

Pole Shed App Ver 01 2022

Job No.: 2502034

Address: 659 Long Plain Road, Tākaka 7183, New Zealand

Date: 3/13/2025

Latitude: -40.910046

Longitude: 172.762292

Elevation: 93.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	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	4.7 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	38.22 m/s
Wind Pressure	0.88 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 4.05 m $C_{p,e} = -0.9$ $p_e = -0.71$ KPa $p_{net} = -0.71$ KPa

For roof $C_{p,e}$ from 4.05 m To 8.10 m $C_{p,e} = -0.5$ $p_e = -0.39$ KPa $p_{net} = -0.39$ 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 13.5 m $C_{p,e} = 0.7$ $p_e = 0.55$ KPa $p_{net} = 0.81$ KPa

For side wall $C_{p,e}$ from 0 m To 4.05 m $C_{p,e} =$ $p_e = -0.51$ KPa $p_{net} = -0.51$ KPa

Maximum Upward pressure used in roof member Design = 0.71 KPa

Maximum Downward pressure used in roof member Design = 0.42 KPa

Maximum Wall pressure used in Design = 0.81 KPa

Maximum Racking pressure used in Design = 0.79 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 4350 mm

Try Purlin 240x45 SG8

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

Second page

Pole Shed App Ver 01 2022

K1 Short term = 1 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 0.94

K8 Upward = 0.60 S1 Downward = 13.82 S1 Upward = 21.36

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

Capacity Checks

M _{1.35D}	0.72 Kn-m	Capacity	2.73 Kn-m	Passing Percentage	379.17 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.43 Kn-m	Capacity	3.64 Kn-m	Passing Percentage	149.79 %
M _{0.9D-WnUp}	-1.03 Kn-m	Capacity	-2.93 Kn-m	Passing Percentage	284.47 %
V _{1.35D}	0.66 Kn	Capacity	10.42 Kn	Passing Percentage	1578.79 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.41 Kn	Capacity	13.89 Kn	Passing Percentage	985.11 %
V _{0.9D-WnUp}	-0.95 Kn	Capacity	-17.37 Kn	Passing Percentage	1828.42 %

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 = 11.01 mm Limit by Woolcock et al, 1999 Span/240 = 17.92 mm

Deflection under Dead and Service Wind = 8.19 mm Limit by Woolcock et al, 1999 Span/100 = 43.00 mm

Reactions

Maximum downward = 1.41 kn Maximum upward = -0.95 kn

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

Rafter Design Internal

Internal Rafter Load Width = 4500 mm Internal Rafter Span = 7850 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}	11.70 Kn-m	Capacity	43.44 Kn-m	Passing Percentage	371.28 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	24.96 Kn-m	Capacity	57.92 Kn-m	Passing Percentage	232.05 %

Pole Shed App Ver 01 2022

M _{0.9D-WnUp}	-16.81 Kn-m	Capacity	-72.42 Kn-m	Passing Percentage	430.81 %
V _{1.35D}	5.96 Kn	Capacity	55.22 Kn	Passing Percentage	926.51 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	12.72 Kn	Capacity	73.64 Kn	Passing Percentage	578.93 %
V _{0.9D-WnUp}	-8.57 Kn	Capacity	-92.04 Kn	Passing Percentage	1073.98 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 16.835 mm Limit by Woolcock et al, 1999 Span/240 = 33.33 mm

Deflection under Dead and Service Wind = 22.135 mm Limit by Woolcock et al, 1999 Span/100 = 80.00 mm

Reactions

Maximum downward = 12.72 kn Maximum upward = -8.57 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 3

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 fpj = 22.7 Mpa for Rafter with effective thickness = 90 mm

For Parallel to grain loading

K₁₁ = 2.0 fcj = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 43.67 Kn > -8.57 Kn

Rafter Design External

External Rafter Load Width = 2250 mm External Rafter Span = 5939 mm Try Rafter 290x45 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 = 0.89

Pole Shed App Ver 01 2022

K8 Upward =0.89 S1 Downward =15.23 S1 Upward =15.23

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

Capacity Checks

M _{1.35D}	3.35 Kn-m	Capacity	3.78 Kn-m	Passing Percentage	112.84 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	7.14 Kn-m	Capacity	5.04 Kn-m	Passing Percentage	70.59 %
M _{0.9D-W_nUp}	-4.81 Kn-m	Capacity	-6.29 Kn-m	Passing Percentage	130.77 %
V _{1.35D}	2.25 Kn	Capacity	12.59 Kn	Passing Percentage	559.56 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	4.81 Kn	Capacity	16.79 Kn	Passing Percentage	349.06 %
V _{0.9D-W_nUp}	-3.24 Kn	Capacity	-20.98 Kn	Passing Percentage	647.53 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 23.06 mm Limit by Woolcock et al, 1999 Span/240= 25.00 mm

Deflection under Dead and Service Wind = 27.29 mm Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward =4.81 kn Maximum upward = -3.24 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 = 45 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 x k₁ x k₄ x k₅ x f_s x b x d_s (Eq 4.12) = -21.73 kn > -3.24 Kn

Single Shear Capacity under short term loads = -9.75 Kn > -3.24 Kn

Girt Design Front and Back

Girt's Spacing = 0 mm

Girt's Span = 2250 mm

Try Girt SG8 Dry

Moisture Condition = Wet (Moisture in timber is less than 18% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1 K4 =1 K5 =1 K8 Downward =NaN

K8 Upward =NaN S1 Downward =NaN S1 Upward =NaN

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

Capacity Checks

$M_{Wind+Snow}$	0.00 Kn-m	Capacity	NaN Kn-m	Passing Percentage	NaN %
$V_{0.9D-WnUp}$	0.00 Kn	Capacity	0.00 Kn	Passing Percentage	NaN %

Deflections

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

Deflection under Snow and Service Wind = NaN mm Limit by Woolcock et al, 1999 Span/100 = 22.50 mm

Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Girt Design Sides

Girt's Spacing = 0 mm

Girt's Span = 3000 mm

Try Girt SG8 Dry

Moisture Condition = Wet (Moisture in timber is less than 18% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1 K4 =1 K5 =1 K8 Downward =NaN

K8 Upward =NaN S1 Downward =NaN S1 Upward =NaN

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

Capacity Checks

$M_{Wind+Snow}$	0.00 Kn-m	Capacity	NaN Kn-m	Passing Percentage	NaN %
$V_{0.9D-WnUp}$	0.00 Kn	Capacity	0.00 Kn	Passing Percentage	NaN %

Pole Shed App Ver 01 2022

Deflections

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

Deflection under Snow and Service Wind = NaN mm Limit by Woolcock et al. 1999 Span/100 = 30.00 mm

Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

225 SED H5 (Minimum 250 dia. at Floor Level)	Dry Use	Height	4340 mm
Area	44279 mm ²	As	33209.1796875 mm ²
Ix	156100441 mm ⁴	Zx	1314530 mm ³
Iy	156100441 mm ⁴	Zx	1314530 mm ³
Lateral Restraint	4340 mm c/c		

Loads

Total Area over Pole = 18 m²

Dead	4.50 Kn	Live	4.50 Kn
Wind Down	7.56 Kn	Snow	0.00 Kn
Moment wind	14.69 Kn-m		
Phi	0.8	K8	0.75
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	481.24 Kn	PhiMnx Wind	28.81 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	288.75 Kn	PhiMnx Dead	17.29 Kn-m	PhiVnx Dead	47.18 Kn

Checks

$$(M_x/\phi M_{nx}) + (N/\phi N_c) = 0.54 < 1 \text{ OK}$$

$$(M_x/\phi M_{nx})^2 + (N/\phi N_c) = 0.29 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 29.13 \text{ mm} < 43.40 \text{ mm}$$

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

Assumed Soil Properties

Gamma 18 Kn/m³ Friction angle 30 deg Cohesion 0 Kn/m³

$$K_0 = (1 - \sin(30)) / (1 + \sin(30))$$

$$K_p = (1 + \sin(30)) / (1 - \sin(30))$$

Geometry For Middle Bay Pole

Ds = 0.6 mm Pile Diameter

L = 1700 mm Pile embedment length

f1 = 3525 mm Distance at which the shear force is applied

f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 14.69 Kn-m

Shear Wind = 4.17 Kn

Pile Properties

Safety Factory 0.55

Hu = 8.38 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 17.52 Kn-m Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.84 < 1 \text{ OK}$$

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

Pole Shed App Ver 01 2022

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(1700) x Ks(1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1700)

Skin Friction = 23.34 Kn

Weight of Pile + Pile Skin Friction = 27.24 Kn

Uplift on one Pile = 8.73 Kn

Uplift is ok