PlanningApplications.com Summer House, Upper Court Road Woldingham Surrey CR3 7BF support@planningapplications.com 07922 148 701	Project BEAM 2 - 203x203x43kgUC S275	Job no. 2023-7459
	Calcs for Mr Colin Williams, 59 Oakhill Road, Horsham RH13 5LE	Start page no./Revision 1

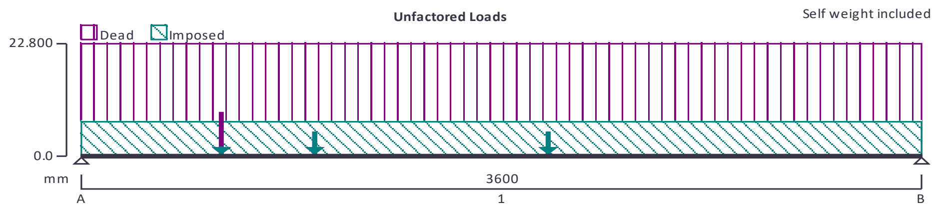
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
SB	12/10/2023	DB	12/10/2023	SB	12/10/2023

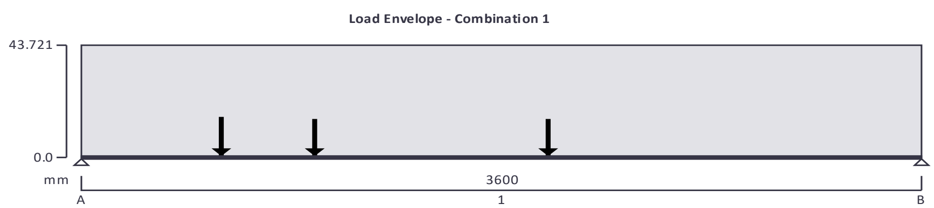
STEEL BEAM ANALYSIS & DESIGN (BS5950)

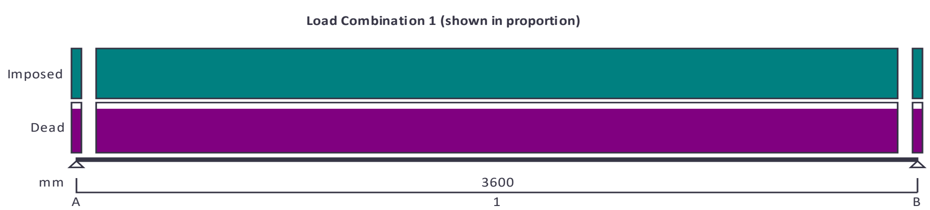
In accordance with BS5950-1:2000 incorporating Corrigendum No.1

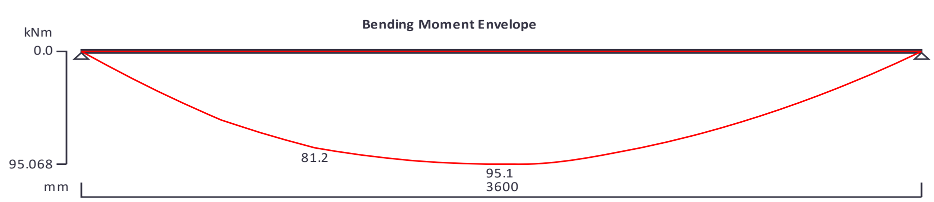
TEDDS calculation version 3.0.07

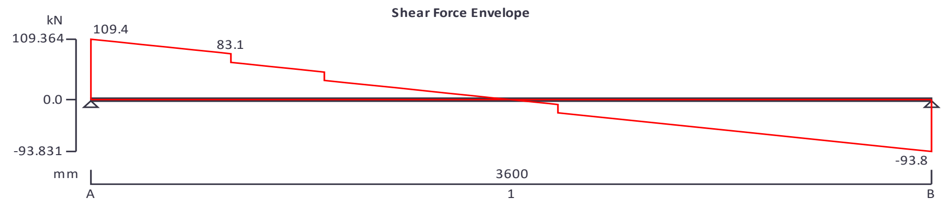
Minimum bearing
each end 150mm











Support conditions

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

Applied loading

Beam loads	Dead self weight of beam × 1
	Dead full UDL 22.8 kN/m
	Imposed full UDL 6.98 kN/m
	Dead point load 5 kN at 1000 mm
	Imposed point load 5 kN at 1000 mm
	Dead point load 9 kN at 600 mm
	Imposed point load 2 kN at 600 mm
	Dead point load 5 kN at 2000 mm
	Imposed point load 5 kN at 2000 mm

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
		Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **95.1** kNm	M_{min} = **0** kNm
Maximum moment span 1 segment 1	$M_{s1\_seg1\_max}$ = **57.7** kNm	$M_{s1\_seg1\_min}$ = **0** kNm
Maximum moment span 1 segment 2	$M_{s1\_seg2\_max}$ = **95.1** kNm	$M_{s1\_seg2\_min}$ = **0** kNm
Maximum shear	V_{max} = **109.4** kN	V_{min} = **-93.8** kN
Maximum shear span 1 segment 1	$V_{s1\_seg1\_max}$ = **109.4** kN	$V_{s1\_seg1\_min}$ = **0** kN
Maximum shear span 1 segment 2	$V_{s1\_seg2\_max}$ = **67.3** kN	$V_{s1\_seg2\_min}$ = **-93.8** kN
Deflection segment 3	δ_{max} = **2.6** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **109.4** kN	R_{A_min} = **109.4** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **55.2** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **20.1** kN	
Maximum reaction at support B	R_{B_max} = **93.8** kN	R_{B_min} = **93.8** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **47.5** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **17.1** kN	

Section details

Section type **UC 203x203x46 (BS4-1)**

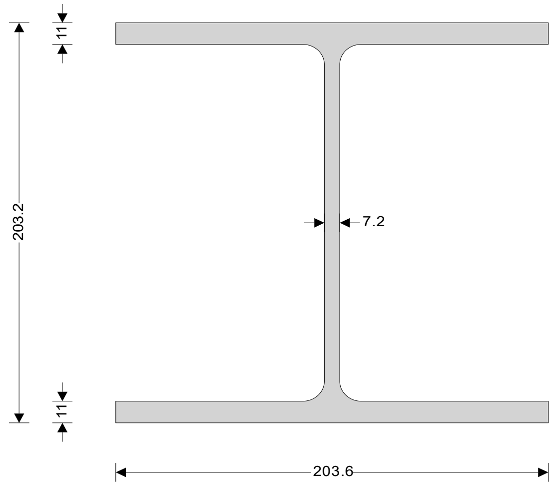
Steel grade **S275**

From table 9: Design strength p_y

Thickness of element max(T, t) = **11.0** mm

Design strength p_y = **275** N/mm^2

Modulus of elasticity E = **205000** N/mm^2



Lateral restraint

Span 1 has lateral restraint at supports plus 600 mm

Effective length factors

Effective length factor in major axis K_x = **1.00**

Effective length factor in minor axis K_y = **1.00**

Effective length factor for lateral-torsional buckling $K_{LT.A}$ = **1.00**

$K_{LT.B}$ = **1.00**

Classification of cross sections - Section 3.5

$\varepsilon = \sqrt{[275 \text{ N/mm}^2 / p_y]}$ = **1.00**

Internal compression parts - Table 11

Depth of section d = **160.8** mm

$d / t = 22.3 \times \varepsilon <= 80 \times \varepsilon$ Class 1 plastic

Outstand flanges - Table 11

Width of section b = B / 2 = **101.8** mm

$b / T = 9.3 \times \varepsilon <= 10 \times \varepsilon$ Class 2 compact

Section is class 2 compact

Shear capacity - Section 4.2.3

Design shear force $F_v = \max(\text{abs}(V_{max}), \text{abs}(V_{min}))$ = **109.4** kN

$d / t < 70 \times \varepsilon$

Web does not need to be checked for shear buckling

Shear area $A_v = t \times D$ = **1463** mm^2

Design shear resistance $P_v = 0.6 \times p_y \times A_v$ = **241.4** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity at span 1 segment 2 - Section 4.2.5

Design bending moment — $M = max(abs(M_{s1\_seg2\_max}), abs(M_{s1\_seg2\_min}))$ = **95.1** kNm

Moment capacity low shear - cl.4.2.5.2 — $M_c = min(p_y \times S_{xx}, 1.2 \times p_y \times Z_{xx})$ = **136.8** kNm

Effective length for lateral-torsional buckling - Section 4.3.5

Effective length for lateral torsional buckling — $L_E = 1.0 \times L_{s1\_seg2}$ = **3000** mm

Slenderness ratio — $\lambda = L_E / r_{yy}$ = **58.431**

Equivalent slenderness - Section 4.3.6.7

Buckling parameter — u = **0.847**

Torsional index — x = **17.713**

Slenderness factor — $v = 1 / [1 + 0.05 \times (\lambda / x)^2]^{0.25}$ = **0.897**

Ratio - cl.4.3.6.9 — β_W = **1.000**

Equivalent slenderness - cl.4.3.6.7 — $\lambda_{LT} = u \times v \times \lambda \times \sqrt{[\beta_W]}$ = **44.372**

Limiting slenderness - Annex B.2.2 — $\lambda_{L0} = 0.4 \times (\pi^2 \times E / p_y)^{0.5}$ = **34.310**

$\lambda_{LT} > \lambda_{L0}$ - Allowance should be made for lateral-torsional buckling

Bending strength - Section 4.3.6.5

Robertson constant — α_{LT} = **7.0**

Perry factor — $\eta_{LT} = max(\alpha_{LT} \times (\lambda_{LT} - \lambda_{L0}) / 1000, 0)$ = **0.070**

Euler stress — $p_E = \pi^2 \times E / \lambda_{LT}^2$ = **1027.6** N/mm²

$\phi_{LT} = (p_y + (\eta_{LT} + 1) \times p_E) / 2$ = **687.5** N/mm²

Bending strength - Annex B.2.1 — $p_b = p_E \times p_y / (\phi_{LT} + (\phi_{LT}^2 - p_E \times p_y)^{0.5})$ = **251.5** N/mm²

Equivalent uniform moment factor - Section 4.3.6.6

Moment at quarter point of segment — M_2 = **90.7** kNm

Moment at centre-line of segment — M_3 = **91.6** kNm

Moment at three quarter point of segment — M_4 = **58.1** kNm

Maximum moment in segment — M_{abs} = **95.1** kNm

Maximum moment governing buckling resistance — $M_{LT} = M_{abs}$ = **95.1** kNm

Equivalent uniform moment factor for lateral-torsional buckling

$m_{LT} = max(0.2 + (0.15 \times M_2 + 0.5 \times M_3 + 0.15 \times M_4) / M_{abs}, 0.44)$ = **0.916**

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment — $M_b = p_b \times S_{xx}$ = **125.1** kNm

M_b / m_{LT} = **136.6** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection — $\delta_{lim} = min(14\ mm, L_{s1} / 360)$ = **10** mm

Maximum deflection span 1 — $\delta = max(abs(\delta_{max}), abs(\delta_{min}))$ = **2.628** mm

PASS - Maximum deflection does not exceed deflection limit