

Job No.: 2405053-5**Address:** 270 Mt Heslington Road, Brightwater, New Zealand**Date:** 29/07/2024**Latitude:** -41.40327**Longitude:** 173.101149**Elevation:** 81.5 m**General Input**

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N0	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	500 Years	Max Height	6.7 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	44.54 m/s
Wind Pressure	1.19 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	Very High	Earthquake ARI	100		

Note: Wind lateral loads are governing over Earthquake loads, So only wind loads are considered in calculations

Pressure Coefficients and Pressures

Shed Type = Gable Enclosed

For roof $C_{p,i} = -0.3$

For roof $C_{p,e}$ from 0 m To 3.08 m $C_{p,e} = -0.992$ $p_e = -1.06$ KPa $p_{net} = -1.06$ KPa

For roof $C_{p,e}$ from 3.08 m To 6.15 m $C_{p,e} = -0.854$ $p_e = -0.91$ KPa $p_{net} = -0.91$ KPa

For wall Windward $C_{p,i} = -0.3$ side Wall $C_{p,i} = -0.3$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 8 m $C_{p,e} = 0.7$ $p_e = 0.75$ KPa $p_{net} = 1.11$ KPa

For side wall $C_{p,e}$ from 0 m To 6.15 m $C_{p,e} =$ $p_e = -0.7$ KPa $p_{net} = -0.7$ KPa

Maximum Upward pressure used in roof member Design = 1.06 KPa

Maximum Downward pressure used in roof member Design = 0.29 KPa

Maximum Wall pressure used in Design = 1.11 KPa

Maximum Racking pressure used in Design = 1.08 KPa

Design Summary**Rafter Design Internal**

Internal Rafter Load Width = 5000 mm

Internal Rafter Span = 7850 mm

Try Rafter 2x360x45 LVL13

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 1.00 S1 Downward = 8.40 S1 Upward = 8.40

Shear Capacity of timber = 5.3 MPa Bending Capacity of timber = 48 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	13.00 Kn-m	Capacity	43.44 Kn-m	Passing Percentage	334.15 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	26.00 Kn-m	Capacity	57.92 Kn-m	Passing Percentage	222.77 %
M _{0.9D-W_nUp}	-32.16 Kn-m	Capacity	-72.42 Kn-m	Passing Percentage	225.19 %
V _{1.35D}	6.62 Kn	Capacity	55.22 Kn	Passing Percentage	834.14 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	13.25 Kn	Capacity	73.64 Kn	Passing Percentage	555.77 %
V _{0.9D-WnUp}	-16.39 Kn	Capacity	-92.04 Kn	Passing Percentage	561.56 %

Deflections

Modulus of Elasticity = 11000 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 18.705 mm	Limit by Woolcock et al, 1999 Span/240 = 33.33 mm
Deflection under Dead and Service Wind = 22.345 mm	Limit by Woolcock et al, 1999 Span/100 = 80.00 mm

Reactions

Maximum downward = 13.25 kn Maximum upward = -16.39 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 2

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Joint Group for Rafters = J2 Joint Group for Pole = J5

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 60 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 12.6 f_{pj} = 22.7 Mpa for Rafter with effective thickness = 90 mm

For Parallel to grain loading

K₁₁ = 2.0 f_{cj} = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 29.11 Kn > -16.39 Kn

Rafter Design External

External Rafter Load Width = 2500 mm	External Rafter Span = 8097 mm	Try Rafter 300x45 LVL13
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Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K₁ Short term = 1 K₁ Medium term = 0.8 K₁ Long term = 0.6 K₄ = 1 K₅ = 1 K₈ Downward = 0.88

K₈ Upward = 0.88 S₁ Downward = 15.50 S₁ Upward = 15.50

Shear Capacity of timber = 5.3 MPa Bending Capacity of timber = 48 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	6.91 Kn-m	Capacity	13.69 Kn-m	Passing Percentage	198.12 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	13.83 Kn-m	Capacity	18.26 Kn-m	Passing Percentage	132.03 %
M _{0.9D-WnUp}	-17.11 Kn-m	Capacity	-22.82 Kn-m	Passing Percentage	133.37 %
V _{1.35D}	3.42 Kn	Capacity	23.01 Kn	Passing Percentage	672.81 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	6.83 Kn	Capacity	30.68 Kn	Passing Percentage	449.19 %
V _{0.9D-WnUp}	-8.45 Kn	Capacity	-38.35 Kn	Passing Percentage	453.85 %

Deflections

Modulus of Elasticity = 11000 MPa NZS3603 Amt 4, Table 2.3

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 35.91 mm

Limit by Woolcock et al, 1999 Span/240 = 33.33 mm

Deflection under Dead and Service Wind = 38.61 mm

Limit by Woolcock et al, 1999 Span/100 = 80.00 mm

Reactions

Maximum downward = 6.83 kn Maximum upward = -8.45 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 2

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Joint Group for Rafters = J2 Joint Group for Pole = J5

Factor of Safety = 0.7

For Perpendicular to grain loading

K11 = 12.6 fpj = 22.7 Mpa for Rafter with effective thickness = 45 mm

For Parallel to grain loading

K11 = 2.0 fcj = 36.1 Mpa for Pole with effective thickness = 100 mm

Eccentric Load check

V = $\phi \times k1 \times k4 \times k5 \times fs \times b \times ds$ (Eq 4.12) = -40.07 kn > -8.45 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -8.45 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2500 mm

Intermediate Span = 5450 mm

Try Intermediate 2x250x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1 K4 = 1 K5 = 1 K8 Downward = 0.97

K8 Upward = 1.00 S1 Downward = 12.68 S1 Upward = 0.99

Shear Capacity of timber = 3 MPa Bending Capacity of timber = 14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{Wind+Snow}	10.30 Kn-m	Capacity	11.66 Kn-m	Passing Percentage	113.20 %
V _{0.9D-WnUp}	7.56 Kn	Capacity	-40.2 Kn	Passing Percentage	531.75 %

Deflections

Modulus of Elasticity = 5400 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 45.33 mm

Limit by Woolcock et al, 1999 Span/100 = 54.50 mm

Reactions

Maximum = 7.56 kn

Girt Design Front and Back

Girt's Spacing = 1200 mm

Girt's Span = 2500 mm

Try Girt 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and does not remain in continuous wet condition after installation)

K1 Short term = 1 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.86 S1 Downward =9.63 S1 Upward =16.05

Shear Capacity of timber =3 MPa Bending Capacity of timber =14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

$M_{Wind+Snow}$	1.04 Kn-m	Capacity	1.80 Kn-m	Passing Percentage	173.08 %
$V_{0.9D-WnUp}$	1.67 Kn	Capacity	12.06 Kn	Passing Percentage	722.16 %

Deflections

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 7.19 mm

Limit by Woolcock et al, 1999 Span/100 = 25.00 mm

Sag during installation = 2.37 mm

Reactions

Maximum = 1.67 kn

Girt Design Sides

Girt's Spacing = 0 mm

Girt's Span = 4000 mm

Try Girt 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and does not remain in continuous wet condition after installation)

K1 Short term = 1 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.65 S1 Downward =9.63 S1 Upward =20.31

Shear Capacity of timber =3 MPa Bending Capacity of timber =14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

$M_{Wind+Snow}$	0.00 Kn-m	Capacity	1.38 Kn-m	Passing Percentage	Infinity %
$V_{0.9D-WnUp}$	0.00 Kn	Capacity	12.06 Kn	Passing Percentage	Infinity %

Deflections

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 0.00 mm

Limit by Woolcock et al. 1999 Span/100 = 40.00 mm

Sag during installation =15.52 mm

Reactions

Maximum = 0.00 kn

Uplift Check

Density of Concrete = 24 Kn/m³

Density of Timber Pole = 5 Kn/m³

Due to cast in place pile, the surface interaction between soil and pile will be rough thus angle of friction between both is taken equal to soil angle of internal friction

Ks (Lateral Earth Pressure Coefficient) for cast into place concrete piles = 1.5

Formula to calculate Skin Friction = Safety factor (0.55) x Density of Soil(18) x Height of Pile(2400) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(2400)

Skin Friction = 46.52 Kn

Weight of Pile + Pile Skin Friction = 50.15 Kn

Uplift on one Pile = 16.70 Kn

Uplift is ok