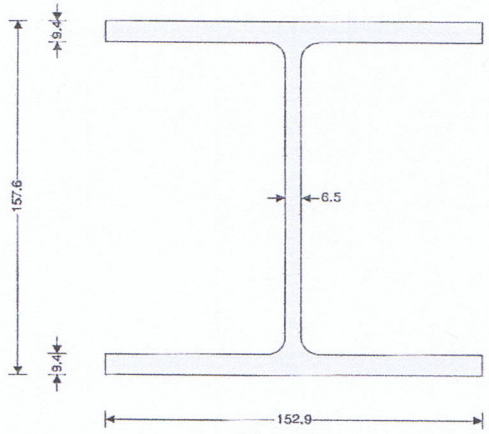
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		Imposed × 1.60
Analysis results		
Maximum moment	M_{max} = **35.8** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **20.3** kN	V_{min} = **-20.3** kN
Deflection	δ_{max} = **2.7** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **20.3** kN	R_{A_min} = **20.3** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **8.9** kN	
Unfactored imposed load reaction at support A	$R_{A_Imposed}$ = **4.9** kN	
Maximum reaction at support B	R_{B_max} = **20.3** kN	R_{B_min} = **20.3** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **8.9** kN	
Unfactored imposed load reaction at support B	$R_{B_Imposed}$ = **4.9** kN	
Section details		
Section type	**UKC 152x152x30 (Corus Advance)**	
Steel grade	**S275**	
From table 9: Design strength p_y		
Thickness of element	max(T, t) = **9.4** mm	
Design strength	p_y = **275** N/mm²	
Modulus of elasticity	E = **205000** N/mm²	



Lateral restraint		
	Span 1 has lateral restraint at supports only	
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		
	$\varepsilon = \sqrt{[275\ N/mm^2 / p_y]}$ = **1.00**	
Internal compression parts - Table 11		
Depth of section	d = **123.6** mm	
	d / t = 19.0 × ε <= 80 × ε	Class 1 plastic

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Outstand flanges - Table 11

Width of section — $b = B / 2 =$ **76.5** mm

$b / T = 8.1 \times \varepsilon <= 9 \times \varepsilon$ — Class 1 plastic

Section is class 1 plastic

Shear capacity - Section 4.2.3

Design shear force — $F_v = \max(\text{abs}(V_{max}), \text{abs}(V_{min})) =$ **20.3** kN

$d / t < 70 \times \varepsilon$

Web does not need to be checked for shear buckling

Shear area — $A_v = t \times D =$ **1024** mm^2

Design shear resistance — $P_v = 0.6 \times p_y \times A_v =$ **169** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment — $M = \max(\text{abs}(M_{s1_max}), \text{abs}(M_{s1_min})) =$ **35.8** kNm

Moment capacity low shear - cl.4.2.5.2 — $M_c = \min(p_y \times S_{xx}, 1.2 \times p_y \times Z_{xx}) =$ **68.1** kNm

Effective length for lateral-torsional buckling - Section 4.3.5

Effective length for lateral torsional buckling — $L_E = 1.0 \times L_{s1} =$ **3600** mm

Slenderness ratio — $\lambda = L_E / r_{yy} =$ **94.063**

Equivalent slenderness - Section 4.3.6.7

Buckling parameter — $u =$ **0.849**

Torsional index — $x =$ **15.999**

Slenderness factor — $v = 1 / [1 + 0.05 \times (\lambda / x)^2]^{0.25} =$ **0.778**

Ratio - cl.4.3.6.9 — $\beta w =$ **1.000**

Equivalent slenderness - cl.4.3.6.7 — $\lambda_{LT} = u \times v \times \lambda \times \sqrt{[\beta w]} =$ **62.102**

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 — $\alpha_{LT} =$ **7.0**

Perry factor — $\eta_{LT} = \max(\alpha_{LT} \times (\lambda_{LT} - \lambda_{L0}) / 1000, 0) =$ **0.195**

Euler stress — $p_E = \pi^2 \times E / \lambda_{LT}^2 =$ **524.6** N/mm^2

$\phi_{LT} = (p_y + (\eta_{LT} + 1) \times p_E) / 2 =$ **450.8** N/mm^2

Bending strength - Annex B.2.1 — $p_b = p_E \times p_y / (\phi_{LT} + (\phi_{LT}^2 - p_E \times p_y)^{0.5}) =$ **208** N/mm^2

Equivalent uniform moment factor - Section 4.3.6.6

Moment at quarter point of segment — $M_2 =$ **18.1** kNm

Moment at centre-line of segment — $M_3 =$ **35.8** kNm

Moment at three quarter point of segment — $M_4 =$ **18.1** kNm

Maximum moment in segment — $M_{abs} =$ **35.8** kNm

Maximum moment governing buckling resistance — $M_{LT} = M_{abs} =$ **35.8** kNm

Equivalent uniform moment factor for lateral-torsional buckling

$m_{LT} = \max(0.2 + (0.15 \times M_2 + 0.5 \times M_3 + 0.15 \times M_4) / M_{abs}, 0.44) =$ **0.851**

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment — $M_b = p_b \times S_{xx} =$ **51.5** kNm

$M_b / m_{LT} =$ **60.5** kNm

PASS - Buckling resistance moment exceeds design bending moment

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Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection $\delta_{lim} = L_{s1} / 360 =$ **10** mm

Maximum deflection span 1 $\delta = max(abs(\delta_{max}), abs(\delta_{min})) =$ **2.658** mm

PASS - Maximum deflection does not exceed deflection limit

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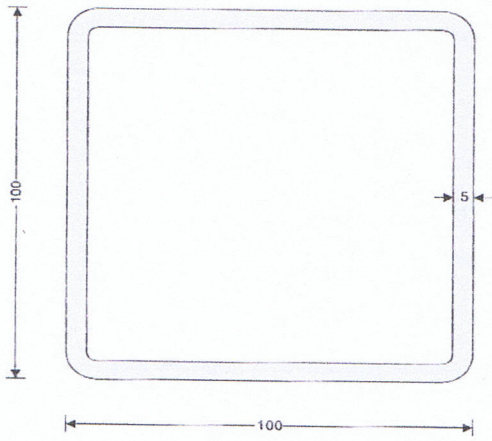
STEEL MEMBER DESIGN (BS5950)

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

TEDDS calculation version 3.0.05

Section details

Section type	**SHS 100x100x5.0 (Corus Celsius)**
Steel grade	**S275**
From table 9: Design strength p_y	
Thickness of element	t = **5.0** mm
Design strength	p_y = **275** N/mm²
Modulus of elasticity	E = **205000** N/mm²



Lateral restraint

Distance between major axis restraints	L_x = **3000** mm
Distance between minor axis restraints	L_y = **0** 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} = **1.00**

Classification of cross sections - Section 3.5

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

Web - major axis - Table 12

Depth of section

$d = D - 3 \times t =$ **85** mm

Stress ratios

$r1 = \min(F_c / (2 \times d \times t \times p_{yw}), 1) =$ **0.171**

$r2 = F_c / (A \times p_{yw}) =$ **0.078**

$d / t = 17.0 \times \varepsilon <= \max(64 \times \varepsilon / (1 + r1), 40 \times \varepsilon)$ Class 1 plastic

Flange - major axis - Table 12

Width of section

$b = B - 3 \times t =$ **85** mm

$b / t = 17.0 \times \varepsilon <= 40 \times \varepsilon$ Class 3 semi-compact

Section is class 3 semi-compact

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Shear capacity - Section 4.2.3

Design shear force — $F_{y,v}$ = **10** kN

$(D - 3 \times t) / t < 70 \times \varepsilon$

Web does not need to be checked for shear buckling

Shear area — $A_v = A \times D / (D + B)$ = **937** mm²

Design shear resistance — $P_{y,v} = 0.6 \times p_y \times A_v$ = **154.5** kN

PASS - Design shear resistance exceeds design shear force

Shear capacity - Section 4.2.3

Design shear force — $F_{x,v}$ = **0** kN

Moment capacity - Section 4.2.5

Design bending moment — M = **5** kNm

Effective plastic modulus - Section 3.5.6

Limiting value for class 2 compact flange — $\beta_{2f} = \min(32 \times \varepsilon, 62 \times \varepsilon - 0.5 \times d / t)$ = **32**

Limiting value for class 3 semi-compact flange — $\beta_{3f} = 40 \times \varepsilon$ = **40**

Limiting value for class 2 compact web — $\beta_{2w} = \max(80 \times \varepsilon / (1 + r1), 40 \times \varepsilon)$ = **68.311**

Limiting value for class 3 semi-compact web — $\beta_{3w} = \max(120 \times \varepsilon / (1 + 2 \times r2), 40 \times \varepsilon)$ = **103.869**

Effective plastic modulus - cl.3.5.6.3

$S_{eff} = \min(Z + (S - Z) \times \min([(\beta_{3w} / (d / t) - 1) / (\beta_{3w} / \beta_{2w} - 1)], [(\beta_{3f} / (b / t) - 1) / (\beta_{3f} / \beta_{2f} - 1)]), S)$ = **66358** mm³

Moment capacity low shear - cl.4.2.5.2 — $M_c = \min(p_y \times S_{eff}, 1.2 \times p_y \times Z)$ = **18.2** kNm

PASS - Moment capacity exceeds design bending moment

Compression members - Section 4.7

Design compression force — F_c = **40** kN

Effective length for major (x-x) axis buckling - Section 4.7.3

Effective length for buckling — $L_{Ex} = L_x \times K_x$ = **3000** mm

Slenderness ratio - cl.4.7.2 — $\lambda_x = L_{Ex} / r_{xx}$ = **77.673**

Compressive strength - Section 4.7.5

Limiting slenderness — $\lambda_0 = 0.2 \times (\pi^2 \times E / p_y)^{0.5}$ = **17.155**

Strut curve - Table 23 — a

Robertson constant — α_x = **2.0**

Perry factor — $\eta_x = \alpha_x \times (\lambda_x - \lambda_0) / 1000$ = **0.121**

Euler stress — $p_{Ex} = \pi^2 \times E / \lambda_x^2$ = **335.4** N/mm²

$\phi_x = (p_y + (\eta_x + 1) \times p_{Ex}) / 2$ = **325.5** N/mm²

Compressive strength - Annex C.1 — $p_{cx} = p_{Ex} \times p_y / (\phi_x + (\phi_x^2 - p_{Ex} \times p_y)^{0.5})$ = **208.4** N/mm²

Compression resistance - Section 4.7.4

Compression resistance - cl.4.7.4 — $P_{cx} = A \times p_{cx}$ = **390.3** kN

PASS - Compression resistance exceeds design compression force

Compression members with moments - Section 4.8.3

Comb.compression & bending check - cl.4.8.3.2 — $F_c / (A \times p_y) + M / M_c$ = **0.352**

PASS - Combined bending and compression check is satisfied

Member buckling resistance - Section 4.8.3.3

Max major axis moment governing M_b — $M_{LT} = M_x$ = **5.00** kNm

Equiv uniform mnt factor - major axis flex buckling — m_x = **1.000**

Buckling resistance check - cl.4.8.3.3.3 — $F_c / P_{cx} + m_x \times M / M_c \times (1 + 0.5 \times F_c / P_{cx})$ = **0.391**

PASS - Member buckling resistance checks are satisfied

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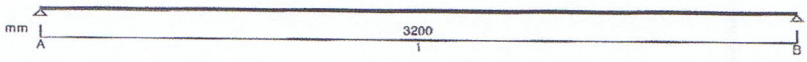
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TIMBER JOIST DESIGN (BS5268-2:2002)

TEDDS calculation version 1.1.02

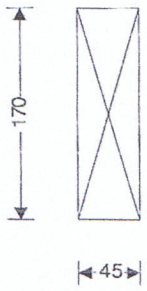
Joist details

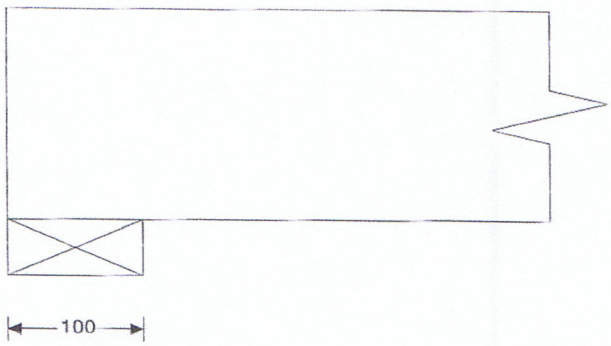
Joist breadth	b = **45** mm
Joist depth	h = **170** mm
Joist spacing	s = **400** mm
Timber strength class	**C24**
Service class of timber	**1**



Span details

Number of spans	N_{span} = **1**
Length of bearing	L_b = **100** mm
Effective length of span	L_{s1} = **3200** mm





Section properties

Second moment of area	$I = b \times h^3 / 12$ = **18423750** mm^4
Section modulus	$Z = b \times h^2 / 6$ = **216750** mm^3

Loading details

Joist self weight	$F_{swt} = b \times h \times \rho_{char} \times g_{acc}$ = **0.03** kN/m
Dead load	F_{d_udl} = **0.75** kN/m^2
Imposed UDL(Medium term)	F_{i_udl} = **1.50** kN/m^2
Imposed point load (Short term)	F_{i_pt} = **1.80** kN

Modification factors

Service class for bending parallel to grain	K_{2m} = **1.00**
Service class for compression	K_{2c} = **1.00**
Service class for shear parallel to grain	K_{2s} = **1.00**

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Service class for modulus of elasticity — K_{2e} = **1.00**
Section depth factor — K_7 = **1.06**
Load sharing factor — K_8 = **1.10**

Consider medium term loads

Load duration factor — K_3 = **1.25**
Maximum bending moment — M = **1.186** kNm
Maximum shear force — V = **1.482** kN
Maximum support reaction — R = **1.482** kN
Maximum deflection — δ = **6.631** mm

Check bending stress

Bending stress — σ_m = **7.500** N/mm²
Permissible bending stress — $\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8$ = **10.977** N/mm²
Applied bending stress — $\sigma_{m_max} = M / Z$ = **5.470** N/mm²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress — τ = **0.710** N/mm²
Permissible shear stress — $\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8$ = **0.976** N/mm²
Applied shear stress — $\tau_{max} = 3 \times V / (2 \times b \times h)$ = **0.291** N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane) — σ_{cp1} = **2.400** N/mm²
Permissible bearing stress — $\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8$ = **3.300** N/mm²
Applied bearing stress — $\sigma_{c_max} = R / (b \times L_b)$ = **0.329** N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection — $\delta_{adm} = \min(L_{s1} \times 0.003, 14\ mm)$ = **9.600** mm
Bending deflection (based on E_{mean}) — $\delta_{bending}$ = **6.356** mm
Shear deflection — δ_{shear} = **0.276** mm
Total deflection — $\delta = \delta_{bending} + \delta_{shear}$ = **6.631** mm

PASS - Actual deflection within permissible limits

Consider short term loads

Load duration factor — K_3 = **1.50**
Maximum bending moment — M = **1.858** kNm
Maximum shear force — V = **2.322** kN
Maximum support reaction — R = **2.322** kN
Maximum deflection — δ = **8.846** mm

Check bending stress

Bending stress — σ_m = **7.500** N/mm²
Permissible bending stress — $\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8$ = **13.173** N/mm²
Applied bending stress — $\sigma_{m_max} = M / Z$ = **8.570** N/mm²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress — τ = **0.710** N/mm²
Permissible shear stress — $\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8$ = **1.172** N/mm²

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Applied shear stress $\tau_{max} = 3 \times V / (2 \times b \times h) = \mathbf{0.455}$ N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane) $\sigma_{cp1} = \mathbf{2.400}$ N/mm²

Permissible bearing stress $\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = \mathbf{3.960}$ N/mm²

Applied bearing stress $\sigma_{c_max} = R / (b \times L_b) = \mathbf{0.516}$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection $\delta_{adm} = \min(L_{s1} \times 0.003, 14\text{ mm}) = \mathbf{9.600}$ mm

Bending deflection (based on E_{mean}) $\delta_{bending} = \mathbf{8.414}$ mm

Shear deflection $\delta_{shear} = \mathbf{0.432}$ mm

Total deflection $\delta = \delta_{bending} + \delta_{shear} = \mathbf{8.846}$ mm

PASS - Actual deflection within permissible limits