STRUCTURAL ENGINEER'S REPORT

STRUCTURAL DESIGN REPORT

Proposed Ridge Beam Replacement Works

57 Downham Road, Chatburn, Clitheroe, BB7 4AU

Prepared for:
Ella Burgess

Prepared by:
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Building Calcs Guys

Date:
May 2026

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1. Introduction

Building Calcs Guys were instructed to undertake a structural inspection and provide structural design commentary in relation to the existing roof structure at the above Grade II listed property.

The instruction follows identification of significant deterioration and structural failure associated with the principal ridge timber within the traditional pitched roof structure.

This report has been prepared to support proposed repair and replacement works associated with the failed ridge member and is intended to accompany Listed Building Consent and/or Building Control submissions where required.

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2. Property Description

The property comprises a traditional Grade II listed stone-built cottage believed to date from the historic period of original construction typical of the locality.

The roof structure generally comprises:

- Traditional cut timber roof construction
- Natural slate roof coverings
- Timber rafters spanning between ridge and purlin locations
- Traditional masonry gable support arrangements
- Historic timber ridge member

The roof void was inspected where reasonably accessible at the time of inspection.

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3. Scope of Inspection

The inspection comprised:

- Visual inspection of accessible roof void areas
- Inspection of the existing ridge timber
- Inspection of accessible rafters and purlins
- Review of visible structural distress and timber deterioration
- Preparation of structural repair recommendations
- Preliminary structural calculations for replacement ridge member

No intrusive opening-up works were undertaken beyond areas already accessible at the time of inspection.

Concealed structural elements, hidden bearings, embedded timber ends, and inaccessible roof areas could not be fully inspected and have therefore been assumed based upon visible construction detailing and typical historic construction practice.

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4. Inspection Findings

The inspection identified significant structural deterioration associated with the principal ridge timber.

The existing ridge beam was observed to exhibit:

- Significant longitudinal splitting
- Advanced localised deterioration
- Structural fracture through the timber section
- Loss of effective structural continuity

The beam appears to have fractured near midspan and subsequently undergone localised temporary stabilisation works through installation of a later vertical timber support post beneath the failed region.

Figure 1: Failed ridge beam.

The installed support post appears relatively modern in comparison to the surrounding historic timber structure and does not appear consistent with the original roof construction methodology.

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Figure 2: Ridge beam support installed by others.

Figure 3: ridge beam supported by party wall.

The support arrangement appears crude and non-engineered in nature and is therefore considered likely to represent a retrospective remedial support introduced following failure of the original ridge member.

The original roof arrangement is therefore understood to have historically comprised a spanning ridge beam bearing into masonry support locations at either end of the structure.

Photographic inspection also identified localised moisture staining and deterioration adjacent to ridge bearing areas, likely associated with historic water ingress over an extended period.

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5. Existing Structural Arrangement

Based upon site measurements and inspection observations, the roof structure is understood to comprise approximately:

Element	Approximate Size
Existing ridge beam	125 mm × 125 mm
Rafters	Approx. 75 mm × 75 mm
Rafter spacing	Approx. 330 mm centres
Rafter span	Approx. 1.37 m
Ridge span	Approx. 4.10 m

The roof structure generally reflects traditional historic construction methods typical of the age and character of the property.

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6. Structural Assessment

Structural assessment has been undertaken based upon measured dimensions, visible construction arrangement, and assumed traditional slate roof loading.

The ridge member has been assessed as supporting load transfer from opposing rafters within the traditional cut roof arrangement.

The following loading assumptions have been adopted:

Load Type	Assumed Load
Dead load (roof coverings and timber)	Approx. 0.9–1.0 kN/m^2
Snow loading allowance	Approx. 0.6 kN/m^2
Total characteristic roof load	Approx. 1.5–1.6 kN/m^2

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Assessment of a direct like-for-like replacement section broadly equivalent to the existing historic ridge timber indicates that the original timber proportions provide insufficient stiffness under current structural assessment criteria for the existing roof loading arrangement.

The observed historic structural failure is considered consistent with this assessment outcome.

Structural calculations have therefore been undertaken to determine the minimum practical increase in member size necessary to achieve satisfactory structural performance whilst remaining sympathetic to the historic roof construction.

The proposed replacement member has been assessed generally in accordance with the principles of BS EN 1995 (Eurocode 5).

Bending stress, shear stress and bearing checks were found to be satisfactory.

Deflection assessment has been undertaken using a span/180 considered appropriate and proportionate for remedial works to an existing historic listed roof structure where preservation of existing fabric and minimisation of intervention are key conservation objectives; where the ridge member is concealed within the roof void and does not directly support brittle finishes or habitable floor loads.

The proposed replacement member represents a substantial structural improvement over the deteriorated existing timber whilst minimising intervention to the historic listed roof fabric.

The assessment has been undertaken based upon the observed roof geometry and visible load transfer behaviour during inspection.

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7. Proposed Structural Repair Works

It is proposed that the failed ridge timber be removed and replaced with a new structural timber ridge beam.

The proposed replacement member has been selected to provide improved structural reliability whilst remaining sympathetic to the historic roof construction and listed character of the building.

The proposed replacement beam shall comprise:

Proposed Ridge Beam

Twin 75 mm × 175 mm structural timber sections

Structural grade minimum D30 hardwood or approved equivalent

Bolted together to form composite member

Installed within existing roof geometry

Bearing into masonry wall supports at each end

Minimum end bearing approximately 100 mm

Twin timber sections to be bolted together using minimum M12 bolts at approximately 600 mm staggered centres unless noted otherwise by contractor's specialist timber supplier.

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The proposed section has been selected as the minimum practical increase necessary to achieve satisfactory structural performance whilst preserving the traditional roof form as closely as reasonably practicable.

A stricter modern deflection criterion would likely necessitate a substantially deeper replacement member, resulting in greater intervention to the historic roof structure and reduced conservation compatibility.

No significant alteration to the external roof appearance is proposed.

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8. Temporary Works and Installation Methodology

The following installation sequence is recommended:

1. Install suitable temporary roof support arrangements prior to disturbing the existing ridge member.
2. Carefully strip localised roof coverings as required to facilitate safe access and replacement works.
3. Support adjacent rafters during removal operations.
4. Remove failed ridge timber in a controlled sequence.
5. Inspect masonry bearing pockets and adjacent timber connections following opening-up.
6. Install replacement ridge beam.
7. Secure rafters to replacement ridge member using appropriate traditional carpentry fixing methods and supplementary fixings where required.
8. Remove temporary support arrangements only following confirmation of satisfactory structural load transfer.

All temporary works and contractor means/methods remain the responsibility of the appointed contractor.

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9. Heritage and Conservation Commentary

The proposed works are considered necessary structural repair works associated with preservation of the existing listed building fabric.

The intervention is considered proportionate and limited to replacement of structurally failed timber elements only.

The proposed replacement beam aims to:

- Maintain the traditional roof arrangement
- Preserve the historic character of the structure

- Minimise alteration to original building fabric
- Retain the existing roof geometry
- Avoid unnecessary structural intervention

The proposed modest increase in ridge beam depth is considered justified on structural grounds whilst remaining sympathetic to the concealed historic roof structure.

As the proposed timber will remain concealed within the roof void, the works are not expected to materially alter the visual character or significance of the listed building.

The proposed works seek to retain the existing structural arrangement and load paths as far as reasonably practicable.

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10. Limitations

This report has been prepared following a non-intrusive visual inspection only.

The following limitations apply:

- Concealed structural elements could not be fully inspected
- Embedded masonry bearing conditions have been assumed
- Timber condition within concealed areas could not be verified
- Hidden defects may exist within inaccessible areas
- Contractor to verify bearing conditions during opening-up works
- Any significant deviations from assumed construction should be referred back to the engineer for review

This report is intended solely for the stated property and proposed repair works and should not be relied upon for any other purpose.

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11. Conclusion

The existing ridge timber is considered to have experienced significant structural deterioration and fracture resulting in loss of adequate structural performance.

The current vertical support arrangement appears to represent a later retrospective remedial support rather than part of the original historic roof construction.

Replacement of the failed ridge member is considered necessary and justified.

The proposed replacement timber arrangement is considered capable of providing satisfactory structural performance whilst remaining sympathetic to the historic character and listed status of the property.

Appendices

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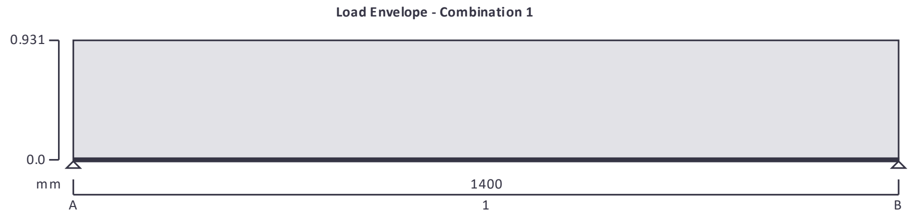
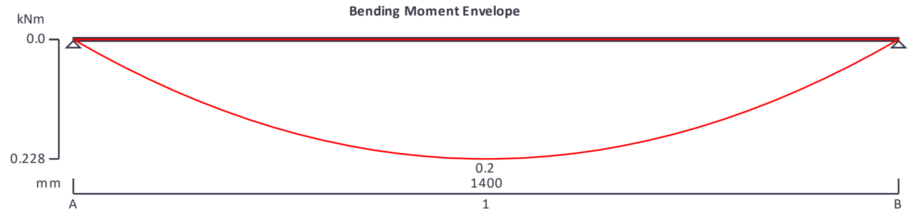
Building Calcs Guys	Project 57 Downham Rd				Job no.	
	Calcs for Rafter Beam				Start page no./Revision 1	
	Calcs by AS	Calcs date 24/05/2026	Checked by AS	Checked date 20/05/2026	Approved by	Approved date

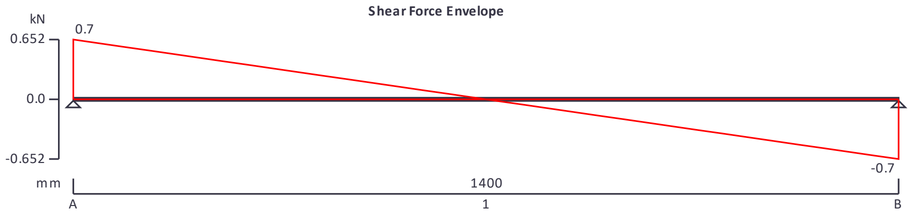
TIMBER BEAM ANALYSIS & DESIGN TO EN1995-1-1:2004

In accordance with EN1995-1-1:2004 + A2:2014 and Corrigendum No.1 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 1.7.03







Applied loading

Beam loads

	Permanent self weight of beam × 1
DL	Permanent full UDL 0.400 kN/m
snow	Variable full UDL 0.250 kN/m

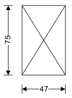
Load combinations

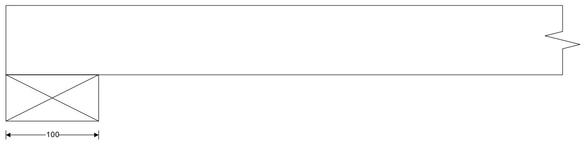
Load combination 1	Support A	Permanent × 1.35
		Variable × 1.50
	Span 1	Permanent × 1.35
		Variable × 1.50
	Support B	Permanent × 1.35
		Variable × 1.50

Analysis results

Maximum moment	M_{max} = **0.228** kNm	M_{min} = **0.000** kNm
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **0.228** kNm	
Maximum shear	F_{max} = **0.652** kN	F_{min} = **-0.652** kN

Design shear	$F = \max(\text{abs}(F_{max}),\text{abs}(F_{min}))$ = **0.652** kN	
Total load on beam	W_{tot} = **1.304** kN	
Reactions at support A	R_{A_max} = **0.652** kN	R_{A_min} = **0.652** kN
Unfactored permanent load reaction at support A	$R_{A\_Permanent}$ = **0.288** kN	
Unfactored variable load reaction at support A	$R_{A\_Variable}$ = **0.175** kN	
Reactions at support B	R_{B_max} = **0.652** kN	R_{B_min} = **0.652** kN
Unfactored permanent load reaction at support B	$R_{B\_Permanent}$ = **0.288** kN	
Unfactored variable load reaction at support B	$R_{B\_Variable}$ = **0.175** kN	





Timber section details

Breadth of timber sections — b = **47** mm

Depth of timber sections — h = **75** mm

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

Overall breadth of timber member — $b_b = N \times b$ = **47** mm

Timber strength class - EN 338:2016 Table 1 — **C24**

Member details

Load duration - cl.2.3.1.2 — **Long-term**

Service class of timber - cl.2.3.1.3 — **1**

Length of span — L_{s1} = **1400** mm

Length of bearing — L_b = **100** mm

Section properties

Cross sectional area of member — $A = N \times b \times h$ = **3525** mm^2

Section modulus — $W_y = N \times b \times h^2 / 6$ = **44063** mm^3

$W_z = h \times (N \times b)^2 / 6$ = **27613** mm^3

Second moment of area — $I_y = N \times b \times h^3 / 12$ = **1652344** mm^4

$I_z = h \times (N \times b)^3 / 12$ = **648894** mm^4

Radius of gyration — $r_y = \sqrt{(I_y / A)}$ = **21.7** mm

$r_z = \sqrt{(I_z / A)}$ = **13.6** mm

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3 — γ_M = **1.300**

Modification factors

Modification factor for load duration and moisture content - Table 3.1

k_{mod} = **0.700**

Deformation factor for service classes - Table 3.2 — k_{def} = **0.600**

Depth factor for bending - exp.3.1 — $k_{h.m} = \min((150\text{ mm} / h)^{0.2}, 1.3)$ = **1.149**

Depth factor for tension - exp.3.1 — $k_{h.t} = \min((150\text{ mm} / \max(b, h))^{0.2}, 1.3)$ = **1.149**

Bending stress re-distribution factor - cl.6.1.6(2) — k_m = **0.700**

Crack factor for shear resistance - cl.6.1.7(2) — k_{cr} = **0.670**

Load configuration factor - exp.6.4 — $k_{c.90}$ = **1.000**

System strength factor - cl.6.6 — k_{sys} = **1.000**

Lateral buckling factor - cl.6.3.3(5) — k_{crit} = **1.000**

Compression perpendicular to the grain - cl.6.1.5

Design compressive stress $\sigma_{c.90.d} = R_{A\_max} / (N \times b \times L_b) = \mathbf{0.139}$ N/mm^2

Design compressive strength $f_{c.90.d} = k_{mod} \times k_{sys} \times k_{c.90} \times f_{c.90.k} / \gamma_M = \mathbf{1.346}$ N/mm^2

$\sigma_{c.90.d} / f_{c.90.d} = \mathbf{0.103}$

PASS - Design compressive strength exceeds design compressive stress at bearing

Bending - cl 6.1.6

Design bending stress $\sigma_{m.d} = M / W_y = \mathbf{5.178}$ N/mm^2

Design bending strength $f_{m.d} = k_{h.m} \times k_{mod} \times k_{sys} \times k_{crit} \times f_{m.k} / \gamma_M = \mathbf{14.845}$ N/mm^2

$\sigma_{m.d} / f_{m.d} = \mathbf{0.349}$

PASS - Design bending strength exceeds design bending stress

Shear - cl.6.1.7

Applied shear stress $\tau_d = 3 \times F / (2 \times k_{cr} \times A) = \mathbf{0.414}$ N/mm^2

Permissible shear stress $f_{v.d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M = \mathbf{2.154}$ N/mm^2

$\tau_d / f_{v.d} = \mathbf{0.192}$

PASS - Design shear strength exceeds design shear stress

Deflection - cl.7.2

Deflection limit $\delta_{lim} = \min(14\text{ mm}, 0.004 \times L_{s1}) = \mathbf{5.600}$ mm

Instantaneous deflection due to permanent load $\delta_{instG} = \mathbf{1.184}$ mm

Final deflection due to permanent load $\delta_{finG} = \delta_{instG} \times (1 + k_{def}) = \mathbf{1.894}$ mm

Instantaneous deflection due to variable load $\delta_{instQ} = \mathbf{0.718}$ mm

Factor for quasi-permanent variable action $\psi_2 = \mathbf{0.3}$

Final deflection due to variable load $\delta_{finQ} = \delta_{instQ} \times (1 + \psi_2 \times k_{def}) = \mathbf{0.848}$ mm

Total final deflection $\delta_{fin} = \delta_{finG} + \delta_{finQ} = \mathbf{2.742}$ mm

$\delta_{fin} / \delta_{lim} = \mathbf{0.490}$

PASS - Total final deflection is less than the deflection limit

Building Calcs Guys	Project 57 Downham Rd				Job no. PGE-2026-109	
	Calcs for Ridge Beam 2x75x175mm				Start page no./Revision 1	
	Calcs by AS	Calcs date 20/05/2026	Checked by AS	Checked date 20/05/2026	Approved by	Approved date

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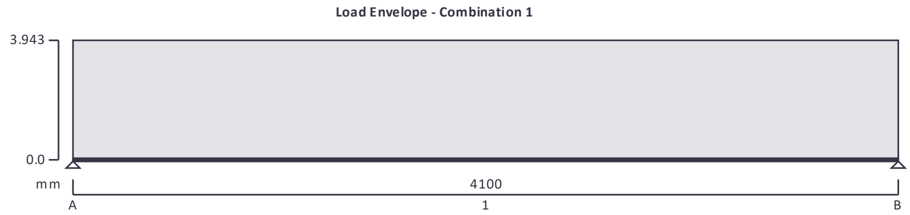
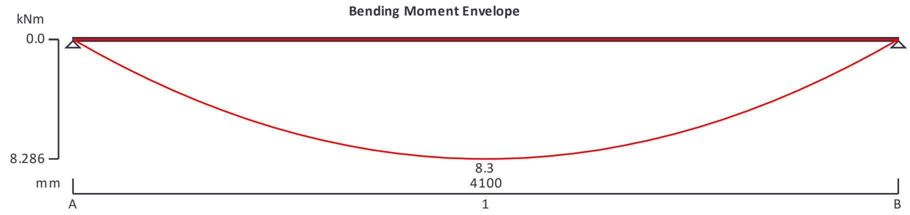
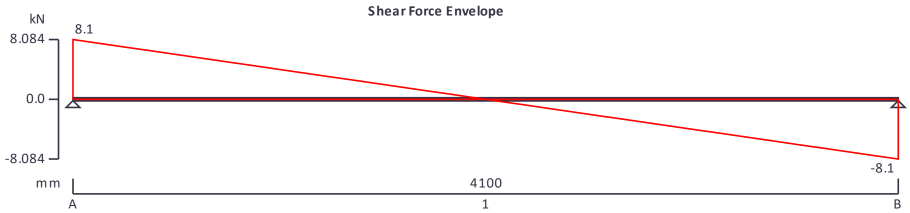






Applied loading

Beam loads

	Permanent self weight of beam × 1	
DL	Permanent full UDL 1.640 kN/m	
snow	Variable full UDL 1.030 kN/m	

Load combinations

Load combination 1	Support A	Permanent × 1.35
		Variable × 1.50
	Span 1	Permanent × 1.35
		Variable × 1.50
	Support B	Permanent × 1.35
		Variable × 1.50

Analysis results

Maximum moment	M_{max} = **8.286** kNm	M_{min} = **0.000** kNm
Design moment	$M = max(abs(M_{max}),abs(M_{min}))$ = **8.286** kNm	
Maximum shear	F_{max} = **8.084** kN	F_{min} = **-8.084** kN

Design shear — $F = max(abs(F_{max}),abs(F_{min}))$ = **8.084** kN

Total load on beam — W_{tot} = **16.167** kN

Reactions at support A — R_{A_max} = **8.084** kN — R_{A_min} = **8.084** kN

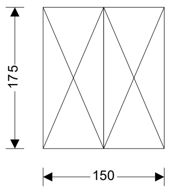
Unfactored permanent load reaction at support A — $R_{A\_Permanent}$ = **3.642** kN

Unfactored variable load reaction at support A — $R_{A\_Variable}$ = **2.112** kN

Reactions at support B — R_{B_max} = **8.084** kN — R_{B_min} = **8.084** kN

Unfactored permanent load reaction at support B — $R_{B\_Permanent}$ = **3.642** kN

Unfactored variable load reaction at support B — $R_{B\_Variable}$ = **2.112** kN



Timber section details

Breadth of timber sections — b = **75** mm

Depth of timber sections — h = **175** mm

Number of timber sections in member — N = **2**

Overall breadth of timber member — $b_b = N \times b$ = **150** mm

Timber strength class - EN 338:2016 Table 3 — **D30**

Member details

Load duration - cl.2.3.1.2 — **Long-term**

Service class of timber - cl.2.3.1.3 — **1**

Length of span — L_{s1} = **4100** mm

Length of bearing — L_b = **100** mm

Section properties

Cross sectional area of member — $A = N \times b \times h$ = **26250** mm^2

Section modulus — $W_y = N \times b \times h^2 / 6$ = **765625** mm^3

$W_z = h \times (N \times b)^2 / 6$ = **656250** mm^3

Second moment of area — $I_y = N \times b \times h^3 / 12$ = **66992187** mm^4

$I_z = h \times (N \times b)^3 / 12$ = **49218750** mm^4

Radius of gyration — $r_y = \sqrt{(I_y / A)}$ = **50.5** mm

$r_z = \sqrt{(I_z / A)}$ = **43.3** mm

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3 — γ_M = **1.300**

Modification factors

Modification factor for load duration and moisture content - Table 3.1

k_{mod} = **0.700**

Deformation factor for service classes - Table 3.2 — k_{def} = **0.600**

Depth factor for bending - exp.3.1 — $k_{h.m}$ = **1.000**

Depth factor for tension - exp.3.1 — $k_{h.t}$ = **1.000**

Bending stress re-distribution factor - cl.6.1.6(2) — k_m = **0.700**

Crack factor for shear resistance - cl.6.1.7(2) — k_{cr} = **0.670**

Load configuration factor - exp.6.4 — $k_{c.90}$ = **1.000**

System strength factor - cl.6.6 — k_{sys} = **1.000**

Lateral buckling factor - cl.6.3.3(5) — k_{crit} = **1.000**

Compression perpendicular to the grain - cl.6.1.5

Design compressive stress — $\sigma_{c.90.d} = R_{A\_max} / (N \times b \times L_b) =$ **0.539** N/mm^2

Design compressive strength — $f_{c.90.d} = k_{mod} \times k_{sys} \times k_{c.90} \times f_{c.90.k} / \gamma_M =$ **2.854** N/mm^2

$\sigma_{c.90.d} / f_{c.90.d} =$ **0.189**

PASS - Design compressive strength exceeds design compressive stress at bearing

Bending - cl 6.1.6

Design bending stress — $\sigma_{m.d} = M / W_y =$ **10.822** N/mm^2

Design bending strength — $f_{m.d} = k_{h.m} \times k_{mod} \times k_{sys} \times k_{crit} \times f_{m.k} / \gamma_M =$ **16.154** N/mm^2

$\sigma_{m.d} / f_{m.d} =$ **0.670**

PASS - Design bending strength exceeds design bending stress

Shear - cl.6.1.7

Applied shear stress — $\tau_d = 3 \times F / (2 \times k_{cr} \times A) =$ **0.689** N/mm^2

Permissible shear stress — $f_{v.d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M =$ **2.100** N/mm^2

$\tau_d / f_{v.d} =$ **0.328**

PASS - Design shear strength exceeds design shear stress

Deflection - cl.7.2

Deflection limit — $\delta_{lim} = \min(22.8 \text{ mm}, 0.0056 \times L_{s1}) =$ **22.800** mm

Instantaneous deflection due to permanent load — $\delta_{instG} =$ **9.117** mm

Final deflection due to permanent load — $\delta_{finG} = \delta_{instG} \times (1 + k_{def}) =$ **14.587** mm

Instantaneous deflection due to variable load — $\delta_{instQ} =$ **5.286** mm

Factor for quasi-permanent variable action — $\psi_2 =$ **0.3**

Final deflection due to variable load — $\delta_{finQ} = \delta_{instQ} \times (1 + \psi_2 \times k_{def}) =$ **6.238** mm

Total final deflection — $\delta_{fin} = \delta_{finG} + \delta_{finQ} =$ **20.825** mm

$\delta_{fin} / \delta_{lim} =$ **0.913**

PASS - Total final deflection is less than the deflection limit