

Job No.: 2405053 - 1**Address:** 270 Mt Heslington Road, Brightwater, New Zealand**Date:** 22/07/2024**Latitude:** -41.403304**Longitude:** 173.101144**Elevation:** 82 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	100 Years	Max Height	5.6 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	40.91 m/s
Wind Pressure	1 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	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 2.67 m $C_{p,e} = -0.9272$ $p_e = -0.84$ KPa $p_{net} = -0.84$ KPa

For roof $C_{p,e}$ from 2.67 m To 5.34 m $C_{p,e} = -0.8864$ $p_e = -0.80$ KPa $p_{net} = -0.80$ 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 19.6 m $C_{p,e} = 0.7$ $p_e = 0.63$ KPa $p_{net} = 0.63$ KPa

For side wall $C_{p,e}$ from 0 m To 5.34 m $C_{p,e} =$ $p_e = -0.59$ KPa $p_{net} = -0.59$ KPa

Maximum Upward pressure used in roof member Design = 0.84 KPa

Maximum Downward pressure used in roof member Design = 0.28 KPa

Maximum Wall pressure used in Design = 0.63 KPa

Maximum Racking pressure used in Design = 0.91 KPa

Design Summary**Purlin Design**

Purlin Spacing = 700 mm

Purlin Span = 4850 mm

Try Purlin 200x50 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 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 0.43 S1 Downward = 11.27 S1 Upward = 26.03

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

Capacity Checks

$M_{1.35D}$	0.69 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	323.19 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	1.95 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	152.31 %
$M_{0.9D-W_nUp}$	-1.27 Kn-m	Capacity	-1.59 Kn-m	Passing Percentage	85.03 %
$V_{1.35D}$	0.57 Kn	Capacity	9.65 Kn	Passing Percentage	1692.98 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.15 Kn	Capacity	12.86 Kn	Passing Percentage	1118.26 %
V _{0.9D-WnUp}	-1.04 Kn	Capacity	-16.08 Kn	Passing Percentage	1546.15 %

Deflections

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3 considering at least 4 members acting together

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 13.00 mm Limit by Woolcock et al, 1999 Span/240 = 20.00 mm

Deflection under Dead and Service Wind = 13.87 mm Limit by Woolcock et al, 1999 Span/100 = 48.00 mm

Reactions

Maximum downward = 1.15 kn Maximum upward = -1.04 kn

Number of Blocking = 0 if 0 then no blocking required, if 1 then one midspan blocking required

Rafter Design Internal

Internal Rafter Load Width = 5000 mm Internal Rafter Span = 7849.999999999999 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+Sn 1.2D+WnDn}	26.00 Kn-m	Capacity	57.92 Kn-m	Passing Percentage	222.77 %
M _{0.9D-WnUp}	-23.69 Kn-m	Capacity	-72.42 Kn-m	Passing Percentage	305.70 %
V _{1.35D}	6.62 Kn	Capacity	55.22 Kn	Passing Percentage	834.14 %
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}	-12.07 Kn	Capacity	-92.04 Kn	Passing Percentage	762.55 %

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 = 22.17 mm Limit by Woolcock et al, 1999 Span/100 = 80.00 mm

Reactions

Maximum downward = 13.25 kn Maximum upward = -12.07 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

$K_{11} = 12.6$ fpj = 22.7 Mpa for Rafter with effective thickness = 90 mm

For Parallel to grain loading

$K_{11} = 2.0$ fcj = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 29.11 Kn > -12.07 Kn

Rafter Design External

External Rafter Load Width = 2500 mm

External Rafter Span = 8097 mm

Try Rafter 360x45 LVL13

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

K_1 Short term = 1 K_1 Medium term = 0.8 K_1 Long term = 0.6 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.81

K_8 Upward = 0.81 S_1 Downward = 17.01 S_1 Upward = 17.01

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	17.70 Kn-m	Passing Percentage	256.15 %
$M_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	13.83 Kn-m	Capacity	23.60 Kn-m	Passing Percentage	170.64 %
$M_{0.9D-W_nUp}$	-12.60 Kn-m	Capacity	-29.50 Kn-m	Passing Percentage	234.13 %
$V_{1.35D}$	3.42 Kn	Capacity	27.61 Kn	Passing Percentage	807.31 %
$V_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	6.83 Kn	Capacity	36.82 Kn	Passing Percentage	539.09 %
$V_{0.9D-W_nUp}$	-6.22 Kn	Capacity	-46.02 Kn	Passing Percentage	739.87 %

Deflections

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

k_2 for Long Term Loads = 2

Deflection under Dead and Live Load = 20.78 mm

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

Deflection under Dead and Service Wind = 22.17 mm

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

Reactions

Maximum downward = 6.83 kn Maximum upward = -6.22 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

$K_{11} = 12.6$ fpj = 22.7 Mpa for Rafter with effective thickness = 45 mm

For Parallel to grain loading

$K_{11} = 2.0 f_{cj} = 36.1 \text{ Mpa}$ for Pole with effective thickness = 100 mm

Eccentric Load check

$V = \phi_i \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots (\text{Eq 4.12}) = -50.09 \text{ kn} > -6.22 \text{ Kn}$

Single Shear Capacity under short term loads = -14.56 Kn > -6.22 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2500 mm Intermediate Span = 2754 mm Try Intermediate 2x150x50 SG8 Dry

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

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 1.00

K_8 Upward = 1.00 S_1 Downward = 9.63 S_1 Upward = 0.53

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

Capacity Checks

$M_{\text{Wind+Snow}}$	1.49 Kn-m	Capacity	4.2 Kn-m	Passing Percentage	281.88 %
$V_{0.9D-WnUp}$	2.17 Kn	Capacity	-24.12 Kn	Passing Percentage	1111.52 %

Deflections

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

Deflection under Snow and Service Wind = 7.77 mm Limit by Woolcock et al, 1999 Span/100 = 27.54 mm

Reactions

Maximum = 2.17 kn

Intermediate Design Sides

Intermediate Spacing = 4000 mm Intermediate Span = 4776 mm Try Intermediate 2x200x50 SG8 Dry

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

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 1.00

K_8 Upward = 1.00 S_1 Downward = 11.27 S_1 Upward = 0.82

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

Capacity Checks

$M_{\text{Wind+Snow}}$	3.59 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	207.80 %
$V_{0.9D-WnUp}$	3.01 Kn	Capacity	32.16 Kn	Passing Percentage	1068.44 %

Deflections

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

Deflection under Snow and Service Wind = 47.425 mm Limit by Woolcock et al, 1999 Span/100 = 47.76 mm

Reactions

Maximum = 3.01 kn

Girt Design Front and Back

Girt's Spacing = 1300 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

$M_{Wind+Snow}$	0.64 Kn-m	Capacity	1.80 Kn-m	Passing Percentage	281.25 %
$V_{0.9D-WnUp}$	1.02 Kn	Capacity	12.06 Kn	Passing Percentage	1182.35 %

Deflections

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

Deflection under Snow and Service Wind = 4.42 mm

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

Sag during installation = 2.37 mm

Reactions

Maximum = 1.02 kn

Girt Design Sides

Girt's Spacing = 1300 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

$M_{Wind+Snow}$	1.64 Kn-m	Capacity	1.38 Kn-m	Passing Percentage	84.15 %
$V_{0.9D-WnUp}$	1.64 Kn	Capacity	12.06 Kn	Passing Percentage	735.37 %

Deflections

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

Deflection under Snow and Service Wind = 28.98 mm

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

Sag during installation =15.52 mm

Reactions

Maximum = 1.64 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(1600) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1600)

Skin Friction = 20.68 Kn

Weight of Pile + Pile Skin Friction = 24.34 Kn

Uplift on one Pile = 24.60 Kn

Uplift is ok