

Pole Shed App Ver 01 2022

Job No.: 623026 - 1 **Address:** 187 Awaroa River Rd, Whangarei, New Zealand **Date:** 19/12/2023
Latitude: -35.725772 **Longitude:** 174.366538 **Elevation:** 18 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 m
Wind Region	NZ1	Terrain Category	2.68	Design Wind Speed	39.3 m/s
Wind Pressure	0.93 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 = Mono Enclosed

For roof $C_{p,i} = -0.5842$

For roof $C_{p,e}$ from 0 m To 3.13 m $C_{p,e} = -0.9$ $p_e = -0.65$ KPa $p_{net} = -1.02$ KPa

For roof $C_{p,e}$ from 3.13 m To 6.26 m $C_{p,e} = -0.5$ $p_e = -0.36$ KPa $p_{net} = -0.73$ KPa

For wall Windward $C_{p,i} = 0.4652$ side Wall $C_{p,i} = -0.5842$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 10.40 m $C_{p,e} = 0.7$ $p_e = 0.58$ KPa $p_{net} = 1.04$ KPa

For side wall $C_{p,e}$ from 0 m To 3.13 m $C_{p,e} =$ $p_e = -0.54$ KPa $p_{net} = -0.08$ KPa

Maximum Upward pressure used in roof member Design = 1.02 KPa

Maximum Downward pressure used in roof member Design = 0.63 KPa

Maximum Wall pressure used in Design = 1.04 KPa

Maximum Racking pressure used in Design = 0.99 KPa

Design Summary

Rafter Design Internal

Internal Rafter Load Width = 5000 mm	Internal Rafter Span = 5850.011538483728 mm	Try Rafter 2x240x63 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 = 1.00

K8 Upward = 1.00 S1 Downward = 4.59 S1 Upward = 4.59

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

Capacity Checks

M _{1.35D}	7.22 Kn-m	Capacity	27.86 Kn-m	Passing Percentage	385.87 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	19.89 Kn-m	Capacity	37.16 Kn-m	Passing Percentage	186.83 %
M _{0.9D-W_nUp}	-17.00 Kn-m	Capacity	-46.44 Kn-m	Passing Percentage	273.18 %
V _{1.35D}	4.94 Kn	Capacity	51.54 Kn	Passing Percentage	1043.32 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	13.60 Kn	Capacity	68.72 Kn	Passing Percentage	505.29 %
V _{0.9D-W_nUp}	-11.63 Kn	Capacity	-85.9 Kn	Passing Percentage	738.61 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 14.27 mm Limit by Woolcock et al, 1999 Span/240 = 25.00 mm

Deflection under Dead and Service Wind = 21.535 mm Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward = 13.60 kn Maximum upward = -11.63 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 = 126 mm

For Parallel to grain loading

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

Capacity under short term loads = 29.11 Kn > -11.63 Kn

Intermediate Design Sides

Intermediate Spacing = 3000.0057692418636 mm Intermediate Span = 2759 mm Try Intermediate 2x140x45 SG8

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 = 10.36 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

$M_{Wind+Snow}$	1.48 Kn-m	Capacity	3.3 Kn-m	Passing Percentage	222.97 %
$V_{0.9D-WnUp}$	2.15 Kn-m	Capacity	20.26 Kn-m	Passing Percentage	942.33 %

Deflections

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

Deflection under Snow and Service Wind = 21.185 mm Limit by Woolcock et al, 1999 Span/100 = 27.59 mm

Reactions

Maximum = 2.15 kn

Girt Design Front and Back

Girt's Spacing = 900 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)

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

K_8 Upward = 0.86 S_1 Downward = 9.63 S_1 Upward = 16.05

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

Capacity Checks

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M _{Wind+Snow}	0.73 Kn-m	Capacity	1.80 Kn-m	Passing Percentage	246.58 %
V _{0.9D-WnUp}	1.17 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	1030.77 %

Deflections

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

Deflection under Snow and Service Wind = 5.05 mm Limit by Woolcock et al, 1999 Span/100 = 25.00 mm
Sag during installation = 2.37 mm

Reactions

Maximum = 1.17 kn

Girt Design Sides

Girt's Spacing = 900 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}	1.05 Kn-m	Capacity	1.65 Kn-m	Passing Percentage	157.14 %
V _{0.9D-WnUp}	1.40 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	861.43 %

Deflections

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

Deflection under Snow and Service Wind = 10.48 mm Limit by Woolcock et al. 1999 Span/100 = 30.00 mm
Sag during installation =4.91 mm

Reactions

Maximum = 1.40 kn

Uplift Check

Density of Concrete = 24 Kn/m³

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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(1450) x Ks(1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1450)

Skin Friction = 16.98 Kn

Weight of Pile + Pile Skin Friction = 21.22 Kn

Uplift on one Pile = 23.85 Kn

Uplift is ok