

Job No.: Preston & Shontelle Mosely
Latitude: -35.590024

Address: 117A King Street, Hikurangi, New Zealand
Longitude: 174.283051

Date: 18/09/2024
Elevation: 120 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	1	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	3.6 m
Wind Region	NZ1	Terrain Category	2.21	Design Wind Speed	36.48 m/s
Wind Pressure	0.8 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	Medium	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 1.65 m $C_{p,e} = -1.028$ $p_e = -0.74$ KPa $p_{net} = -0.74$ KPa

For roof $C_{p,e}$ from 1.65 m To 3.3 m $C_{p,e} = -0.836$ $p_e = -0.60$ KPa $p_{net} = -0.60$ 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 12 m $C_{p,e} = 0.7$ $p_e = 0.50$ KPa $p_{net} = 0.74$ KPa

For side wall $C_{p,e}$ from 0 m To 3.3 m $C_{p,e} =$ $p_e = -0.46$ KPa $p_{net} = -0.46$ KPa

Maximum Upward pressure used in roof member Design = 0.74 KPa

Maximum Downward pressure used in roof member Design = 0.48 KPa

Maximum Wall pressure used in Design = 0.74 KPa

Maximum Racking pressure used in Design = 0.7 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 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

$M_{1.35D}$	0.89 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	250.56 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	2.13 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	139.44 %
$M_{0.9D-W_nUp}$	-1.36 Kn-m	Capacity	-1.59 Kn-m	Passing Percentage	84.57 %
$V_{1.35D}$	0.74 Kn	Capacity	9.65 Kn	Passing Percentage	1304.05 %

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V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.70 Kn	Capacity	12.86 Kn	Passing Percentage	756.47 %
V _{0.9D-W_nUp}	-1.12 Kn	Capacity	-16.08 Kn	Passing Percentage	1435.71 %

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 = 16.71 mm Limit by Woolcock et al, 1999 Span/240 = 20.00 mm

Deflection under Dead and Service Wind = 20.61 mm Limit by Woolcock et al, 1999 Span/100 = 48.00 mm

Reactions

Maximum downward = 1.70 kn Maximum upward = -1.12 kn

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

Rafter Design External

External Rafter Load Width = 2500 mm External Rafter Span = 5830 mm Try Rafter 300x50 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 = 0.94

K₈ Upward = 0.94 S₁ Downward = 13.93 S₁ Upward = 13.93

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

Capacity Checks

M _{1.35D}	3.58 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	131.84 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	8.28 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	76.09 %
M _{0.9D-W_nUp}	-5.47 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	143.88 %
V _{1.35D}	2.46 Kn	Capacity	14.47 Kn	Passing Percentage	588.21 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.68 Kn	Capacity	19.30 Kn	Passing Percentage	339.79 %
V _{0.9D-W_nUp}	-3.75 Kn	Capacity	-24.12 Kn	Passing Percentage	643.20 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 20.83 mm Limit by Woolcock et al, 1999 Span/240 = 25.00 mm

Deflection under Dead and Service Wind = 25.69 mm Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward = 5.68 kn Maximum upward = -3.75 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 = J5 Joint Group for Pole = J5

Factor of Safety = 0.7

For Perpendicular to grain loading

$K_{11} = 14.9 \text{ f}_{pj} = 12.9 \text{ Mpa}$ for Rafter with effective thickness = 50 mm

For Parallel to grain loading

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

Eccentric Load check

$V = \phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots (\text{Eq 4.12}) = -25.20 \text{ kn} > -3.75 \text{ Kn}$

Single Shear Capacity under short term loads = -10.84 Kn > -3.75 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2500 mm Intermediate Span = 2849 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 = 0.54

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

Capacity Checks

$M_{\text{Wind+Snow}}$	1.88 Kn-m	Capacity	4.2 Kn-m	Passing Percentage	223.40 %
$V_{0.9D-WnUp}$	2.64 Kn	Capacity	-24.12 Kn	Passing Percentage	913.64 %

Deflections

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

Deflection under Snow and Service Wind = 10.45 mm Limit by Woolcock et al, 1999 Span/100 = 28.49 mm

Reactions

Maximum = 2.64 kn

Intermediate Design Sides

Intermediate Spacing = 3000 mm Intermediate Span = 3150 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 = 0.57

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

Capacity Checks

$M_{\text{Wind+Snow}}$	1.38 Kn-m	Capacity	4.2 Kn-m	Passing Percentage	304.35 %
$V_{0.9D-WnUp}$	1.75 Kn	Capacity	24.12 Kn	Passing Percentage	1378.29 %

Deflections

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

Deflection under Snow and Service Wind = 18.725 mm

Limit by Woolcock et al, 1999 Span/100 = 31.50 mm

Reactions

Maximum = 1.75 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}	0.75 Kn-m	Capacity	1.80 Kn-m	Passing Percentage	240.00 %
V _{0.9D-WnUp}	1.20 Kn	Capacity	12.06 Kn	Passing Percentage	1005.00 %

Deflections

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

Deflection under Snow and Service Wind = 5.19 mm

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

Sag during installation = 2.37 mm

Reactions

Maximum = 1.20 kn

Girt Design Sides

Girt's Spacing = 1300 mm

Girt's Span = 3000 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 =0.79 S1 Downward =9.63 S1 Upward =17.59

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

Capacity Checks

M _{Wind+Snow}	1.08 Kn-m	Capacity	1.65 Kn-m	Passing Percentage	152.78 %
V _{0.9D-WnUp}	1.44 Kn	Capacity	12.06 Kn	Passing Percentage	837.50 %

Deflections

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

Deflection under Snow and Service Wind = 10.77 mm

Limit by Woolcock et al. 1999 Span/100 = 30.00 mm

Sag during installation =4.91 mm

Reactions

Maximum = 1.44 kn

End Pole Design

Geometry For End Bay Pole

Geometry

150 SED H5 (Minimum 175 dia. at Floor Level)	Dry Use	Height	3300 mm
Area	8125 mm ²	As	6093.75 mm ²
Ix	17879232 mm ⁴	Zx	220052 mm ³
Iy	17879232 mm ⁴	Zy	220052 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 15 m²

Dead	3.75 Kn	Live	3.75 Kn
Wind Down	7.20 Kn	Snow	0.00 Kn
Moment Wind	2.83 Kn-m		
Phi	0.8	K8	0.66
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Peeling	Steaming	Normal	Dry Use
fb =	36.3 MPa	fs =	2.96 MPa
fc =	18 MPa	fp =	7.2 MPa
ft =	22 MPa	E =	9257 MPa

Capacities

PhiNcx Wind	76.66 Kn	PhiMnx Wind	4.19 Kn-m	PhiVnx Wind	14.43 Kn
PhiNcx Dead	46.00 Kn	PhiMnx Dead	2.51 Kn-m	PhiVnx Dead	8.66 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.87 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.65 < 1$ OK

Deflection at top under service lateral loads = 31.04 mm < 35.91 mm

Ds =	0.6 mm	Pile Diameter
L =	1300 mm	Pile embedment length
f1 =	2700 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 15 m²

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Moment Wind = 2.83 Kn-m
Shear Wind = 1.05 Kn

Pile Properties

Safety Factor 0.55
Hu = 4.89 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 7.84 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.36 < 1 OK

Drained Lateral Strength of End pile in cohesionless soils Free Head short pile

Assumed Soil Properties

Gamma 18 Kn/m³ Friction angle 30 deg Cohesion 0 Kn/m³
K0 = $(1 - \sin(30)) / (1 + \sin(30))$
Kp = $(1 + \sin(30)) / (1 - \sin(30))$

Geometry For End Bay Pole

Ds = 0.6 mm Pile Diameter
L = 1300 mm Pile embedment length
f1 = 2700 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 2.83 Kn-m
Shear Wind = 1.05 Kn

Pile Properties

Safety Factor 0.55
Hu = 4.89 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 7.84 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.36 < 1 OK

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 (1300) x Ks (1.5) x 0.5 x tan(30) x Pi x Dia of Pile (0.6) x Height of Pile (1300)

Skin Friction = 13.65 Kn

Weight of Pile + Pile Skin Friction = 17.91 Kn

Uplift on one Pile = 15.45 Kn

Uplift is ok