ARP ENGINEERS 27 Hollow Lane, Hayling Island PO11 9AA Tel: 07742 071 318 Email: alexewart@arpengineers.com	Project SOUTHWAY JUNIOR SCHOOL, BURGESS HILL RH15 9SU				Job no. 100263-ARP-R001	
	Calcs for TANK ROOM ROOF DESIGN				Start page no./Revision 1. 0	
	Calcs by AEw	Calcs date 11/04/2025	Checked by	Checked date	Approved by	Approved date

Fig. 1 – South East Aerial View on Southway Junior School – Showing 1st Floor Level Tank Room

INTRODUCTION

IT IS PROPOSED TO DEMOLISH THE EXISTING 1ST FLOOR LEVEL TANK ROOM AT SOUTHWAY JUNIOR SCHOOL AND TO CONSTRUCT A NEW FLAT ROOF IN PLACE OF THE EXISTING TANK ROOM FLOOR. THE DEMOLITION WORKS ARE TO INCLUDE REMOVAL OF THE TANK ROOM FLOOR, TIMBER CLAD WALLS AND ROOF. IT IS ALSO PROPOSED TO REDUCE THE EXISITNG CHMINEY HEIGHT DOWN TO THE SAME HEIGHT AS THE BRICKWORK BELOW THE TIMBER STUD WALLS.

THE NEW CONSTRUCTION IS TO COMPRISE ASSUMED NEW ROOFING FELT AND INSULATION ON WBP PLYWOOD BOARDING ON NEW TIMBER ROOF JOISTS SUPPORTED ON THE EXISTING BRICKWORK CAVITY WALLS.

THE EXISTING TANK ROOM FIRST FLOOR STRUCTURE COMPRISES STEEL BEAMS RUNNING THE LONG LENGTH OF THE BUILDING, WHICH SUPPORT TIMBER FLOOR JOISTS, BOARDING AND PLASTERBOARD CEILING BELOW. THE STEEL BEAMS ALSO SUPPORT TIMBER FRAMING WHICH SUPPORS LARGE WATER TANKS. THE ENDS OF THE STEEL BEAMS ARE SUPPORTED ON CONCRETE PADTONES BUILT INTO 215mm THICK BRICK WORK LOADBEARING WALLS.

THE EXISITNG TANK ROOM STUD WALLS COMPRISE 50 x 100mm VERTICAL STUDS AT 400mm CRS WITH PLASTERBOARD SHEETHIN INTERNALLLY AND BITUMEN COATED BAORDING AND HORIZONTAL TIMBER CLADDING BOARDING EXTERNALLY.

THE EXISTING TANK ROOM ROOF COMPRISES FELT ROOFING OVER BOARDING AND TIMBER FLAT ROOF JOISTS. IT MAY BE POSSIBLE TO RE-USE THE EXISTING TIMBER ROOF JOISTS TO FORM THE NEW LOWER LEVEL FLAT ROOF, SUBJECT TO APPRAISAL OF THE EXISTING MEMBERS ON SITE.

THE EXISITNG BUILDING FOUNDATIONS ARE ASSUMED TO COMPRISE TRADITIONAL MASS CONCRETE STRIP FOOTINGS. THE LOADING APPLIED TO THE EXISTING BUILDING LOADBEARING WALLS WILL EFFECTIVELY REDUCE WITH THE REMOVAL OF THE EXISTING TANKROOM WATER TANKS, FIRST FLOOR STRUCUTRE AND HIGH LEVEL TIMBER STUD WALLS.

ARP ENGINEERS CARRIED OUT A VISUAL STRUCURAL SURVEY ON 14TH MARCH 2025 (A DRY AND BRIGHT DAY) AND WHICH WAS BASED ON ACCESS INTERNALLY AT GROUND LEVEL, INTERNALLY AT 1ST FLOOR LEVEL AND EXTERNALLY AT FLAT ROOF LEVEL OVER THE BUILDINGS SURROUNDING THE 1ST FLOOR LEVEL TANK ROOM. BASED ON THE VISUAL INSPECTION NO CRACKING DAMAGE WAS NOTED TO THE EXISTING WALLS AND TIBMER STRUCTURAL ELEMENTS.

BASED ON THE PROPOSED ALTERATIONS LEADING TO A REDUCTION IN WALL LOADING ONTO THE EXISTING FOUNDATIONS AND ALSO THAT THE EXISTING WALLS WERE NOTED TO BE IN GOOD CONDITION WITH NO EVIDENCE OF STRUCTURAL CRACKING OR DEFORMATION, IT IS NOT CONSIDERED NECESSARY TO ASSESS OR INVESTIGATE THE EXISITNG FOUNDATIONS.

THE FOLLOWING CALCULATIONS SHOULD BE READ IN CONJUCTION WITH ARP ENGINEERS DRAWING No. 100263-ARP-001 – TANK ROOM ROOF LAYOUT AND DETAILS.

NEW FLAT ROOF LOADING

ROOF LOADING (FLAT TIMBER ROOF)

Dead load

Chippings $Roof_{D1}$ = **0.10** kN/m^2

Felt $Roof_{D2}$ = **0.15** kN/m^2

Insulation and vapour barrier $Roof_{D3}$ = **0.05** kN/m^2

Boarding $Roof_{D4}$ = **0.20** kN/m^2

Joists $Roof_{D5}$ = **0.15** kN/m^2

Ceiling $Roof_{D6}$ = **0.14** kN/m^2

Services $Roof_{D7}$ = **0.25** kN/m^2

Total dead load on plan

$Roof_{DL}$ = sum($Roof_{D1}$,$Roof_{D2}$,$Roof_{D3}$,$Roof_{D4}$,$Roof_{D5}$,$Roof_{D6}$,$Roof_{D7}$) = **1.04** kN/m^2

Imposed load

Roof imposed load $Roof_{IL}$ = **0.75** kN/m^2

Total roof loads

Unfactored foundation design loads w_{roof_u} = $Roof_{DL}$ + $Roof_{IL}$ = **1.79** kN/m^2

Factored design loads w_{roof_f} = 1.4 × $Roof_{DL}$ + 1.6 × $Roof_{IL}$ = **2.66** kN/m^2

EXISTING 100MM WIDE INNER LEAF CAVITY WALL LOAD

CAVITY WALL LOADING

Dead load

Masonry (outer leaf) CW_{D1} = **2.25** kN/m^2

Masonry (inner leaf) CW_{D2} = **2.25** kN/m^2

Lathe and plaster CW_{D3} = **0.00** kN/m^2

Total dead load CW_{DL} = sum(CW_{D1},CW_{D2},CW_{D3}) = **4.50** kN/m^2

Total cavity wall load

Unfactored foundation design loads w_{cw_u} = CW_{DL} = **4.50** kN/m^2

Factored design loads w_{cw_f} = 1.4 × CW_{DL} = **6.30** kN/m^2

EXISTING 215MM WIDE INNER LEAF CAVITY WALL LOAD

CAVITY WALL LOADING

Dead load

Masonry (outer leaf) CW_{D1} = **2.25** kN/m^2

Masonry (inner leaf) CW_{D2} = **4.50** kN/m^2

Lathe and plaster CW_{D3} = **0.00** kN/m^2

Total dead load CW_{DL} = sum(CW_{D1},CW_{D2},CW_{D3}) = **6.75** kN/m^2

Total cavity wall load

Unfactored foundation design loads w_{cw_u} = CW_{DL} = **6.75** kN/m^2

Factored design loads w_{cw_f} = 1.4 × CW_{DL} = **9.45** kN/m^2

DESIGN CHECK EXISTING 100MM WIDE X 140MM DEEP PRECAST CONCRETE WINDOW LINTELS ALONG EAST ELEVATIONS SUPPORTING 100MM WIDE INNER LEAF OF EXISTING CAVITY WALL

Span of flat roof onto inner leaf L_1 = 4506 mm

Height of inner leaf above window head h_{wall_1} = 2025 mm

WALL LOAD CHASE DOWN (BS6399:PART1:1996)

TEDDS calculation version 1.1.00

Roof Loading - flat timber roof

Dead load

Chippings $Roof_{D1}$ = **0.10** kN/m^2

Felt $Roof_{D2}$ = **0.15** kN/m^2

Insulation and vapour barrier $Roof_{D3}$ = **0.05** kN/m^2

Boarding $Roof_{D4}$ = **0.20** kN/m^2

Joists $Roof_{D5}$ = **0.15** kN/m^2

Ceiling $Roof_{D6}$ = **0.14** kN/m^2

Services $Roof_{D7}$ = **0.25** kN/m^2

Total dead load on plan

$Roof_{DL}$ = sum($Roof_{D1}$,$Roof_{D2}$,$Roof_{D3}$,$Roof_{D4}$,$Roof_{D5}$,$Roof_{D6}$,$Roof_{D7}$) = **1.04** kN/m^2

Imposed load

Roof imposed load $Roof_{IL}$ = **0.75** kN/m^2

Total roof loads

Unfactored foundation design loads w_{roof_u} = $Roof_{DL}$ + $Roof_{IL}$ = **1.79** kN/m^2

Factored design loads w_{roof_f} = 1.4 × $Roof_{DL}$ + 1.6 × $Roof_{IL}$ = **2.66** kN/m^2

Timber floor Loading - ground floor

Dead load

Boards $Floor_{grnd\_D1}$ = **0.00** kN/m^2

Joists $Floor_{grnd\_D2}$ = **0.00** kN/m^2

Total dead load $Floor_{grnd\_DL}$ = sum($Floor_{grnd\_D1}$,$Floor_{grnd\_D2}$) = **0.00** kN/m^2

Imposed load

Imposed load $Floor_{grnd\_I1}$ = **0.00** kN/m^2

Partitions $Floor_{grnd\_I2}$ = **0.00** kN/m^2

Total imposed load $Floor_{grnd\_IL}$ = sum($Floor_{grnd\_I1}$,$Floor_{grnd\_I2}$) = **0.00** kN/m^2

Total ground floor loads

Unfactored foundation design loads w_{grnd_u} = $Floor_{grnd\_DL}$ + $Floor_{grnd\_IL}$ = **0.00** kN/m^2

Factored design loads w_{grnd_f} = 1.4 × $Floor_{grnd\_DL}$ + 1.6 × $Floor_{grnd\_IL}$ = **0.00** kN/m^2

Cavity Wall Loading

Dead load

Masonry (outer leaf) CW_{D1} = **0.00** kN/m^2

Masonry (inner leaf) CW_{D2} = **2.25** kN/m^2

Plaster CW_{D3} = **0.00** kN/m^2

Total dead load CW_{DL} = sum(CW_{D1},CW_{D2},CW_{D3}) = **2.25** kN/m^2

Total cavity wall load

Unfactored foundation design loads $w_{cw\_u} = CW_{DL} = \mathbf{2.25}$ kN/m^2

Factored design loads $w_{cw\_f} = 1.4 \times CW_{DL} = \mathbf{3.15}$ kN/m^2

<u>Cavity wall design loads - 1 storey building</u>

Roof

Span of roof - one side of wall $Span_{cw\_roof\_1} = \mathbf{4.51}$ m

Other side $Span_{cw\_roof\_2} = \mathbf{0.50}$ m

Total span on both sides of wall $Span_{cw\_roof} = Span_{cw\_roof\_1} + Span_{cw\_roof\_2} = \mathbf{5.01}$ m

Factored load on cavity wall from roof $W_{cw\_roof\_f} = w_{roof\_f} \times Span_{cw\_roof} / 2 = \mathbf{6.6}$ kN/m

Unfactored load on cavity wall from roof $W_{cw\_roof\_u} = w_{roof\_u} \times Span_{cw\_roof} / 2 = \mathbf{4.5}$ kN/m

Ground floor

Height of the ground floor $H_{grnd} = \mathbf{2.00}$ m

Span of ground floor - one side of wall $Span_{cw\_grnd\_1} = \mathbf{0.00}$ m

Other side $Span_{cw\_grnd\_2} = \mathbf{0.00}$ m

Total span on both sides of wall $Span_{cw\_grnd} = Span_{cw\_grnd\_1} + Span_{cw\_grnd\_2} = \mathbf{0.00}$ m

Factored load on cavity wall

Self weight from roof to ground floor $W_{cwgrnd\_f} = w_{cw\_f} \times H_{grnd} = \mathbf{6.3}$ kN/m

Load from ground floor $W_{cw\_grnd\_f} = w_{grnd\_f} \times Span_{cw\_grnd} / 2 = \mathbf{0.0}$ kN/m

Unfactored load on cavity wall

Self weight from roof to ground floor $W_{cwgrnd\_u} = w_{cw\_u} \times H_{grnd} = \mathbf{4.5}$ kN/m

Load from ground floor $W_{cw\_grnd\_u} = w_{grnd\_u} \times Span_{cw\_grnd} / 2 = \mathbf{0.0}$ kN/m

Below ground floor

Height of the cavity wall below ground floor $H_{below} = \mathbf{0.03}$ m

Factored load on cavity wall

Self weight below ground floor $W_{cwbelow\_f} = w_{cw\_f} \times H_{below} = \mathbf{0.1}$ kN/m

Unfactored load on cavity wall

Self weight below ground floor $W_{cwbelow\_u} = w_{cw\_u} \times H_{below} = \mathbf{0.1}$ kN/m

Factored design loads for walls - conservatively use factored loads at base of wall

Factored design load for ground floor wall $W_{cw\_grnd} = W_{cwgrnd\_f} + W_{cw\_roof\_f} = \mathbf{12.95}$ kN/m

Total factored load on foundation of the cavity wall $W_{cw\_f} = W_{cwgrnd\_f} + W_{cwbelow\_f} + W_{cw\_roof\_f} + W_{cw\_grnd\_f} = \mathbf{13.03}$ kN/m

Total unfactored load on foundation of cavity wall $W_{cw\_u} = W_{cwgrnd\_u} + W_{cwbelow\_u} + W_{cw\_roof\_u} + W_{cw\_grnd\_u} = \mathbf{9.04}$ kN/m

Unfactored dead and imposed UDL on inner leaf wall $W_{wall\_IL\_u} = W_{cw\_u} = \mathbf{9.04}$ kN/m

ULS load factor for bearing check $\gamma_{fl\_lintel} = W_{cw\_f} / W_{cw\_u} = \mathbf{1.44}$

Applied unfactored dead and imposed UDL on inner leaf lintel $W_{lintel\_IL\_u} = W_{wall\_IL\_u} = \mathbf{9.04}$ kN/m

Clear span of lintel $L_{lintel\_clear} = 1050$ mm

Assume exisitng window lintels similar to 100mm wide x 140mm deep Type ER2 lintel by Naylor Lintels

Allowable dead and imposed UDL $W_{lintel\_allow} = \mathbf{20.83}$ kN/m

Lintel capacity > applied UDL O.K.

CONSIDER EXISTING WINDOW LINTELS HAVE SUFFICIENT CAPACITY TO SUPPORT NEW ROOF LOADING.
CONSERVATIVE AS BRICK ARCHING OVER LINTEL WILL REDUCE LOADS APPLIED TO LINTELS.

See over for Naylor load span table.

Economy Range

Our best-selling range. Economy lintels are cost effective and fully reversible. Ideal for standard housing or small load situations.

An extruded concrete finish for use in plastered situations. Available up to 3m in length and offer 30 minutes fire resistance only.

Load Table Unfactored Loads in kN/m		ER1 100mm 65mm	ER2 100mm 140mm	ER3 140mm 65mm	ER4 215mm 65mm	ER6 140mm 140mm	ER7 100mm 215mm	ER8 140mm 215mm
Suitable For Foundation Use		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Available Range Finish		Standard	Standard	Standard	Standard	Standard	Standard	Standard
Length	Clear Span	100x65	100x140	140x65	215x65	140x140	100x215	140x215
900mm	700mm	9.27	35.30	9.80	19.67	27.18	58.49	67.89
1200mm	1000mm	5.00	20.83	5.56	11.24	15.95	35.32	40.93
1500mm	1200mm	3.46	14.69	3.84	7.79	11.19	24.85	28.76
1800mm	1500mm	2.18	9.49	2.40	4.92	7.16	16.26	18.78
2100mm	1800mm	1.48	6.59	1.61	3.34	4.91	11.40	13.13
2400mm	2100mm	1.05	4.81	1.13	2.38	3.52	8.38	9.62
2700mm	2400mm	n/a	3.63	0.82	1.75	2.61	6.38	7.30
3000mm	2700mm	n/a	2.82	0.61	1.32	1.98	4.99	5.67
Lintel Weight kg/m		16	34	22	34	47	52	72

CHECK MASONRY BEARING FROM INNER LEAF LINTEL

From sheet 1.5 above

Dead and imposed ULS factor γ_{fl_lintel} = **1.44**

Dead load ULS factor γ_{fl_DL} = 1.4

Unfactored dead and imposed UDL on single inner leaf lintel $W_{lintel\_IL\_u}$ = **9.04** kN/m

Apply as dead load UDL $W_{lintel\_IL\_DL} = W_{lintel\_IL\_u} \times \gamma_{fl\_lintel} / \gamma_{fl\_DL}$ = **9.30** kN/m

Clear span of lintel L_{lintel_clear} = **1050** mm

Unfactored dead + imposed reaction at bearing $P_{bear\_lintel\_u} = W_{lintel\_IL\_DL} \times (L_{lintel\_clear} \times 1.1) / 2$ = **5.37** kN

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.08

Masonry details

Masonry type **Clay or calcium silicate bricks**

Compressive strength of unit p_{unit} = **10.0** N/mm^2

Mortar designation **iii**

Category of masonry units **Category II**

Category of construction control **Normal**

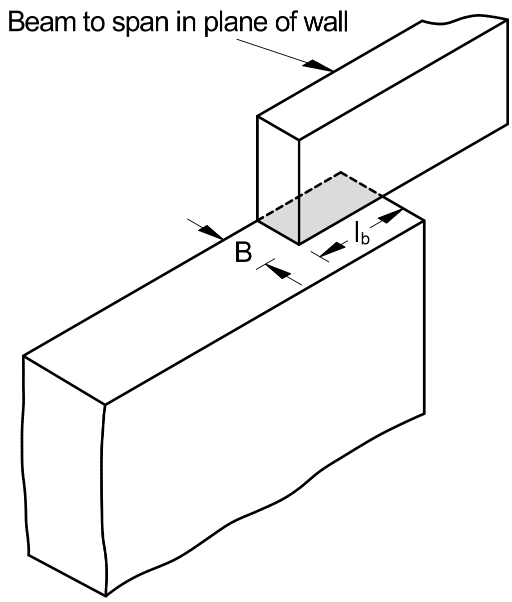
Partial safety factor for material strength γ_m = **3.5**

Thickness of load bearing leaf t = **100** mm

Effective thickness of masonry wall t_{ef} = **215** mm

Height of masonry wall h = **2100** mm

Effective height of masonry wall h_{ef} = **2100** mm



Bearing details

Beam spanning in plane of wall

Width of bearing B = **100** mm

Length of bearing l_b = **200** mm

Compressive strength from Table 2 BS5628:Part 1 - Clay or calcium silicate bricks

Mortar designation — Mortar = **"iii"**

Brick compressive strength — p_{unit} = **10.0** N/mm^2

Characteristic compressive strength — f_k = **3.40** N/mm^2

Loading details

Characteristic concentrated dead load — G_k = **5** kN

Characteristic concentrated imposed load — Q_k = **0** kN

Design concentrated load — $F = (G_k \times 1.4) + (Q_k \times 1.6)$ = **7.5** kN

Characteristic distributed dead load — g_k = **9.3** kN/m

Characteristic distributed imposed load — q_k = **0.0** kN/m

Design distributed load — $f = (g_k \times 1.4) + (q_k \times 1.6)$ = **13.0** kN/m

Masonry bearing type

Bearing type — **Type 2**

Bearing safety factor — γ_{bear} = **1.50**

Check design bearing without a spreader

Design bearing stress — $f_{ca} = F / (B \times l_b) + f / t$ = **0.506** N/mm^2

Allowable bearing stress — $f_{cp} = \gamma_{bear} \times f_k / \gamma_m$ = **1.457** N/mm^2

PASS - Allowable bearing stress exceeds design bearing stress

Check design bearing at 0.4 × h below the bearing level

Slenderness ratio — h_{ef} / t_{ef} = **9.77**

Eccentricity at top of wall — e_x = **0.0** mm

From BS5628:1 Table 7

Capacity reduction factor — β = **0.99**

Length of bearing distributed at 0.4 × h — l_d = **1040** mm

Maximum bearing stress — $f_{ca} = F / (l_d \times t) + f / t$ = **0.202** N/mm^2

Allowable bearing stress — $f_{cp} = \beta \times f_k / \gamma_m$ = **0.962** N/mm^2

PASS - Allowable bearing stress at 0.4 × h below bearing level exceeds design bearing stress

DESIGN NEW ROOF JOISTS

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

Joist details

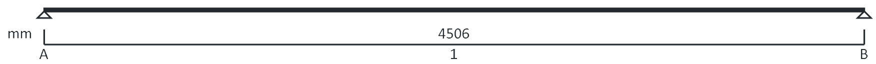
Joist breadth b = **47** mm

Joist depth h = **200** mm

Joist spacing s = **400** mm

Timber strength class **C24**

Service class of timber **1**

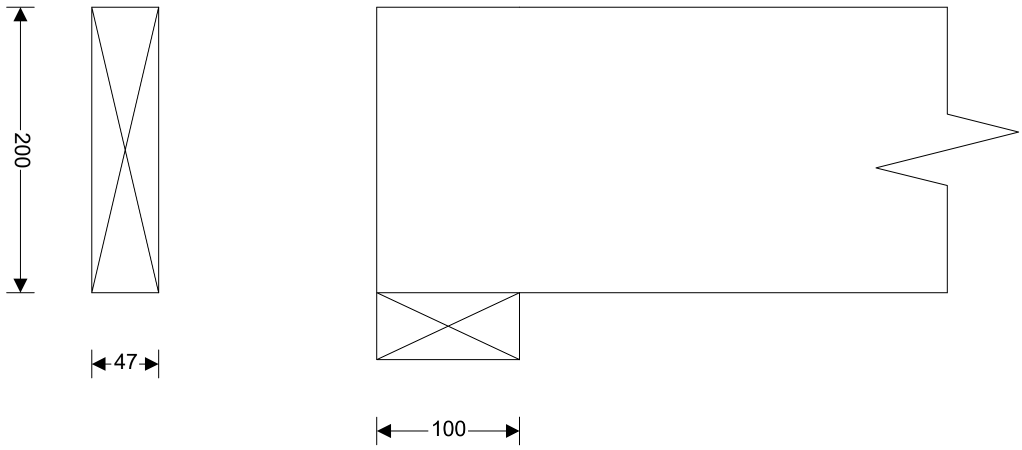


Span details

Number of spans N_{span} = **1**

Length of bearing L_b = **100** mm

Effective length of span L_{s1} = **4506** mm



Section properties

Second moment of area $I = b \times h^3 / 12$ = **31333333** mm^4

Section modulus $Z = b \times h^2 / 6$ = **313333** 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} = **1.04** kN/m^2

Imposed UDL(Medium term) F_{i_udl} = **0.75** kN/m^2

Imposed point load (Short term) F_{i_pt} = **0.90** 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**

Service class for modulus of elasticity — K_{2e} = **1.00**

Section depth factor — K_7 = **1.05**

Load sharing factor — K_8 = **1.10**

Consider medium term loads

Load duration factor — K_3 = **1.25**

Maximum bending moment — M = **1.899** kNm

Maximum shear force — V = **1.686** kN

Maximum support reaction — R = **1.686** kN

Maximum deflection — δ = **12.229** mm

Check bending stress

Bending stress — σ_m = **7.500** N/mm^2

Permissible bending stress — $\sigma_{m\_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8$ = **10.783** N/mm^2

Applied bending stress — σ_{m_max} = M / Z = **6.061** N/mm^2

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress — τ = **0.710** N/mm^2

Permissible shear stress — $\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8$ = **0.976** N/mm^2

Applied shear stress — $\tau_{max} = 3 \times V / (2 \times b \times h)$ = **0.269** N/mm^2

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane) — σ_{cp1} = **2.400** N/mm^2

Permissible bearing stress — $\sigma_{c\_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8$ = **3.300** N/mm^2

Applied bearing stress — $\sigma_{c\_max} = R / (b \times L_b)$ = **0.359** N/mm^2

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection — $\delta_{adm} = \min(L_{s1} \times 0.003, 14\text{ mm})$ = **13.518** mm

Bending deflection (based on E_{mean}) — $\delta_{bending}$ = **11.869** mm

Shear deflection — δ_{shear} = **0.359** mm

Total deflection — $\delta = \delta_{bending} + \delta_{shear}$ = **12.229** mm

PASS - Actual deflection within permissible limits

Consider short term loads

Load duration factor — K_3 = **1.50**

Maximum bending moment — M = **2.152** kNm

Maximum shear force — V = **1.910** kN

Maximum support reaction — R = **1.910** kN

Maximum deflection — δ = **12.587** mm

Check bending stress

Bending stress σ_m = **7.500** N/mm^2

Permissible bending stress $\sigma_{m\_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8$ = **12.939** N/mm^2

Applied bending stress $\sigma_{m\_max} = M / Z$ = **6.867** N/mm^2

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress τ = **0.710** N/mm^2

Permissible shear stress $\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8$ = **1.172** N/mm^2

Applied shear stress $\tau_{max} = 3 \times V / (2 \times b \times h)$ = **0.305** N/mm^2

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane) σ_{cp1} = **2.400** N/mm^2

Permissible bearing stress $\sigma_{c\_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8$ = **3.960** N/mm^2

Applied bearing stress $\sigma_{c\_max} = R / (b \times L_b)$ = **0.406** N/mm^2

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection $\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm})$ = **13.518** mm

Bending deflection (based on E_{mean}) $\delta_{bending}$ = **12.180** mm

Shear deflection δ_{shear} = **0.407** mm

Total deflection $\delta = \delta_{bending} + \delta_{shear}$ = **12.587** mm

PASS - Actual deflection within permissible limits