



**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	<b>323.19 %</b>
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	1.95 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	<b>152.31 %</b>
$M_{0.9D-W_nUp}$	-1.27 Kn-m	Capacity	-1.59 Kn-m	Passing Percentage	<b>125.20 %</b>
$V_{1.35D}$	0.57 Kn	Capacity	9.65 Kn	Passing Percentage	<b>1692.98 %</b>

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V <sub>1.2D+1.5L 1.2D+Sn 1.2D+WnDn</sub>	1.15 Kn	Capacity	12.86 Kn	Passing Percentage	<b>1118.26 %</b>
V <sub>0.9D-WnUp</sub>	-1.04 Kn	Capacity	-16.08 Kn	Passing Percentage	<b>1546.15 %</b>

**Deflections**

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

k<sub>2</sub> 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)

K<sub>1</sub> Short term = 1 K<sub>1</sub> Medium term = 0.8 K<sub>1</sub> Long term = 0.6 K<sub>4</sub> = 1 K<sub>5</sub> = 1 K<sub>8</sub> Downward = 1.00

K<sub>8</sub> Upward = 1.00 S<sub>1</sub> Downward = 8.40 S<sub>1</sub> 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 <sub>1.35D</sub>	13.00 Kn-m	Capacity	43.44 Kn-m	Passing Percentage	<b>334.15 %</b>
M <sub>1.2D+1.5L 1.2D+Sn 1.2D+WnDn</sub>	26.00 Kn-m	Capacity	57.92 Kn-m	Passing Percentage	<b>222.77 %</b>
M <sub>0.9D-WnUp</sub>	-23.69 Kn-m	Capacity	-72.42 Kn-m	Passing Percentage	<b>305.70 %</b>
V <sub>1.35D</sub>	6.62 Kn	Capacity	55.22 Kn	Passing Percentage	<b>834.14 %</b>
V <sub>1.2D+1.5L 1.2D+Sn 1.2D+WnDn</sub>	13.25 Kn	Capacity	73.64 Kn	Passing Percentage	<b>555.77 %</b>
V <sub>0.9D-WnUp</sub>	-12.07 Kn	Capacity	-92.04 Kn	Passing Percentage	<b>762.55 %</b>

**Deflections**

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

k<sub>2</sub> 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

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

For Parallel to grain loading

$K_{11} = 2.0 \text{ fcj} = 36.1 \text{ Mpa}$  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 = 5131 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

$M_{1.35D}$	2.78 Kn-m	Capacity	17.70 Kn-m	Passing Percentage	<b>636.69 %</b>
$M_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	5.55 Kn-m	Capacity	23.60 Kn-m	Passing Percentage	<b>425.23 %</b>
$M_{0.9D-W_nUp}$	-5.06 Kn-m	Capacity	-29.50 Kn-m	Passing Percentage	<b>583.00 %</b>
$V_{1.35D}$	2.16 Kn	Capacity	27.61 Kn	Passing Percentage	<b>1278.24 %</b>
$V_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	4.33 Kn	Capacity	36.82 Kn	Passing Percentage	<b>850.35 %</b>
$V_{0.9D-W_nUp}$	-3.94 Kn	Capacity	-46.02 Kn	Passing Percentage	<b>1168.02 %</b>

### 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 = 3.54 mm

Limit by Woolcock et al, 1999 Span/240 = 21.42 mm

Deflection under Dead and Service Wind = 3.78 mm

Limit by Woolcock et al, 1999 Span/100 = 51.40 mm

### Reactions

Maximum downward = 4.33 kn    Maximum upward = -3.94 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

$K_{11} = 12.6 \text{ fpj} = 22.7 \text{ Mpa}$  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

$V = \phi_i \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots (\text{Eq 4.12}) = -50.09 \text{ kn} > -3.94 \text{ Kn}$

Single Shear Capacity under short term loads = -14.56 Kn > -3.94 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	<b>281.88 %</b>
$V_{0.9D-WnUp}$	2.17 Kn	Capacity	-24.12 Kn	Passing Percentage	<b>1111.52 %</b>

#### 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 = 2570.0064512406843 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

$M_{\text{Wind+Snow}}$	2.31 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	<b>322.94 %</b>
$V_{0.9D-WnUp}$	1.93 Kn	Capacity	32.16 Kn	Passing Percentage	<b>1666.32 %</b>

#### Deflections

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

Deflection under Snow and Service Wind = 30.47 mm                      Limit by Woolcock et al, 1999 Span/100 = 47.76 mm

**Reactions**

Maximum = 1.93 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	<b>281.25 %</b>
$V_{0.9D-WnUp}$	1.02 Kn	Capacity	12.06 Kn	Passing Percentage	<b>1182.35 %</b>

**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 = 2570 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 =0.85    S1 Downward =9.63    S1 Upward =16.28

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

**Capacity Checks**

$M_{Wind+Snow}$	0.68 Kn-m	Capacity	1.78 Kn-m	Passing Percentage	<b>261.76 %</b>
$V_{0.9D-WnUp}$	1.05 Kn	Capacity	12.06 Kn	Passing Percentage	<b>1148.57 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 4.94 mm

Limit by Woolcock et al. 1999 Span/100 = 25.70 mm

Sag during installation =2.65 mm

**Reactions**

Maximum = 1.05 kn

## **Uplift Check**

Density of Concrete = 24 Kn/m<sup>3</sup>

Density of Timber Pole = 5 Kn/m<sup>3</sup>

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