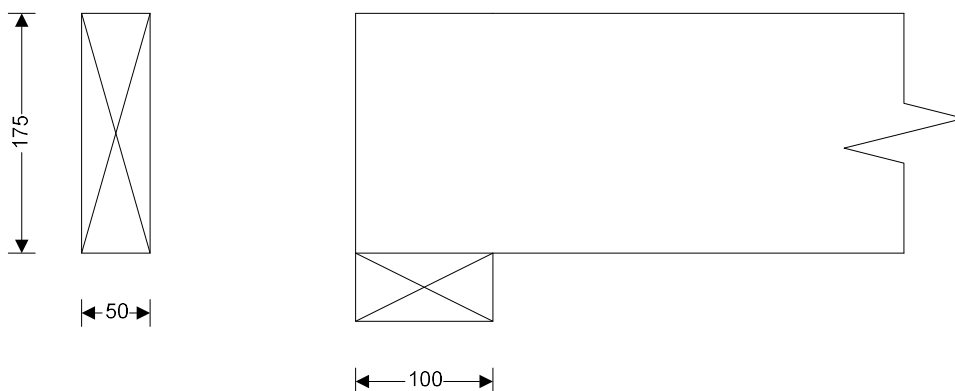
Joist details

Joist breadth; $b = 50$ mm; Joist depth; $h = 175$ mm
Joist spacing; $s = 400$ mm; Service class of timber; **1**
Timber strength class; **C24**



Span details

Number of spans; $N_{\text{span}} = 1$; Length of bearing; $L_b = 100$ mm
Clear length of span; $L_{s1} = 3450$ mm; ;



Section properties

Second moment of area; $I = 22330729$ mm⁴; Section modulus; $Z = 255208$ mm³

Loading details

Joist self weight; $F_{\text{swt}} = 0.03$ kN/m; Dead load; $F_{d_udl} = 1.54$ kN/m²
Imposed UDL(Medium term); $F_{i_udl} = 0.75$ kN/m²
Imposed point load (Short); $F_{i_pt} = 0.90$ kN

Consider medium term loads

Design bending moment; $M = 1.408$ kNm; Design shear force; $V = 1.632$ kN
Design support reaction; $R = 1.632$ kN; Design deflection; $\delta = 7.522$ mm



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Check bending stress

Permissible bending stress; $\sigma_{m_adm} = 10.942 \text{ N/mm}^2$; Applied bending stress; $\sigma_{m_max} = 5.515 \text{ N/mm}^2$
PASS - Applied bending stress within permissible limits

Check shear stress

Permissible shear stress; $\tau_{adm} = 0.976 \text{ N/mm}^2$; Applied shear stress; $\tau_{max} = 0.280 \text{ N/mm}^2$
PASS - Applied shear stress within permissible limits

Check bearing stress

Permissible bearing stress; $\sigma_{c_adm} = 3.300 \text{ N/mm}^2$; Applied bearing stress; $\sigma_{c_max} = 0.326 \text{ N/mm}^2$
PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection; $\delta_{adm} = 10.350 \text{ mm}$; Actual deflection; $\delta = 7.522 \text{ mm}$
PASS - Actual deflection within permissible limits

Consider short term loads

Design bending moment; $M = 1.737 \text{ kNm}$; Design shear force; $V = 2.014 \text{ kN}$
Design support reaction; $R = 2.014 \text{ kN}$; Design deflection; $\delta = 8.487 \text{ mm}$

Check bending stress

Permissible bending stress; $\sigma_{m_adm} = 13.131 \text{ N/mm}^2$; Applied bending stress; $\sigma_{m_max} = 6.808 \text{ N/mm}^2$
PASS - Applied bending stress within permissible limits

Check shear stress

Permissible shear stress; $\tau_{adm} = 1.172 \text{ N/mm}^2$; Applied shear stress; $\tau_{max} = 0.345 \text{ N/mm}^2$
PASS - Applied shear stress within permissible limits

Check bearing stress

Permissible bearing stress; $\sigma_{c_adm} = 3.960 \text{ N/mm}^2$; Applied bearing stress; $\sigma_{c_max} = 0.403 \text{ N/mm}^2$
PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection; $\delta_{adm} = 10.350 \text{ mm}$; Actual deflection; $\delta = 8.487 \text{ mm}$
PASS - Actual deflection within permissible limits

Provide 50x175 C24 at max 400 centres.