

Job No.: 2312001 - 1

Address: 49 Martin Loop, Mariri, New Zealand

Date: 30/01/2024

Latitude: -41.168836

Longitude: 173.03198

Elevation: 2.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N3	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	D
Importance Level	2	Ultimate wind & Earthquake ARI	500 Years	Max Height	4.75 m
Wind Region	NZ2	Terrain Category	1.0	Design Wind Speed	43.31 m/s
Wind Pressure	1.13 KPa	Lee Zone	NO	Ultimate Snow ARI	150 Years
Wind Category	High	Earthquake ARI	500		

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 2.61 m $C_{p,e} = -0.891$ $p_e = -0.90$ KPa $p_{net} = -0.90$ KPa

For roof $C_{p,e}$ from 2.61 m To 5.23 m $C_{p,e} = -0.891$ $p_e = -0.90$ KPa $p_{net} = -0.90$ 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 10 m $C_{p,e} = 0.7$ $p_e = 0.71$ KPa $p_{net} = 1.05$ KPa

For side wall $C_{p,e}$ from 0 m To 5.23 m $C_{p,e} =$ $p_e = -0.66$ KPa $p_{net} = -0.66$ KPa

Maximum Upward pressure used in roof member Design = 0.90 KPa

Maximum Downward pressure used in roof member Design = 0.33 KPa

Maximum Wall pressure used in Design = 1.05 KPa

Maximum Racking pressure used in Design = 0.91 KPa

Design Summary

Rafter Design Internal

Internal Rafter Load Width = 5000 mm

Internal Rafter Span = 9850 mm

Try Rafter 2x300x50 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 = 1.00 S1 Downward = 6.81 S1 Upward = 6.81

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

Capacity Checks

M _{1.35D}	20.47 Kn-m	Capacity	10.08 Kn-m	Passing Percentage	49.24 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	40.93 Kn-m	Capacity	13.44 Kn-m	Passing Percentage	32.84 %
M _{0.9D-W_nUp}	-40.93 Kn-m	Capacity	-16.8 Kn-m	Passing Percentage	41.05 %

Pole Shed App Ver 01 2022

V _{1.35D}	8.31 Kn	Capacity	28.94 Kn	Passing Percentage	348.26 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	16.62 Kn	Capacity	38.6 Kn	Passing Percentage	232.25 %
V _{0.9D-WnUp}	-16.62 Kn	Capacity	-48.24 Kn	Passing Percentage	290.25 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 144.675 mm

Limit by Woolcock et al, 1999 Span/360 = 27.78 mm

Deflection under Dead and Service Wind = 178.165 mm

Limit by Woolcock et al, 1999 Span/250 = 66.67 mm

Reactions

Maximum downward = 16.62 kn Maximum upward = -16.62 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

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

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 100 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 = 21.67 Kn > -16.62 Kn

Rafter Design External

External Rafter Load Width = 2500 mm

External Rafter Span = 4808 mm

Try Rafter 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 = 1.00 S₁ Downward = 11.27 S₁ Upward = 11.27

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

Capacity Checks

M _{1.35D}	2.44 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	91.39 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	4.88 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	60.86 %
M _{0.9D-WnUp}	-4.88 Kn-m	Capacity	-3.72 Kn-m	Passing Percentage	76.23 %
V _{1.35D}	2.03 Kn	Capacity	9.65 Kn	Passing Percentage	475.37 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	4.06 Kn	Capacity	12.86 Kn	Passing Percentage	316.75 %
V _{0.9D-WnUp}	-4.06 Kn	Capacity	-16.08 Kn	Passing Percentage	396.06 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 33.91 mm

Limit by Woolcock et al, 1999 Span/360 = 13.89 mm

Deflection under Dead and Service Wind = 37.58 mm

Limit by Woolcock et al, 1999 Span/250 = 33.33 mm

Reactions

Maximum downward = 4.06 kN Maximum upward = -4.06 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

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 50 mm

For Parallel to grain loading

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

Eccentric Load check

V = $\phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s$ (Eq 4.12) = -14.70 kN > -4.06 kN

Single Shear Capacity under short term loads = -10.84 kN > -4.06 kN

Girt Design Front and Back

Girt's Spacing = 600 mm

Girt's Span = 5000 mm

Try Girt 190x45 SG8

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 = 0.98

K₈ Upward = 0.65 S₁ Downward = 12.23 S₁ Upward = 20.38

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

Capacity Checks

M _{Wind+Snow}	1.97 kN-m	Capacity	1.98 kN-m	Passing Percentage	100.51 %
V _{0.9D-WnUp}	1.57 kN-m	Capacity	13.75 kN-m	Passing Percentage	875.80 %

Deflections

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

Deflection under Snow and Service Wind = 29.75 mm

Limit by Woolcock et al, 1999 Span/250 = 20.00 mm

Sag during installation = 46.79 mm

Reactions

Maximum = 1.57 kn

Girt Design Sides

Girt's Spacing = 600 mm

Girt's Span = 5000 mm

Try Girt 190x45 SG8

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 =0.98

K8 Upward =0.65 S1 Downward =12.23 S1 Upward =20.38

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

Capacity Checks

M _{Wind+Snow}	1.97 Kn-m	Capacity	1.98 Kn-m	Passing Percentage	100.51 %
V _{0.9D-WnUp}	1.57 Kn-m	Capacity	13.75 Kn-m	Passing Percentage	875.80 %

Deflections

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

Deflection under Snow and Service Wind = 29.75 mm

Limit by Woolcock et al. 1999 Span/100 = 20.00 mm

Sag during installation =46.79 mm

Reactions

Maximum = 1.57 kn

Middle Pole Design

Geometry

275 SED H5 (Minimum 300 dia. at Floor Level)	Dry Use	Height	4750 mm
Area	64885 mm ²	As	48663.8671875 mm ²
I _x	335197731 mm ⁴	Z _x	2331810 mm ³
I _y	335197731 mm ⁴	Z _y	2331810 mm ³
Lateral Restraint	4750 mm c/c		

Loads

Total Area over Pole = 25 m²

Dead	6.25 Kn	Live	6.25 Kn
Wind Down	8.25 Kn	Snow	0.00 Kn
Moment wind	19.20 Kn-m		
Phi	0.8	K8	0.84
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Peeling	Steaming	Normal	Dry Use
f _b =	36.3 MPa	f _s =	2.96 MPa
f _c =	18 MPa	f _p =	7.2 MPa
f _t =	22 MPa	E =	9257 MPa

Capacities

PhiNcx Wind	781.92 Kn	PhiMnx Wind	56.67 Kn-m	PhiVnx Wind	115.24 Kn
PhiNcx Dead	469.15 Kn	PhiMnx Dead	34.00 Kn-m	PhiVnx Dead	69.14 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.37 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.14 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 19.62 \text{ mm} < 31.67 \text{ mm}$$

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

Assumed Soil Properties

Gamma	18 Kn/m ³	Friction angle	30 deg	Cohesion	0 Kn/m ³
K0 =	$(1 - \sin(30)) / (1 + \sin(30))$				
Kp =	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For Middle Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1800 mm	Pile embedment length
f1 =	3563 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	19.20 Kn-m
Shear Wind =	5.39 Kn

Pile Properties

Safety Factor	0.55	
Hu =	9.69 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	20.58 Kn-m	Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.93 < 1 \text{ OK}$$

Uplift Check

$$\text{Density of Concrete} = 24 \text{ Kn/m}^3$$

$$\text{Density of Timber Pole} = 5 \text{ Kn/m}^3$$

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

$$K_s (\text{Lateral Earth Pressure Coefficient}) \text{ for cast into place concrete piles} = 1.5$$

$$\text{Formula to calculate Skin Friction} = \text{Safety factor (0.55)} \times \text{Density of Soil (18)} \times \text{Height of Pile (1800)} \times K_s (1.5) \times 0.5 \times \tan(30) \times \pi \times \text{Dia of Pile (0.6)} \times \text{Height of Pile (1800)}$$

Skin Friction = 26.17 Kn

Weight of Pile + Pile Skin Friction = 29.32 Kn

Uplift on one Pile = 16.88 Kn

Uplift is ok