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Calc sheet no.	Prepared by	Date	Project no.
1	MW	Nov '19	19-172

Title of scheme: THE OLD MALTHOUSE, BANBURY

INTRODUCTION

THE FOLLOWING CALCULATIONS ARE FOR PROPOSED ALTERATIONS TO THIS EXISTING BUILDING.

IT IS PROPOSED TO ADD A PLANT ACCESS MEZZANINE OVER PART OF THE FIRST FLOOR. IT IS DESIGNED TO PROVIDE ACCESS TO PLANT & SUPPORT TO DUCTWORK ONLY. IT WILL ALSO PROVIDE SUPPORT TO A SUSPENDED CEILING.

THE TRUSSES HAVE BEEN REPAIRED TO STRENGTHEN THE JOINTS USING STEEL PLATES & ARE NOW STRONGER THAN THEIR ORIGINAL CONDITION. A STEEL FRAME HAS ALSO BEEN PROVIDED TO RELIEVE THE LOAD ON THE TRUSS BUT THIS WILL (CONSERVATIVELY) BE IGNORED CHECKING ONLY USING THE TRUSS. DROP TIE ROD HAVE ALSO BEEN INSTALLED BUT MAKE LITTLE OR NO CONTRIBUTION TO THE STRUCTURAL ARRANGEMENT & ARE SLACK

A PAIR OF STEEL BEAMS IS ALSO TO BE PROVIDED TO ALLOW INCREASE IN THE OPENING IN A 225mm BRICK WALL.

DESIGNS WILL BE IN ACCORDANCE WITH

1) LOADING BS 6399
2) TIMBER BS 5268
3) STEELWORK BS 5950
4) MASONRY BS 5628

COMPUTER ANALYSIS/DESIGN WILL UTILISE TEDDS

LOADING

FLAT ROOF

MEMBRANE	0.1 kN/m²
FIRRINGS 'K' DECK	0.12
RAFTERS/TIES	0.15
INSULATION & SERVICES	0.05
CEILING	0.15
	0.57 kN/m²
IMPOSED	0.75

PITCHED ROOF

SLATES	0.45 kN/m²
FELT & BATTEN	0.05
RAFTERS	0.12
INSULATION & SERVICES	0.03
CEILING	0.15
	0.8 kN/m².
PITCH FACTOR (30°).	1.15
	0.92 kN/m².
IMPOSED	0.75

PLANT ACCESS FLOOR

PARTITION	0.25 kN/m²
BOARDS	0.15
JOISTS	0.15
CEILING	0.15
	0.7 kN/m².
IMPOSED	1.5

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3	MW	Nov '19	19-172

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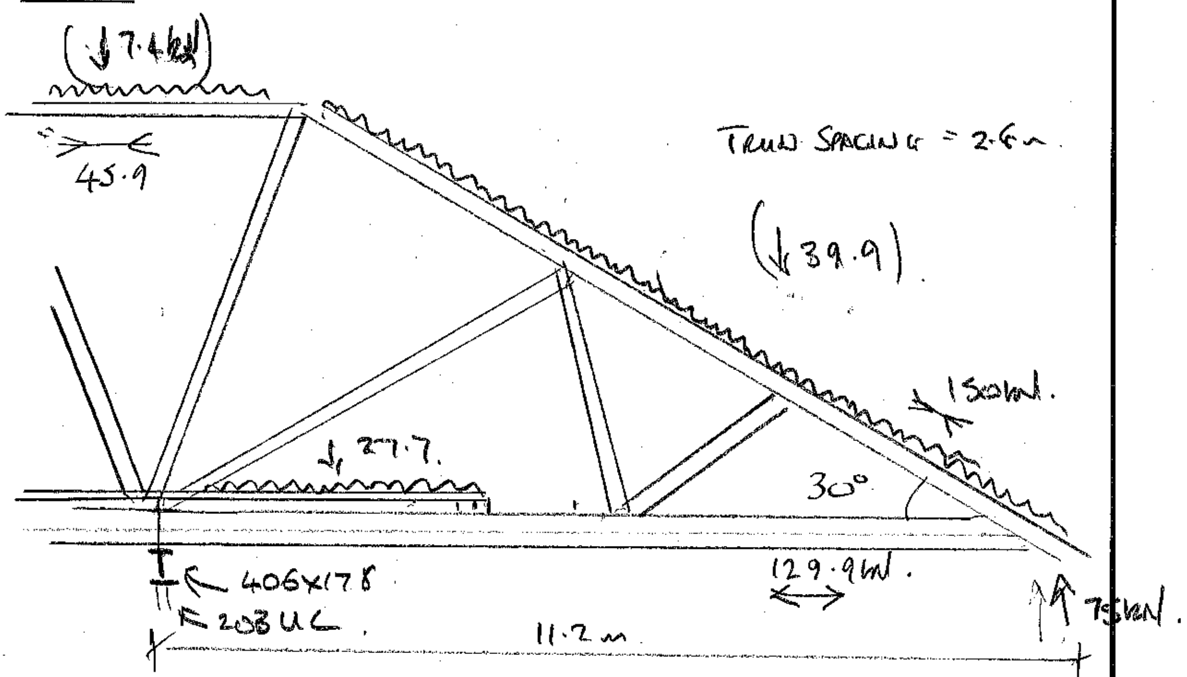
TRUSS



REACTION

	DEAD	IMP	
PITCH ROOF DEAD = 0.8kN/m² IMP = 0.75 LOADED AREA = 9.2.2.8 = 25.8m²	20.6	19.3	(39.9)
FLAT ROOF DEAD = 0.57kN/m² IMP = 0.75 LOADED AREA = 2.2.8 = 5.6m²	3.2	4.2	(7.4)
PLANT ROOM DEAD = 0.7kN/m² IMP = 1.5 LOADED AREA = 4.5.2.8 = 12.6m²	8.8	18.9kN	(27.7)
	32.6.	42.4kN ⇒ 75	
	*23.8	*23.5 ⇒ *47.8	

75kN.

COMP FORCE IN PRINCIPAL RAFTER = 75/cos60 = 150kN.

TIE FORCE = 150 cos 30 = 129.9 kN.

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Calc sheet no.	4
Prepared by	MW
Date	Nov '19
Project no.	19-172

Title of scheme: THE OLD MALTHOUSE, BANBURY

COMP IN TOP FLAT MEMBER

$C = (75 \cdot 11.2 - 39.9 \cdot 6.6 - 27.7 \cdot 2.25)/11.2$ (840, 263, 62.3)

$= 45.9$ kN.

TENSION AT BOTTOM CHORD ≯ 45.9 kN.
(NOTING THAT THIS POINT IS ALSO SUPPORTED.

CHECK COMPRESSION IN PRINC RAFTER:

MEMBER SIZE = 300 X 175

COMP = 150 kN

le (x) = 2000 mm.
(y) = 400

BENDING MOM = $(0.8+0.75) \cdot 2.8 \cdot 2.0^2/8$ = 8.7 kNm

SHEAR = $(0.8+0.75) \cdot 2.8/2$ = 2.2 kN.

MEMBER OK - SEE TEDDS OUTPUT (< 50% UTILISATION).

TOP FLAT MEMBER

COMP = 45.9 kN

SECTION SIZE = 150 x 175.

COMP = $45.9 \times 10^3 / 150 \cdot 175$ = 1.7 N/mm² OK BY INSPECTION.

BOTTOM CHORD - COMBINED TENSION & BENDING.

SPAN = 3.0 m MEMBER 325 x 175.

UDL = DEAD = $0.7 \cdot 2.8$ = 1.96 kN/m } 6.2 kN/m
IMP = $1.5 \cdot 2.8$ = 4.2

COMP ≯ 129.9 kN. BM = $6.2 \cdot 3.0^2/8$ = 7.0 kNm

SHEAR = $6.2 \cdot 1.5$ = 9.3 kN.

MEM OK (MAX UTILISATION = 82%)

TIMBER MEMBER DESIGN TO BS5268-2:2002

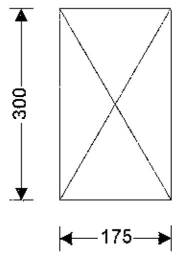
TEDDS calculation version 1.7.01

Analysis results

Design moment in major axis M_x = **8.700** kNm

Design shear F = **2.200** kN

Design axial compression P = **150.000** kN



Timber section details

Breadth of sections b = **175** mm

Depth of sections h = **300** mm

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

Overall breadth of member b_b = N × b = **175** mm

Timber strength class **C24**

Member details

Service class of timber **1**

Load duration **Long term**

Effective length - cl.2.11.3

Unbraced length in x-axis L_x = **2000** mm

Effective length factor in x-axis - Table 21 K_x = **1**

Effective length in x-axis $L_{ex} = L_x \times K_x$ = **2000** mm

Unbraced length in y-axis L_y = **400** mm

Effective length factor in y-axis - Table 21 K_y = **1**

Effective length in y-axis $L_{ey} = L_y \times K_y$ = **400** mm

Section properties

Cross sectional area of member $A = N \times b \times h$ = **52500** mm^2

Section modulus $Z_x = N \times b \times h^2 / 6$ = **2625000** mm^3

$Z_y = h \times (N \times b)^2 / 6$ = **1531250** mm^3

Second moment of area $I_x = N \times b \times h^3 / 12$ = **393750000** mm^4

$I_y = h \times (N \times b)^3 / 12$ = **133984375** mm^4

Radius of gyration $i_x = \sqrt{(I_x / A)}$ = **86.6** mm

$i_y = \sqrt{(I_y / A)}$ = **50.5** mm

Modification factors

Duration of loading - Table 17 K_3 = **1.00**

Total depth of member - cl.2.10.6 $K_7 = (300\ mm / h)^{0.11}$ = **1.00**

Load sharing - cl.2.9 K_8 = **1.00**

Members subject to axial compression - Table 22 K_{12} = **0.89**

Lateral support - cl.2.10.8

Ends held in position and members held in line, as by direct connection of sheathing, deck or joists, together with adequate bridging or blocking spaced at intervals not exceeding 6 x depth

Permissible depth-to-breadth ratio - Table 19 **6.00**

Actual depth-to-breadth ratio $h / (N \times b)$ = **1.71**

PASS - Lateral support is adequate

Slenderness ratio - cl.2.11.4

Permissible slenderness ratio λ_{max} = **180**

Slenderness ratio $\lambda = \max(L_{ex} / i_x, L_{ey} / i_y)$ = **23.094**

PASS - Slenderness ratio is less than permissible slenderness ratio

Bending parallel to grain

Permissible bending stress $\sigma_{m\_adm} = \sigma_m \times K_3 \times K_7 \times K_8$ = **7.500** N/mm^2

Applied bending stress $\sigma_{m\_a} = M_x / Z_x$ = **3.314** N/mm^2

$\sigma_{m\_a} / \sigma_{m\_adm}$ = **0.442**

PASS - Applied bending stress is less than permissible bending stress

Compression parallel to grain

Permissible compressive stress $\sigma_{c\_adm} = \sigma_c \times K_3 \times K_8 \times K_{12}$ = **7.020** N/mm^2

Applied compressive stress $\sigma_{c\_a} = P / A$ = **2.857** N/mm^2

$\sigma_{c\_a} / \sigma_{c\_adm}$ = **0.407**

PASS - Applied compressive stress is less than permissible compressive stress

Members subject to axial compression and bending - cl.2.11.6

Euler critical stress $\sigma_e = (\pi^2 \times E_{min}) / \lambda^2$ = **133.240** N/mm^2

Euler coefficient $K_{eu} = 1 - (1.5 \times \sigma_{c\_a} \times K_{12} / \sigma_e)$ = **0.971**

Combined axial compression and bending check $\sigma_{m\_a} / (\sigma_{m\_adm} \times K_{eu}) + \sigma_{c\_a} / \sigma_{c\_adm}$ = **0.862 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Shear parallel to grain

Permissible shear stress $\tau_{adm} = \tau \times K_3 \times K_8$ = **0.710** N/mm^2

Applied shear stress $\tau_a = 3 \times F / (2 \times A)$ = **0.063** N/mm^2

τ_a / τ_{adm} = **0.089**

PASS - Applied shear stress is less than permissible shear stress

TIMBER MEMBER DESIGN TO BS5268-2:2002

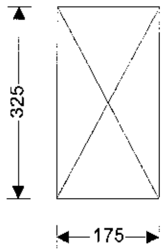
TEDDS calculation version 1.7.01

Analysis results

Design moment in major axis — M_x = **7.000** kNm

Design shear — F = **9.300** kN

Design axial tension — P = **129.900** kN



Timber section details

Breadth of sections — b = **175** mm

Depth of sections — h = **325** mm

Number of sections in member — N = **1**

Overall breadth of member — $b_b = N \times b$ = **175** mm

Timber strength class — **C24**

Member details

Service class of timber — **1**

Load duration — **Long term**

Section properties

Cross sectional area of member — $A = N \times b \times h$ = **56875** mm^2

Section modulus — $Z_x = N \times b \times h^2 / 6$ = **3080729** mm^3

$Z_y = h \times (N \times b)^2 / 6$ = **1658854** mm^3

Second moment of area — $I_x = N \times b \times h^3 / 12$ = **500618490** mm^4

$I_y = h \times (N \times b)^3 / 12$ = **145149740** mm^4

Radius of gyration — $i_x = \sqrt{(I_x / A)}$ = **93.8** mm

$i_y = \sqrt{(I_y / A)}$ = **50.5** mm

Modification factors

Duration of loading - Table 17 — K_3 = **1.00**

Total depth of member - cl.2.10.6 — $K_7 = 0.81 \times (h^2 + 92300\ mm^2) / (h^2 + 56800\ mm^2)$ = **0.99**

Load sharing - cl.2.9 — K_8 = **1.00**

Members subject to axial tension - cl.2.12.2 — $K_{14} = (300\ mm / max(b, h))^{0.11}$ = **0.99**

Lateral support - cl.2.10.8

Ends held in position and members held in line, as by direct connection of sheathing, deck or joists, together with adequate bridging or blocking spaced at intervals not exceeding 6 x depth

Permissible depth-to-breadth ratio - Table 19 — **6.00**

Actual depth-to-breadth ratio — $h / (N \times b)$ = **1.86**

PASS - Lateral support is adequate

Bending parallel to grain

Permissible bending stress — $\sigma_{m\_adm} = \sigma_m \times K_3 \times K_7 \times K_8$ = **7.403** N/mm^2

Applied bending stress — $\sigma_{m\_a} = M_x / Z_x$ = **2.272** N/mm^2

σ_{m_a} / σ_{m_adm} = **0.307**

PASS - Applied bending stress is less than permissible bending stress

Tension parallel to grain

Permissible tensile stress $\sigma_{t\_adm} = \sigma_t \times K_3 \times K_8 \times K_{14}$ = **4.461** N/mm^2

Applied tensile stress $\sigma_{t\_a} = P / A$ = **2.284** N/mm^2

σ_{t_a} / σ_{t_adm} = **0.512**

PASS - Applied tensile stress is less than permissible tensile stress

Members subject to axial tension and bending - cl.2.12.3

Combined axial tension and bending check $\sigma_{m\_a} / \sigma_{m\_adm} + \sigma_{t\_a} / \sigma_{t\_adm}$ = **0.819 < 1**

PASS - Combined tensile and bending stresses are within permissible limits

Shear parallel to grain

Permissible shear stress $\tau_{adm} = \tau \times K_3 \times K_8$ = **0.710** N/mm^2

Applied shear stress $\tau_a = 3 \times F / (2 \times A)$ = **0.245** N/mm^2

τ_a / τ_{adm} = **0.345**

PASS - Applied shear stress is less than permissible shear stress

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9	MW	Nov '19	19-172

Title of scheme: THE OLD MALTHOUSE, BANBURY

FLOOR JOISTS.

SPAN = 2.8m

SPACING = 400mm

D'CAD LOAD = 0.7kN/m²
IMP " = 1.5.

USE 150 x 47 C24 @ 400c/c - SEE TEDDS OUTPUT.

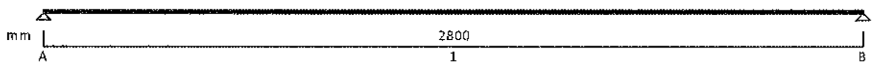
Tekla Tedds Wellan Ltd Wellan House, Aylesmore Shipston-on-Stour Warwickshire, CV36 5EJ	Project The Old Malthouse, Banbury			Job no. 19-172	
	Calcs for Plant Mezzanine Floor Joists			Start page no./Revision 10	
	Calcs by MW	Calcs date Nov 19			

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

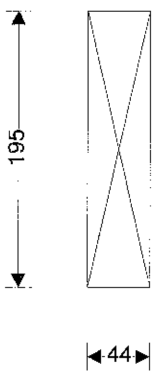
Joist details

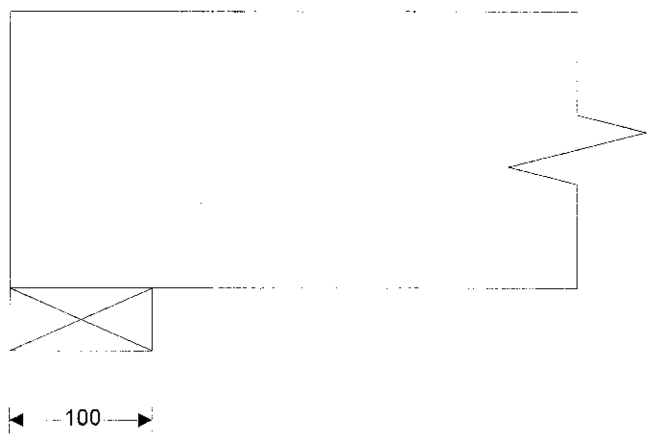
Joist breadth	b = **44** mm	Joist depth	h = **195** mm
Joist spacing	s = **600** mm	Service class of timber	**1**
Timber strength class	**C24**		



Span details

Number of spans	N_{span} = **1**	Length of bearing	L_b = **100** mm
Clear length of span	L_{s1} = **2800** mm		





Section properties

Second moment of area	I = **27187875** mm^4	Section modulus	Z = **278850** mm^3

Loading details

Joist self weight	F_{swt} = **0.03** kN/m	Dead load	F_{d_udl} = **0.70** kN/m^2
Imposed UDL(Long term)	F_{i_udl} = **1.50** kN/m^2		
Imposed point load (Medium)	F_{i_pt} = **2.00** kN		

Consider long term loads

Design bending moment	M = **1.322** kNm	Design shear force	V = **1.889** kN
Design support reaction	R = **1.889** kN	Design deflection	δ = **3.952** mm

Check bending stress

Permissible bending stress	σ_{m_adm} = **8.650** N/mm^2	Applied bending stress	σ_{m_max} = **4.743** N/mm^2

PASS - Applied bending stress within permissible limits

Check shear stress

Permissible shear stress	τ_{adm} = **0.781** N/mm^2	Applied shear stress	τ_{max} = **0.330** N/mm^2

PASS - Applied shear stress within permissible limits

Check bearing stress

Permissible bearing stress σ_{c_adm} = **2.640** N/mm^2 Applied bearing stress σ_{c_max} = **0.429** N/mm^2

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **8.400** mm Actual deflection δ = **3.952** mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Design bending moment M = **1.840** kNm Design shear force V = **2.629** kN

Design support reaction R = **2.629** kN Design deflection δ = **4.721** mm

Check bending stress

Permissible bending stress σ_{m_adm} = **10.813** N/mm^2 Applied bending stress σ_{m_max} = **6.600** N/mm^2

PASS - Applied bending stress within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **0.976** N/mm^2 Applied shear stress τ_{max} = **0.460** N/mm^2

PASS - Applied shear stress within permissible limits

Check bearing stress

Permissible bearing stress σ_{c_adm} = **3.300** N/mm^2 Applied bearing stress σ_{c_max} = **0.598** N/mm^2

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **8.400** mm Actual deflection δ = **4.721** mm

PASS - Actual deflection within permissible limits

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Calc sheet no.	Prepared by	Date	Project no.
12	MW	Nov '19	19-172

Title of scheme: THE OLD MALTHOUSE, BANBURY

BEAM TO WIDEN OPENING AT FIRST FLOOR NEAR STAIRS

SPAN = 4.5 m

		DEAD	IMP
ROOF DEAD = 0.8 kN/m², IMP = 0.75 kN/m², LOADED WIDTH = 3.8 m		3.04	2.9
BRICK DEAD = 4.5 kN/m, IMP = 2.6		9.6	
		12.64	2.9 kN/m

SPREAD TO 2 BEAMS ⇒ LOAD = 6.3 1.5 kN/m.

USE PAIR 178 x 102 UBs

TOTAL MOMENT = (2.25 . 6.3 . 1.4 + 2.25 . 1.5 . 1.6) . 2/2

= 35 kNm = 17.5 kNm/m

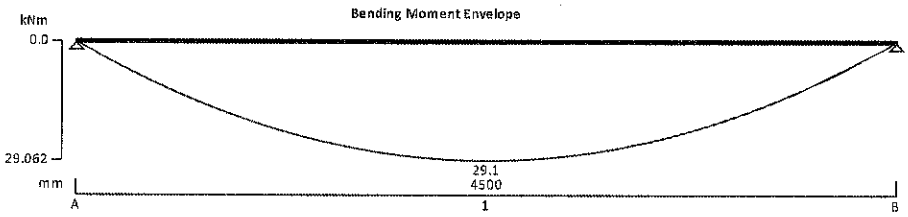
USE 440 x 100 PADSTONE - BY INSPECTION

Tekla Tedds Wellan Ltd Wellan House, Aylesmore Shipston-on-Stour Warwickshire, CV36 5EJ	Project The Old Malthouse, Banbury			Job no. 19-172	
	Calcs for Steel Beam to Form Fisrt Floor Opening Next to Stairs			Start page no./Revision 13	
	Calcs by MW	Calcs date Nov 19			

STEEL BEAM ANALYSIS & DESIGN (BS5950)

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

TEDDS calculation version 3.0.07



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 6.3 kN/m Imposed full UDL 1.5 kN/m

Load combinations

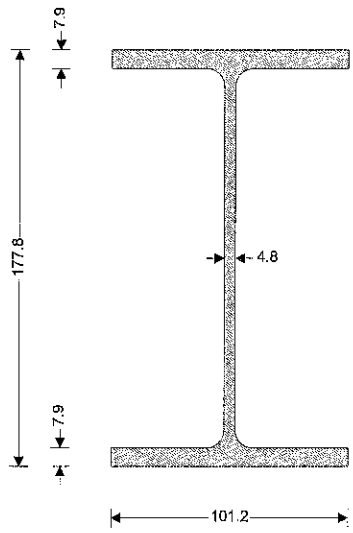
Load combination 1	Support A	Dead × 1.40 Imposed × 1.60
		Dead × 1.40 Imposed × 1.60
	Support B	Dead × 1.40 Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **29.1** kNm	M_{min} = **0** kNm
Maximum moment span 1 segment 1	$M_{s1\_seg1\_max}$ = **29.1** kNm	$M_{s1\_seg1\_min}$ = **0** kNm
Maximum moment span 1 segment 2	$M_{s1\_seg2\_max}$ = **29.1** kNm	$M_{s1\_seg2\_min}$ = **0** kNm
Maximum shear	V_{max} = **25.8** kN	V_{min} = **-25.8** kN
Maximum shear span 1 segment 1	$V_{s1\_seg1\_max}$ = **25.8** kN	$V_{s1\_seg1\_min}$ = **0** kN
Maximum shear span 1 segment 2	$V_{s1\_seg2\_max}$ = **0** kN	$V_{s1\_seg2\_min}$ = **-25.8** kN
Deflection segment 3	δ_{max} = **2.9** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **25.8** kN	R_{A_min} = **25.8** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **14.6** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **3.4** kN	
Maximum reaction at support B	R_{B_max} = **25.8** kN	R_{B_min} = **25.8** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **14.6** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **3.4** kN	

Section details

Section type **UKB 178x102x19 (Tata Steel Advance)** Steel grade **S275**



Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **1.00** Section classification **Plastic**

Shear capacity - Section 4.2.3

Design shear force F_v = **25.8** kN Design shear resistance P_v = **140.8** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity at span 1 segment 1 - Section 4.2.5

Design bending moment M = **29.1** kNm Moment capacity low shear M_c = **47.1** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **31.5** kNm M_b / m_{LT} = **40.3** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection δ_{lim} = **12.5** mm Maximum deflection δ = **2.881** mm

PASS - Maximum deflection does not exceed deflection limit