



Gable ladders – deemed to satisfy details

Introduction

The purpose of this document is to provide standard details for gable ladders with minimum timber size and fixing specifications. This document includes calculations as justification for the details proposed. As such, if these details and guidance is followed, no further calculation justification is required. Any gable ladders not covered by this document would require separate verification.

Design assumptions

Loadings:

Top Chord Dead Load	Maximum = 0.900 kN/m ² Minimum = 0.366 kN/m ² (for assessing effects of wind uplift)
Top Chord Imposed Load	Snow Load Maximum = 0.750 kN/m ² x 0.8 (μ1) = 0.600 kN/m ² Category H Access Load = 0.600 kN/m ²
Wind Load (qp(z))	Maximum = 1.350 kN/m ² Equivalent to 27 m/s, Distance from Sea = 60 km, Altitude = 180 m Equivalent to 27 m/s, Distance from Sea = 0 km (Coastal), Altitude = 75 m
Pressure Coefficients	Cpe (upper edge) = -0.9 (Based on Zone F, 15 Degrees) Cpe (lower edge) = +0.8 (Based on adjacent wall pressure)
Permissible Roof Pitch	15-60 Degrees

The following Standard Details for eight Gable Ladder configurations are presented in this document:

Reference	Outer Skin	Inner Skin - Above	Inner Skin - Below	Construction Type
TRA-GL01	Masonry	Masonry Cavity Wall	Masonry Cavity Wall	Double sided ladder
TRA-GL02	Masonry	Masonry Cavity Wall	Masonry Cavity Wall	Single sided ladder
TRA-GL03	Masonry	Gable Panel	Masonry Cavity Wall	Double sided ladder
TRA-GL04	Masonry	Gable Panel	Masonry Cavity Wall	Single sided ladder
TRA-GL05	Masonry	Gable Panel	Timber Frame	Runner over noggins
TRA-GL06	Masonry	Gable Panel	Timber Frame	Intermediate noggins
TRA-GL07	Cladding/Render	Gable Panel	Masonry Or Timber Frame	Runner over noggins
TRA-GL08	Cladding/Render	Gable Panel	Masonry Or Timber Frame	Intermediate noggins

Annex A provides justification for design of connections

Annex B provides justification for member calculations

TRA-GL01: masonry cavity wall

Gable ladders manufactured using min. 35x72mm timbers, C24 grade or better.

Outer/Inner rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails.

Noggings at max. 600mm centres along rafter.

Gable ladder fixed to first truss using 3.35dia x 65mm lg round wire / ring nails at 300mm staggered centres along rafter.

Gable ladder must be evenly supported on both skins of masonry cavity wall.

3.35dia x 65mm lg hand smooth nails can be replaced by 3.1dia x 65mm machine smooth nails.

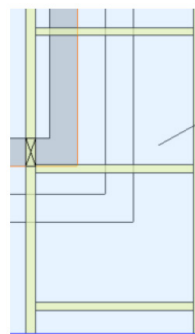
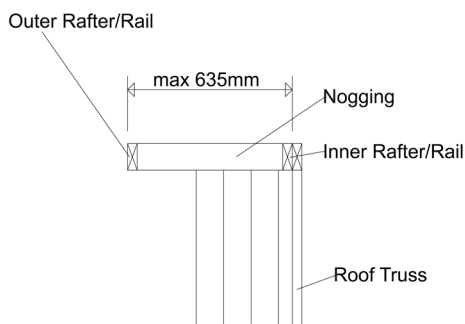
3.35dia x 75mm lg hand ring nails can be replaced by 3.1dia x 75mm machine ring nails.

If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

Where Nett Design Uplift Load exceeds 1.1 kN/m², the gable ladder should be fixed to masonry via straps or similar.

Nett Design Uplift Load = 1.5 x Wind Load (inc Cpe) - 1.0 x Dead Load.

Note: Overhang from face of brickwork should not exceed the back span of the ladder.



First Structural nogging set in maximum 750mm measured along the slope of the gable ladder. This nogging must always be supported on the external masonry skin and, where possible, the internal masonry skin.

TRA-GL02: masonry cavity wall - single sided ladder

Gable ladders manufactured using min. 35x72mm timbers, C24 grade or better.

Outer rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails.

Noggings at max. 600mm centres along rafter

Gable ladder fixed to first truss using min 2no. 3.35dia x 75mm lg ring nails into the end grain of every nogging.

Gable ladder must be evenly supported on both skins of masonry cavity wall.

3.35dia x 65mm lg hand smooth nails can be replaced by 3.1dia x 65mm machine smooth nails.

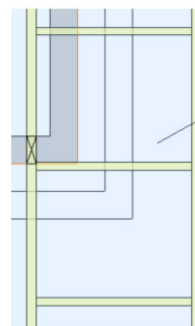
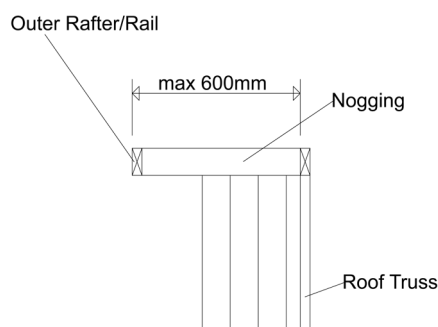
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If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

Where Nett Design Uplift Load exceeds 1.1 kN/m², the gable ladder should be fixed to masonry via straps or similar.

Nett Design Uplift Load = 1.5 x Wind Load (inc Cpe) - 1.0 x Dead Load.

Note: Overhang from face of brickwork should not exceed the back span of the ladder.



First Structural nogging set in maximum 750mm measured along the slope of the gable ladder. This nogging must always be supported on the external masonry skin and, where possible, the internal masonry skin.

TRA-GL03: gable panel over masonry cavity wall

Gable ladders manufactured using min.35x72mm timbers, C24 grade or better.

Outer rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails.

Noggings at max. 600mm centres along rafter.

Gable ladder fixed to first truss using min 2no. 3.35dia x 75mm lg ring nails into the end grain of every nogging.

Gable ladder must be evenly supported on both skins of masonry cavity wall.

3.35dia x 65mm lg hand smooth nails can be replaced by 3.1 dia x 65mm machine smooth nails.

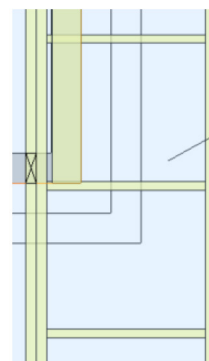
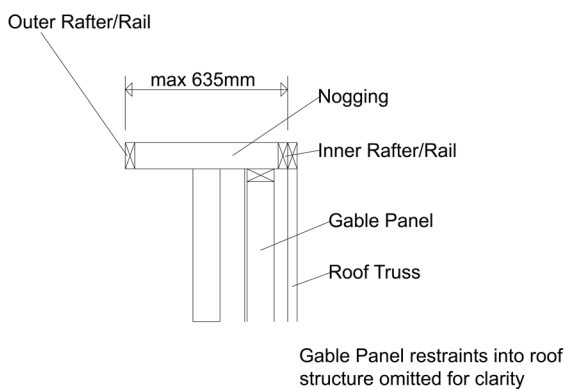
3.35dia x 75mm lg hand ring nails can be replaced by 3.1 dia x 75mm machine ring nails.

If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

Where Nett Design Uplift Load exceeds 1.1 kN/m², the gable ladder should be fixed to masonry via straps or similar.

Nett Design Uplift Load = 1.5 x Wind Load (inc Cpe) - 1.0 x Dead Load.

Note: Overhang from face of brickwork should not exceed the back span of the ladder.



First Structural nogging set in maximum 750mm measured along the slope of the gable ladder. This nogging must always be supported on the external masonry skin and, where possible, the gable panel.

TRA-GL04: gable panel over masonry cavity wall - single sided ladder

Gable ladders manufactured using min.35x72mm timbers, C24 grade or better.

Outer rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails.

Noggings at max. 600mm centres along rafter.

Gable ladder fixed to first truss using min 2no. 3.35dia x 75mm lg ring nails into the end grain of every nogging/

Gable ladder must be evenly supported on both skins of masonry cavity wall.

3.35dia x 65mm lg hand smooth nails can be replaced by 3.1 dia x 65mm machine smooth nails.

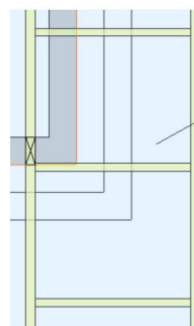
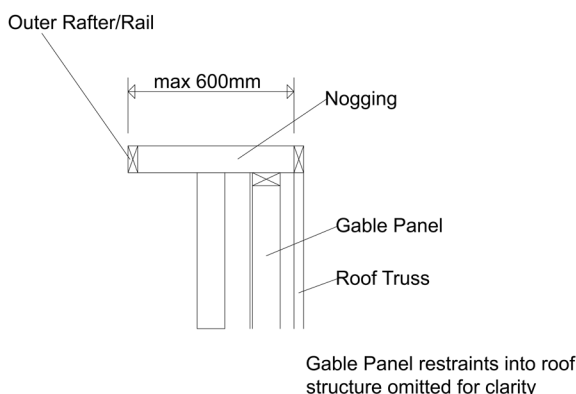
3.35dia x 75mm lg hand ring nails can be replaced by 3.1 dia x 75mm machine ring nails.

If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

Where Nett Design Uplift Load exceeds 1.1 kN/m², the gable ladder should be fixed to masonry via straps or similar.

Nett Design Uplift Load = 1.5 x Wind Load (inc Cpe) - 1.0 x Dead Load.

Note: Overhang from face of brickwork should not exceed the back span of the ladder.



First Structural nogging set in maximum 750mm measured along the slope of the gable ladder. This nogging must always be supported on the external masonry skin and, where possible, the internal masonry skin.

TRA-GL05: gable ladder - gable panel timber frame construction - runner

Outer rafters to be min. 35x97mm timber Noggings to be min. 35x72mm timber, C24 grade or better.

Runner to be minimum 22x97mm timber, free from major strength-reducing defects.

Outer/Inner rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails (4no. nails to 2-Ply noggings - 2 per nogging).

Noggings at max. 600mm centres along rafter.

Gable ladder fixed to first truss using 3.35dia x 65mm lg round wire / ring nails at 300mm staggered centres along rafter.

Runner spaced at max 600mm from outer rafters to provide support to tiling battens. Fix runners to noggings below using min. 2no. 3.35dia x 65mm lg ring nails (4no. nails to 2-Ply noggings - 2 per nogging).

Noggings fixed to gable panels below using min. 2no. 4.00dia x 90mm lg skewed ring nails to every nogging, and 1no. truss clip to alternate noggings, ensuring the lowest 2-Ply nogging that is fixed to the panel is secured with 2no. framing anchors.

2-Ply Noggings joined using 3.35dia x 65mm lg round wire / ring nails at 150mm staggered centres.

3.35dia x 65mm lg hand smooth nails can be replaced by 3.1dia x 65mm machine smooth nails.

3.35dia x 75mm lg hand ring nails can be replaced by 3.1dia x 75mm

machine ring nails.

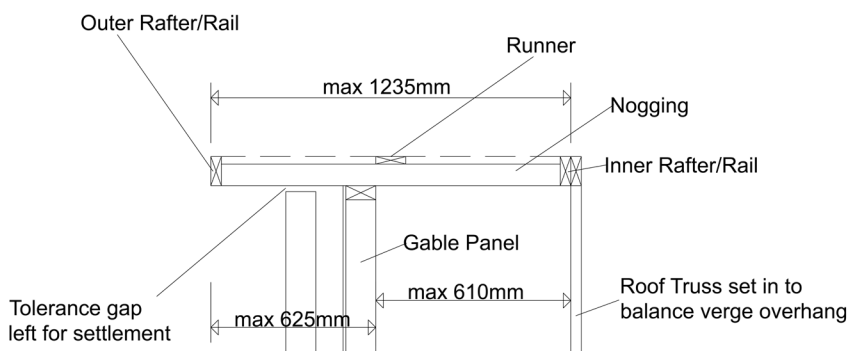
4.00dia x 90mm lg hand ring nails can be replaced by 3.1dia x 90mm machine ring nails.

If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

Note: Where slope dimension to first structural nogging exceeds 600mm, Gable ladder noggings must be manufactured using min. 97mm material. In this case use 2 x 3 No. Nails to fix min 122mm outer/inner rails to the 2-Ply nogging. Alternatively, 72mm noggings/97mm rails can be used but connections from the rails to the noggings must be strengthened using proprietary metalwork (ie. mini joist hangers).

Note: if Nett uplift on ladder fixing to gable panel is less than 0.7 kN/m unfactored, then ladder can be secured to gable panel using nails only.

Note: Building Designer should verify that the tiling batten to runner fixings are adequate under high uplift loads.

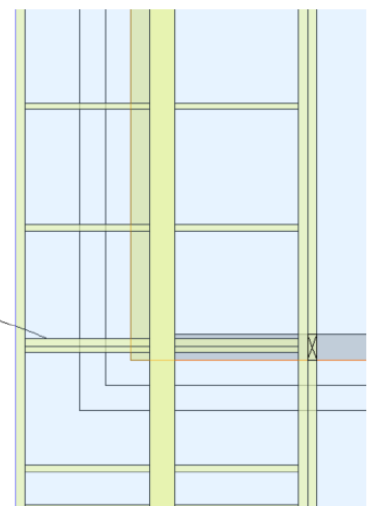


Gable Panel restraints into roof structure omitted for clarity

First Structural nogging to be min. 2-Ply and set in maximum 750mm measured along the slope of the gable ladder. This nogging must be supported on the gable panel or timber frame structure

NOTE: Where slope dimension to first structural nogging exceeds 600mm, Gable ladder noggings must be manufactured using min. 97mm material. In this case use 2 x 3 No. Nails to fix min 122mm outer/inner rails to the 2-Ply nogging

Alternatively 72mm noggings/97mm rails can be used but connections from the rails to the noggings must be strengthened using proprietary metalwork (ie. mini joist hangers)

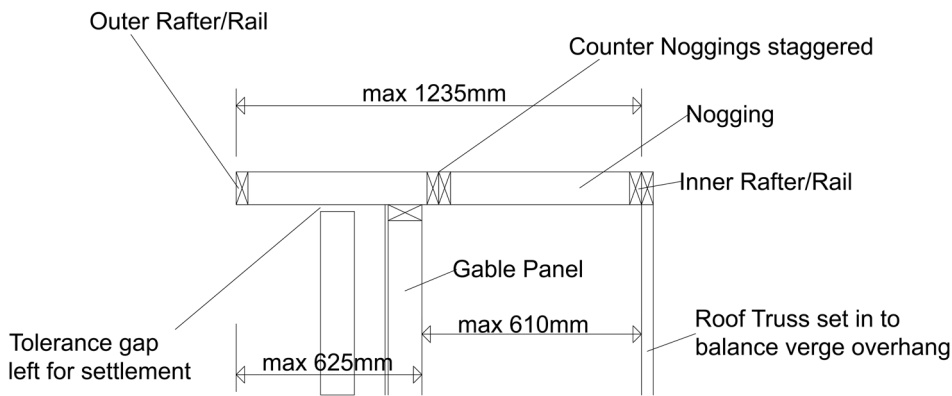


TRA-GL06: gable ladder - gable panel timber frame construction - intermediate nogging

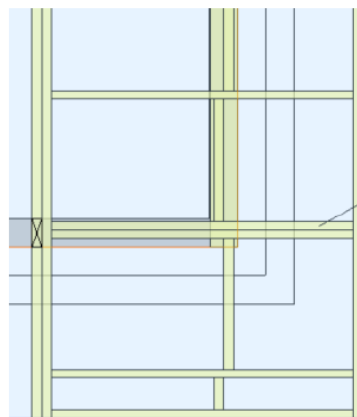
Gable ladders manufactured using min. 35x97mm or 38x89mm timbers, C24 grade or better.
 Outer/Inner rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails (4no. nails to 2-Ply noggings - 2 per nogging). Use min 6no. nails to 2-Ply noggings - 3 per nogging where overhang slope length = 601-750mm
 Noggings at max. 600mm centres along rafter
 Gable ladder fixed to first truss using 3.35dia x 65mm lg round wire / ring nails at 300mm staggered centres along rafter.
 Noggings fixed to gable panels below using min. 2no. 4.00dia x 90mm lg skewed ring nails to every nogging, and 1no. truss clip to alternate noggings, ensuring the lowest 2-Ply nogging that is fixed to the panel is secured with 2no. framing anchors.
 2-Ply Noggings joined using 3.35dia x 65mm lg round wire / ring nails at 150mm staggered centres

Counter noggings offset to facilitate nailing and fixed to noggings using min. 2no. 3.35dia x 65mm lg round wire nails.
 3.35dia x 65mm lg hand smooth nails can be replaced by 3.1dia x 65mm machine smooth nails.
 3.35dia x 75mm lg hand ring nails can be replaced by 3.1dia x 75mm machine ring nails.
 4.00dia x 90mm lg hand ring nails can be replaced by 3.1dia x 90mm machine ring nails.
 If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

Note: if Nett uplift on ladder fixing to gable panel is less than 0.7 kN/m unmanufactured, then ladder can be secured to gable panel using nails only.



Gable Panel restraints into roof structure omitted for clarity



First Structural nogging to be min. 2-Ply and set in maximum 750mm measured along the slope of the gable ladder. This nogging must be supported on the gable panel or timber frame structure

NOTE: Where slope dimension to first structural nogging exceeds 600mm, using 2 x 3 No. Nails to fix outer/inner rails to the 2-Ply nogging

TRA GL07 - Gable panel clad/rendered externally over timber frame or masonry construction - runner

Outer rafters to be min. 35x97mm timber Noggings to be min. 35x72mm timber, C24 grade or better.

Runner to be minimum 22x97mm timber, free from major strength reducing defects.

Outer/Inner rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails (4no. nails to 2-Ply noggings - 2 per nogging)

Noggings at max. 600mm centres along rafter

Gable ladder fixed to first truss using 3.35dia x 65mm lg round wire / ring nails at 300mm staggered centres along rafter.

Runner spaced at max 600mm from outer rafters to provide support to tiling battens. Fix runners to noggings below using min. 2no. 3.35dia x 65mm lg ring nails (4no. nails to 2-Ply noggings - 2 per nogging)

Noggings fixed to gable panels below using min. 2no. 4.00dia x 90mm lg skewed ring nails to every nogging, and 1no. truss clip to alternate noggings, ensuring the lowest 2-Ply nogging that is fixed to the panel is secured with 2no. framing anchors.

2-Ply Noggings joined using 3.35dia x 65mm lg round wire / ring nails at 150mm staggered centres.

3.35dia x 65mm lg hand smooth nails can be replaced by 3.1dia x 65mm machine smooth nails.

3.35dia x 75mm lg hand ring nails can be replaced by 3.1dia x 75mm

machine ring nails.

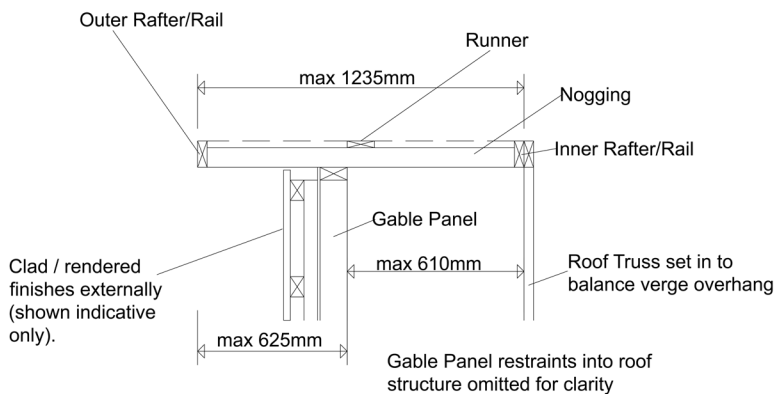
4.00dia x 90mm lg hand ring nails can be replaced by 3.1dia x 90mm machine ring nails.

If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

Note: Where slope dimension to first structural nogging exceeds 600mm, Gable ladder noggings must be manufactured using min. 97mm material. In this case use 2 x 3 No. Nails to fix min 122mm outer/inner rails to the 2-Ply nogging. Alternatively 72mm noggings/97mm rails can be used but connections from the rails to the noggings must be strengthened using proprietary metalwork (ie. mini joist hangers).

Note: if Nett uplift on ladder fixing to gable panel is less than 0.7 kN/m unmanufactured, then ladder can be secured to gable panel using nails only.

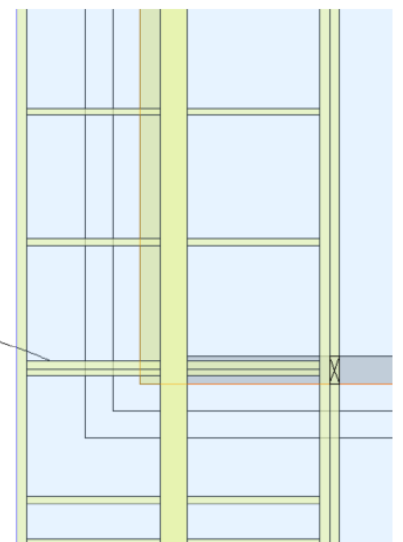
Note: Building Designer should verify that the tiling batten to runner fixings are adequate under high uplift loads.



First Structural nogging to be min. 2-Ply and set in maximum 750mm measured along the slope of the gable ladder. This nogging must be supported on the gable panel or timber frame structure

NOTE: Where slope dimension to first structural nogging exceeds 600mm, Gable ladder noggings must be manufactured using min. 97mm material. In this case use 2 x 3 No. Nails to fix min 122mm outer/inner rails to the 2-Ply nogging

Alternatively 72mm noggings/97mm rails can be used but connections from the rails to the noggings must be strengthened using proprietary metalwork (ie. mini joist hangers)

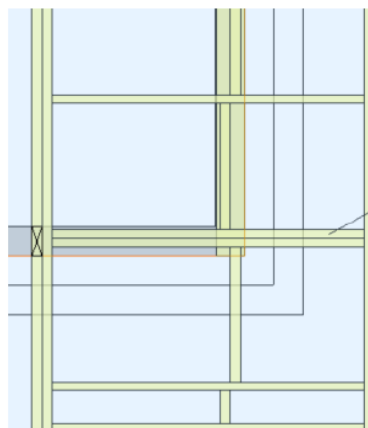
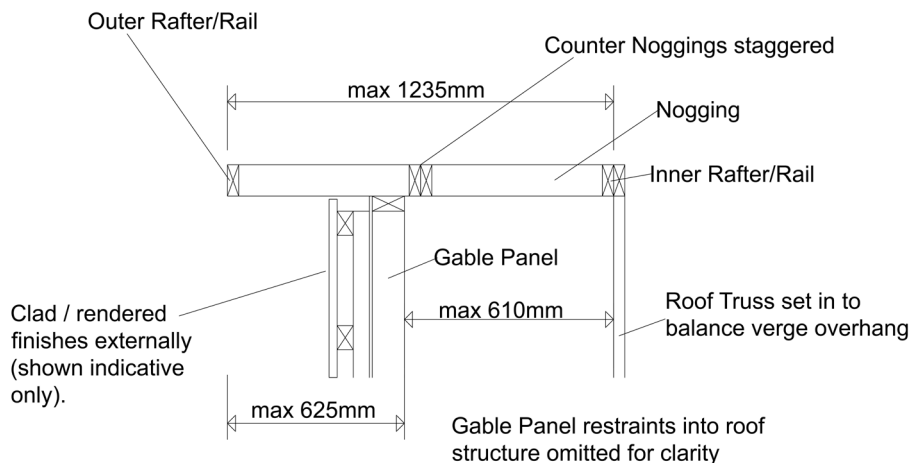


TRA GL08: Gable panel clad/rendered externally over timber frame or masonry construction - intermediate noggings

Gable ladders manufactured using min. 35x97mm or 38x89mm timbers, C24 grade or better.
 Outer/Inner rafters fixed into end grain of noggings using min 2no. 3.35dia x 75mm lg ring nails (4no. nails to 2-Ply noggings - 2 per nogging). Use min 6no. nails to 2-Ply noggings - 3 per nogging where overhang slope length = 601-750mm.
 Noggings at max. 600mm centres along rafter.
 Gable ladder fixed to first truss using 3.35dia x 65mm lg round wire / ring nails at 300mm staggered centres along rafter.
 Noggings fixed to gable panels below using min. 2no. 4.00dia x 90mm lg skewed ring nails to every nogging, and 1no. truss clip to alternate noggings, ensuring the lowest 2-Ply nogging that is fixed to the panel is secured with 2no. framing anchors.
 2-Ply Noggings joined using 3.35dia x 65mm lg round wire / ring nails at 150mm staggered centres.

Counter noggings offset to facilitate nailing and fixed to noggings using min. 2no. 3.35dia x 65mm lg round wire nails.
 3.35dia x 65mm lg hand smooth nails can be replaced by 3.1dia x 65mm machine smooth nails.
 3.35dia x 75mm lg hand ring nails can be replaced by 3.1dia x 75mm machine ring nails.
 4.00dia x 90mm lg hand ring nails can be replaced by 3.1dia x 90mm machine ring nails.
 If wider timbers are used the nail lengths should be increased to ensure the same pointside embedments are provided.

NOTE: if Nett uplift on ladder fixing to gable panel is less than 0.7 kN/m unfactored, then ladder can be secured to gable panel using nails only.



First Structural nogging to be min. 2-Ply and set in maximum 750mm measured along the slope of the gable ladder. This nogging must be supported on the gable panel or timber frame structure

NOTE: Where slope dimension to first structural nogging exceeds 600mm, using 2 x 3 No. Nails to fix outer/inner rails to the 2-Ply nogging

Annex A - Design of connections

Table 1. Fixing Characteristic Capacities

Application	Direction	Characteristic Capacity (N)
Gable Ladder to truss (side grain)	Shear	779
Outer/Inner Rail to Nogging (end grain)	Shear	270
Nogging to Gable Panel (min. 30mm penetration)	Withdrawal	419
Runner to Ladder/Truss (min. 40mm penetration)	Withdrawal	515
Tiling Batten to Ladder/Truss (min. 40mm penetration)	Withdrawal	304

Notes: Capacities assume 35mm/38mm wide, min. C24 grade ladder material. Where wider material is used in the fabrication of the gable ladders, the nail lengths should be adjusted accordingly to ensure the same penetration is achieved.

End grain shear capacity based on side grain capacity of smooth nail divided by 3, as per BS EN 1995-1-1 (8.3.1.2(4))

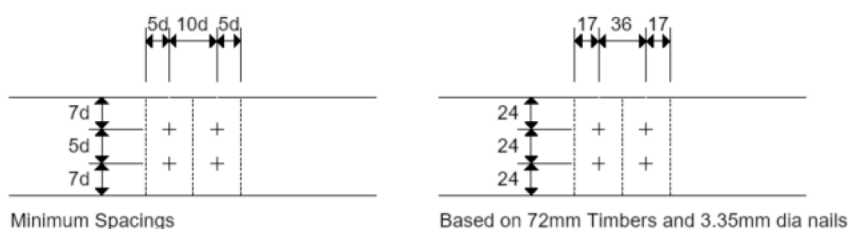
Characteristic Capacity based on worst case of 3.35mm dia smooth/ring hand nail or 3.1mm dia ringed machine nail.

Table 2: Connection Design Capacities

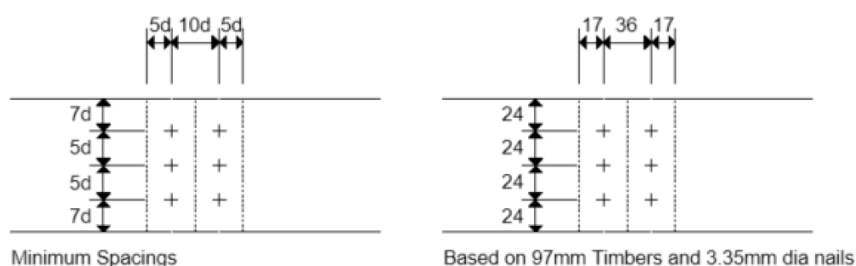
Fixing	Characteristic Capacity (N)	No. of Fixings	Char Cap Connection (N)	Perm (N)	ST (N)	Inst (N)
3.35x65mm Smooth Nail	779	2	1558	719	1079	1318
3.35x75mm Ring Nail	270	2	540	249	374	457
4.00x90mm Ring Nail	419	2	838	387	580	709
3.35x65mm Ring Nail	515	2	1030	475	713	872
3.35x65mm Smooth Nail	304	1	304	140	210	257

Notes: Ksys generally ignored, unless noted otherwise in connection calculations.

Minimum Fixing Spacings (as per BS EN 1995-1-1 Table 8.2, Load 90 Deg. to grain)

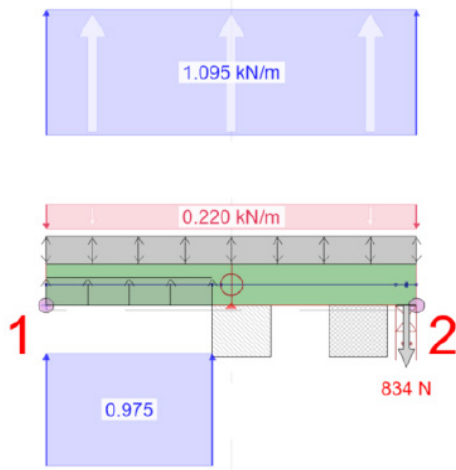


Minimum Fixing Spacings – Timber Frame ladder noggings where overhang slope length = 601-750mm (as per BS EN 1995-1-1 Table 8.2, Load 90 Deg. to grain)



Connection 1 – Gable Ladder to Trussed Rafter Connection

Worst Case; Wind Uplift in masonry construction where ladder is supported on first truss only in uplift condition.



Fixing = 1 Row 3.35x65mm Smooth Nails at 300mm staggered centres.

Under wind uplift forces It is assumed that any rotational forces due to the uplift can be resisted by the bending capacity of the continuous tiling battens. This applies where the moment due to a Nett Uplift design load of max 1.1 kN/m² factored is not exceeded. If this Nett Uplift load acting on the gable ladder is exceeded then additional fixings will be required to hold the gable ladder down to the substructure below (ie. straps to Masonry). The tiling battens are assumed to be 25x50mm, equivalent to C16 grade timber, at maximum 400mm spacings.

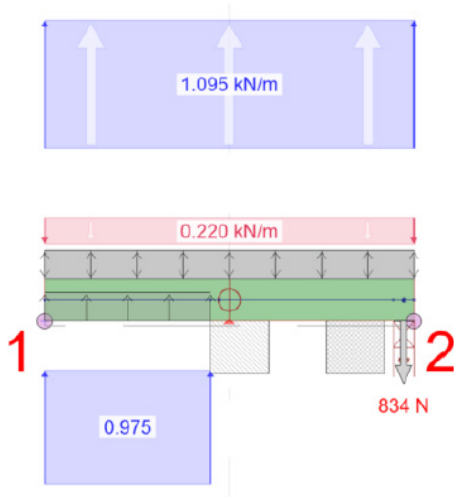
The Nett Uplift Load is assumed in this case to be:
1.5 x Wind Load (inc Cpe modifications) – 1.0 x Top Chord Dead Load

Design Load (Inst) = 1.1 kN/m² x 0.4 = 0.44 kN/m
Moment at connection = 0.44 x 0.635² / 2 = 0.089 kNm
Section modulus of batten, Z = 50*25²/6 = 5208 mm³
Design bending stress = 88710/5208 = 17.0 N/mm²
Design bending strength based on C16 = 1.1*1.1*16*1.3/1.3 = 19 N/mm²

Therefore the design is OK

Connection 2 – Gable Ladder Nogging to Inner Rail Connection

Worst Case; Wind Uplift in masonry construction where ladder is supported on first truss only in uplift condition



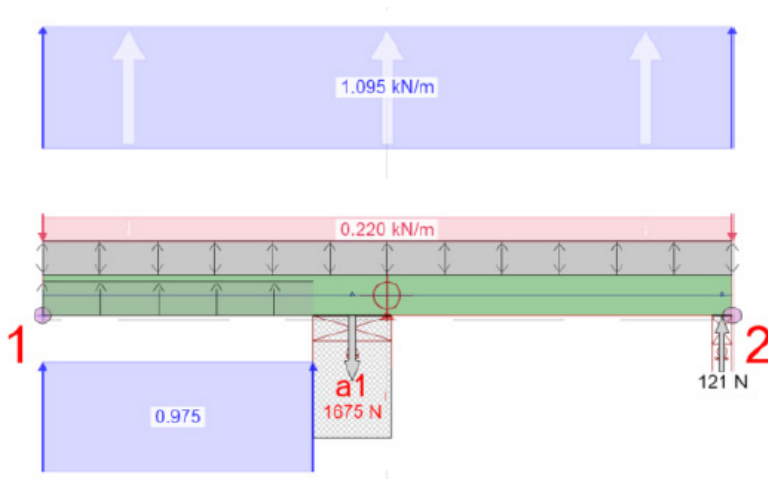
Fixing = 2no. 3.35x75mm Ring Nail into end grain of nogging

As per Connection 1, under wind uplift forces It is assumed that any rotational forces due to the uplift can be resisted by the bending capacity of the continuous tiling battens (refer to Connection 1 for verification)

Therefore the design is OK.

Connection 3 – Gable Ladder to Gable Panel Connection

Worst Case; Wind Uplift acting on gable ladder in Timber Frame/Gable Panel condition.



Standard Fixing = 1 No. Truss clip plus 2 No. 4.00dia x 90lg skew Ring Nails to alternate noggings (min 30mm penetration)

Design Load = 1675 x 2 (alternate noggings) = 3350 N (Inst)

Characteristic Capacity of truss clips range 3300 N – 5130 N (Simpson Strong-Tie, BPC Fixings, ITW Cullen)

Design Capacity truss clip = 3300 x 1.1 (Kmod) / 1.3 (Ym) = 2792 N

Design Capacity connection = 2792 (truss clip) + 684 (2no. 4.00x90 nails) = 3476 N (withdrawal in C16 panel)

Therefore Design is OK

Reduced Fixing = 2 No. 4.00dia x 90lg skew Ring Nails to each nogging (min 30mm penetration)

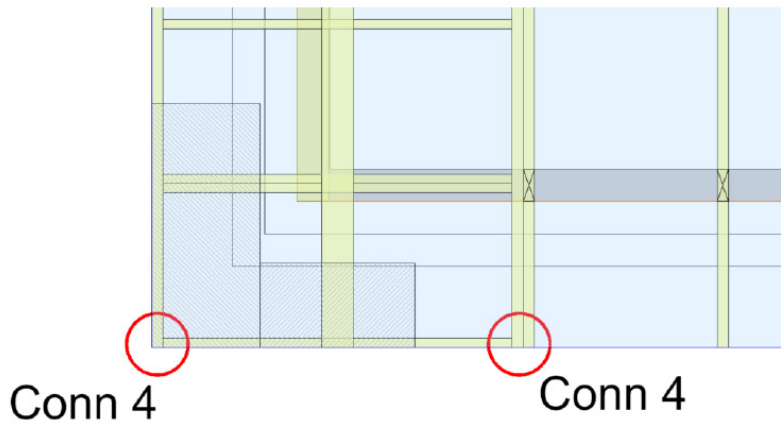
Design Load = 700 N/mm x 1.5 (Load factor) = 1050 N/mm (Inst)

Design Capacity = 684 / 0.6 (nogging centres) = 1140 N/mm (withdrawal in C16 panel)

Therefore Design is OK where unfactored nett uplift design load is < 0.7 kN/m

Connection 4 – Overhang Noggings to Inner/Outer Rail (Eaves Overhang ≤600mm on slope)

Worst Case; Permanent and Short term loading conditions



Fixing = 2no. 3.35x75mm Ring Nail into end grain of nogging

$$\text{Design Load (Perm)} = (0.3 \times 0.6 / 2) \times (900 \times 1.35) = 110 \text{ N (Perm)}$$

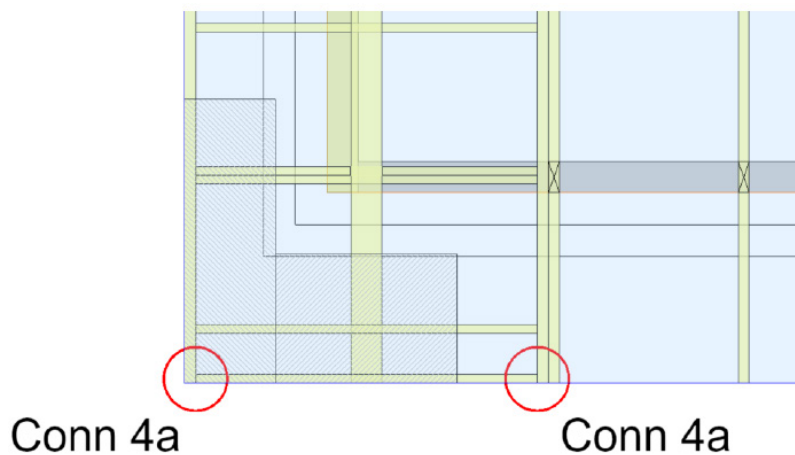
$$\text{Design Load (ST)} = (0.3 \times 0.6 / 2) \times [(900 \times 1.35 \times 0.925) + (600 \times 1.5)] = 182 \text{ N (ST)}$$

$$\text{Design Capacity} = 249 \text{ N (Perm) and } 374 \text{ N (ST)}$$

Therefore Design is OK

Connection 4a – Overhang Noggings to Inner/Outer Rail (Eaves Overhang 601-750mm on slope)

Worst Case; Permanent and Short term loading conditions



Fixing = 2no. 3.35x75mm Ring Nail into end grain of nogging

$$\text{Design Load (Perm)} = ((0.3+0.15) \times 0.6 / 2) \times (900 \times 1.35) = 164 \text{ N (Perm)}$$

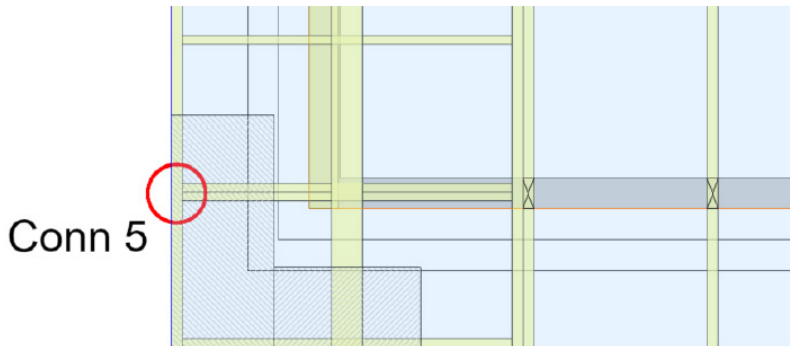
$$\text{Design Load (ST)} = ((0.3+0.15) \times 0.6 / 2) \times [(900 \times 1.35 \times 0.925) + (600 \times 1.5)] = 273 \text{ N (ST)}$$

$$\text{Design Capacity} = 249 \text{ N (Perm) and } 374 \text{ N (ST)}$$

Therefore Design is OK

Connection 5 – Outer Rail to Principle 2-Ply Nogging (Eaves Overhang ≤600mm on slope)

Worst Case; Permanent and Short term loading conditions



Fixing = 2 x 2no. 3.35x75mm Ring Nail into end grain of 2-Ply nogging

Design Load (Perm) = $(0.3 \times 0.9) \times (900 \times 1.35) + 110$ (Conn 4) = 438 N (Perm)

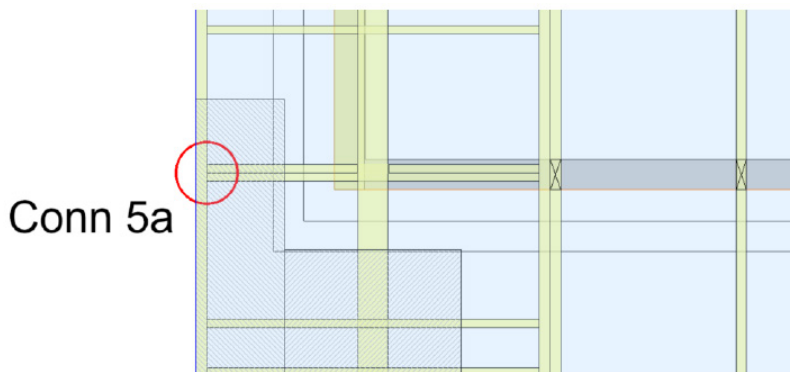
Design Load (ST) = $(0.3 \times 0.9) \times [(900 \times 1.35 \times 0.925) + (600 \times 1.5)] + 182$ (Conn 4) = 728 N (ST)

Design Capacity = $2 \times 249 = 498$ N (Perm), and $2 \times 374 = 748$ N (ST)

Therefore Design is OK

Connection 5a – Outer Rail to Principle 2-Ply Nogging (Eaves Overhang 601-750mm on slope)

Worst Case; Permanent and Short term loading conditions



Fixing = 2 x 3no. 3.35x75mm Ring Nail into end grain of 2-Ply nogging (Assumes min. 97mm nogging)

Design Load (Perm) = $(0.3 \times 1.05) \times (900 \times 1.35) + 164$ (Conn 4a) = 547 N (Perm)

Design Load (ST) = $(0.3 \times 1.05) \times [(900 \times 1.35 \times 0.925) + (600 \times 1.5)] + 273$ (Conn 4a) = 910 N (ST)

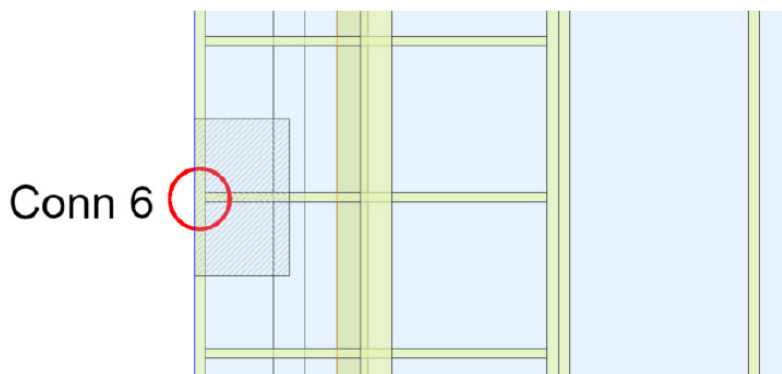
Design Capacity = $3 \times 249 = 747$ N (Perm), and $3 \times 374 = 1122$ N (ST)

Alternatively, if noggings <97mm deep, use 2 x 2no. 3.35x75mm Ring Nail into end grain of 2-Ply nogging plus a proprietary metalwork fixing (ie. mini joist hanger)

Therefore Design is OK

Connection 6 – Outer Rail to Standard Nogging

Worst Case; Permanent and Short term loading conditions



Fixing = 2no. 3.35x75mm Ring Nail into end grain of nogging

Design Load (Perm) = $(0.3 \times 0.6) \times (900 \times 1.35) = 220 \text{ N (Perm)}$

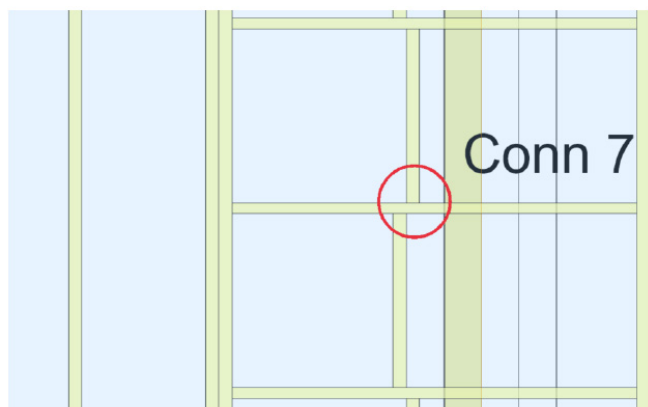
Design Load (ST) = $(0.3 \times 0.6) \times [(900 \times 1.35 \times 0.925) + (600 \times 1.5)] = 364 \text{ N (ST)}$

Design Capacity = 249 N (Perm) and 374 N (ST)

Therefore Design is OK

Connection 7 – Counter Nogging to Standard Nogging

Worst Case; Permanent and Short term loading conditions



Fixing = 2no. 3.35x75mm Ring Nail into end grain of nogging

Design Load (Perm) = $(0.3 \times 0.6) \times (900 \times 1.35) = 220 \text{ N (Perm)}$

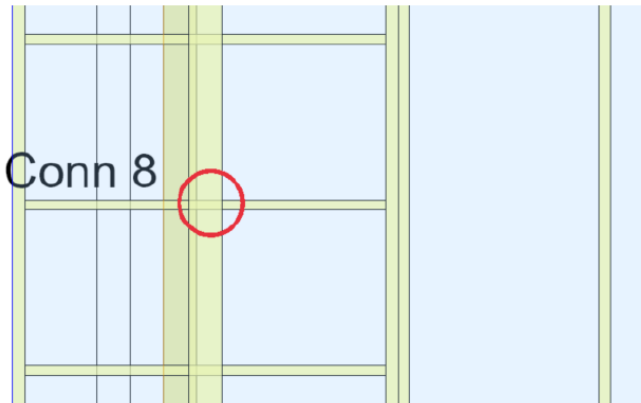
Design Load (ST) = $(0.3 \times 0.6) \times [(900 \times 1.35 \times 0.925) + (600 \times 1.5)] = 364 \text{ N (ST)}$

Design Capacity = 249 N (Perm) and 374 N (ST)

Therefore Design is OK

Connection 8 – Runner to Standard Nogging

Worst Case; Instantaneous Uplift loading conditions



Fixing = 2no. 3.35x65mm Ring Nail into top of nogging

$$\text{Design Load (Inst)} = (0.6 \times 0.6) \times [(1350 \times 0.9 \times 1.50) - (366 \times 1.0)] = 524 \text{ N (Inst)}$$

$$\text{Design Capacity} = 872 \text{ N (Inst)}$$

Therefore Design is OK

Consider Nail Head pull through, assuming min C16 grade runner and min 7mm diameter head

$$f_{\text{head,k}} = 70 \times 10^{-6} \times 310^2 = 6.73 \text{ N/mm}^2$$

$$F_{\text{ax,Rk}} = 6.73 \times 7^2 = 330 \text{ N}$$

$$\text{Design Capacity 2 Nails} = 2 \times 330 \times 1.1/1.3 = 558 \text{ N}$$

Therefore Design is OK

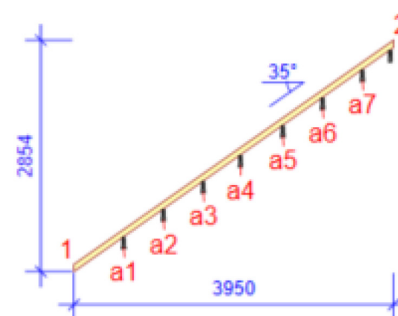
Annex B - Member Calculation Sheets

Outer Rail – max 635mm wide ladder – 35x72mm

Truss calculation performed with computer program MiTek Pamir

General project parameters

Basis of structural design	EN 1990:2002
Design of structures	EN 1995-1-1:2004 + A2:2014 + UK-NA+ PD6693-1:2012
Dead load and live load	EN 1991-1-1:2004 + UK-NA
Snow load	EN 1991-1-3:2003 + UK-NA
Wind load	EN 1991-1-4:2005 + A1:2010 + UK-NA
Manufacturing inspection	No
Service class	2 = 65% RH < 85%
Building category	Domestic
Load sharing factor	1.1
Spacing	300 mm
Number of plies	1



Deviating parameters that apply to this part of the truss are specified in the “Timber parameters” table.
 The shape of the truss is shown in the accompanying drawing.
 Forces are calculated according to first order deflection theory.
 Effect of shear deformation has been taken into account.

Timber parameters

Timber group	Joints	Cross section mm	Grade	Bracing mm/ no.	SSI %	CSI %
Top chord Left	1-2	35x97	C24	360	36	58

Max node deflection

Load case type: combined

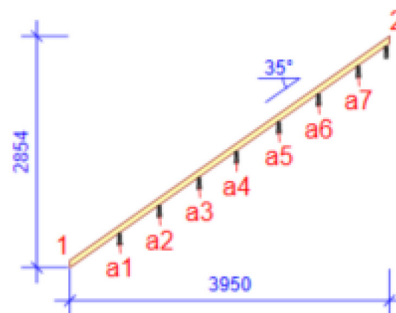
Situation	Joints	Absolute mm	Negative deflection mm	Ratio %
Wnet, fin	1	8,2	-2.7	33.0

Outer Rail – max 1235mm wide ladder – 35x97mm

Truss calculation performed with computer program MiTek Pamir

General project parameters

Basis of structural design	EN 1990:2002
Design of structures	EN 1995-1-1:2004 + A2:2014 + UK-NA+ PD6693-1:2012
Dead load and live load	EN 1991-1-1:2004 + UK-NA
Snow load	EN 1991-1-3:2003 + UK-NA
Wind load	EN 1991-1-4:2005 + A1:2010 + UK-NA
Manufacturing inspection	No
Service class	2 = 65% RH < 85%
Building category	Domestic
Load sharing factor	1.1
Spacing	600 mm
Number of plies	1



Deviating parameters that apply to this part of the truss are specified in the “Timber parameters” table.

The shape of the truss is shown in the accompanying drawing.

Forces are calculated according to first order deflection theory.

Effect of shear deformation has been taken into account.

Timber parameters

Timber group	Joints	Cross section mm	Grade	Bracing mm/ no.	SSI %	CSI %
Top chord Left	1-2	35x97	C24	360	36	58

Max node deflection

Load case type: combined

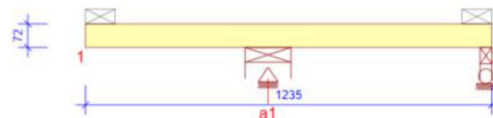
Situation	Joints	Absolute mm	Negative deflection mm	Ratio %
Wnet, fin	1	8,2	-4.1	49,5

Nogging – Timber Frame Construction – 35x72mm (1-Ply)

Truss calculation performed with computer program MiTek Pamir

General project parameters

Basis of structural design	EN 1990:2002
Design of structures	EN 1995-1-1:2004 + A2:2014 + UK-NA+ PD6693-1:2012
Dead load and live load	EN 1991-1-1:2004 + UK-NA
Snow load	EN 1991-1-3:2003 + UK-NA
Wind load	EN 1991-1-4:2005 + A1:2010 + UK-NA
Manufacturing inspection	No
Service class	2 = 65% RH < 85%
Building category	Domestic
Load sharing factor	1.1
Spacing	600 mm
Number of plies	1



Deviating parameters that apply to this part of the truss are specified in the “Timber parameters” table.

The shape of the truss is shown in the accompanying drawing.

Forces are calculated according to first order deflection theory.

Effect of shear deformation has been taken into account.

Timber parameters

Timber group	Joints	Cross section mm	Grade	Bracing mm/ no.	SSI %	CSI %
Top chord Left	1-2	35x72	C24	1235	48	78

Max node deflection

Load case type: combined

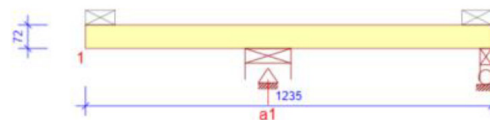
Situation	Joints	Absolute mm	Negative deflection mm	Ratio %
Wnet, fin	1	7.4	-2.9	39.8

Principle Nogging – Timber Frame Construction – 35x72mm (2-Ply)

Truss calculation performed with computer program MiTek Pamir

General project parameters

Basis of structural design	EN 1990:2002
Design of structures	EN 1995-1-1:2004 + A2:2014 + UK-NA+ PD6693-1:2012
Dead load and live load	EN 1991-1-1:2004 + UK-NA
Snow load	EN 1991-1-3:2003 + UK-NA
Wind load	EN 1991-1-4:2005 + A1:2010 + UK-NA
Manufacturing inspection	No
Service class	2 = 65% RH < 85%
Building category	Domestic
Load sharing factor	1.1
Spacing	600 mm
Number of plies	2



Deviating parameters that apply to this part of the truss are specified in the “Timber parameters” table.

The shape of the truss is shown in the accompanying drawing.

Forces are calculated according to first order deflection theory.

Effect of shear deformation has been taken into account.

Forces are shown for a single truss, support reactions are shown for all plies together.

Timber parameters

Timber group	Joints	Cross section mm	Grade	Bracing mm/ no.	SSI %	CSI %
Top chord Left	1-2	35x72	C24	1235	32	59

Max node deflection

Load case type: combined

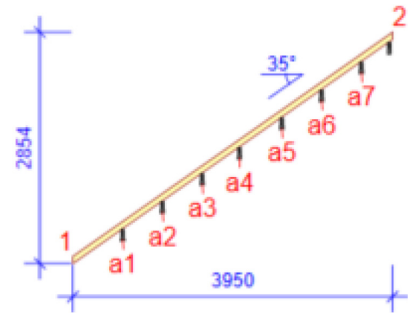
Situation	Joints	Absolute mm	Negative deflection mm	Ratio %
Wnet, fin	1	7.4	-6.6	89.4

Runner – max 1235mm wide ladder – 25x100 (assumed min. C16 Grade)

Truss calculation performed with computer program MiTek Pamir

General project parameters

Basis of structural design	EN 1990:2002
Design of structures	EN 1995-1-1:2004 + A2:2014 + UK-NA+ PD6693-1:2012
Dead load and live load	EN 1991-1-1:2004 + UK-NA
Snow load	EN 1991-1-3:2003 + UK-NA
Wind load	EN 1991-1-4:2005 + A1:2010 + UK-NA
Manufacturing inspection	No
Service class	2 = 65% RH < 85%
Building category	Domestic
Load sharing factor	1.1
Spacing	600 mm
Number of plies	1



Deviating parameters that apply to this part of the truss are specified in the “Timber parameters” table.

The shape of the truss is shown in the accompanying drawing.

Forces are calculated according to first order deflection theory.

Effect of shear deformation has been taken into account.

Timber parameters

Timber group	Joints	Cross section mm	Grade	Bracing mm/ no.	SSI %	CSI %
Top chord Left	1-2	25x100	C16	360	29	92

Max node deflection

Load case type: combined

Situation	Joints	Absolute mm	Positive deflection mm	Ratio %
Wnet, fin	1	3	0.3	10.8