

Pole Shed App Ver 01 2022

Job No.: Lisa Welch and Daniel Mouatt **Address:** Lot 10 DP 535188 Te Kapua Rise, Puketapu, New Zealand **Date:** 17/04/2025
Latitude: -39.483081 **Longitude:** 176.817103 **Elevation:** 29.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N1	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	3	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.67 m
Wind Region	NZ2	Terrain Category	1.78	Design Wind Speed	37.68 m/s
Wind Pressure	0.85 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 Open

For roof $C_{p,i} = -0.3$

For roof $C_{p,e}$ from 0 m To 2.68 m $C_{p,e} = -1.035$ $p_e = -0.77$ KPa $p_{net} = -0.77$ KPa

For roof $C_{p,e}$ from 2.68 m To 5.35 m $C_{p,e} = -0.8325$ $p_e = -0.62$ KPa $p_{net} = -0.62$ 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 $C_{p,e} = 0.7$ $p_e = 0.53$ KPa $p_{net} = 0.78$ KPa

For side wall $C_{p,e}$ from 0 m To 5.35 m $C_{p,e} =$ $p_e = -0.49$ KPa $p_{net} = -0.49$ KPa

Maximum Upward pressure used in roof member Design = 0.77 KPa

Maximum Downward pressure used in roof member Design = 0.33 KPa

Maximum Wall pressure used in Design = 0.78 KPa

Maximum Racking pressure used in Design = 0.89 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm Purlin Span = 6040 mm Try Purlin 240x45 LVL13

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 = 0.45 S1 Downward = 13.82 S1 Upward = 25.21

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

Capacity Checks

M _{1.35D}	1.39 Kn-m	Capacity	9.37 Kn-m	Passing Percentage	674.10 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	3.72 Kn-m	Capacity	12.49 Kn-m	Passing Percentage	335.75 %
M _{0.9D-W_nUp}	-2.24 Kn-m	Capacity	-7.53 Kn-m	Passing Percentage	336.16 %
V _{1.35D}	0.92 Kn	Capacity	18.41 Kn	Passing Percentage	2001.09 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.83 Kn	Capacity	24.54 Kn	Passing Percentage	1340.98 %
V _{0.9D-W_nUp}	-1.48 Kn	Capacity	-30.68 Kn	Passing Percentage	2072.97 %

Deflections

Modulus of Elasticity = 12100 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 = 19.88 mm Limit by Woolcock et al, 1999 Span/240 = 24.96 mm

Deflection under Dead and Service Wind = 15.99 mm Limit by Woolcock et al, 1999 Span/100 = 59.90 mm

Reactions

Maximum downward = 1.83 kn Maximum upward = -1.48 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 = 6190 mm Internal Rafter Span = 8050 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}	16.92 Kn-m	Capacity	43.44 Kn-m	Passing Percentage	256.74 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	33.85 Kn-m	Capacity	57.92 Kn-m	Passing Percentage	171.11 %

Pole Shed App Ver 01 2022

M _{0.9D-WnUp}	-27.33 Kn-m	Capacity	-72.42 Kn-m	Passing Percentage	264.98 %
V _{1.35D}	8.41 Kn	Capacity	55.22 Kn	Passing Percentage	656.60 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	16.82 Kn	Capacity	73.64 Kn	Passing Percentage	437.81 %
V _{0.9D-WnUp}	-13.58 Kn	Capacity	-92.04 Kn	Passing Percentage	677.76 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 25.56 mm Limit by Woolcock et al, 1999 Span/240 = 34.17 mm

Deflection under Dead and Service Wind = 31.48 mm Limit by Woolcock et al, 1999 Span/100 = 82.00 mm

Reactions

Maximum downward = 16.82 kn Maximum upward = -13.58 kn

Rafter to Pole Connection check

Bolt Size = M16 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 = 76.25 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 = 68.64 Kn > -13.58 Kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 3095 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

Pole Shed App Ver 01 2022

K8 Upward =0.55 S1 Downward =12.23 S1 Upward =22.68

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

Capacity Checks

M _{Wind+Snow}	0.84 Kn-m	Capacity	1.65 Kn-m	Passing Percentage	196.43 %
V _{0.9D-WnUp}	1.09 Kn	Capacity	13.75 Kn	Passing Percentage	1261.47 %

Deflections

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

Deflection under Snow and Service Wind = 4.87 mm Limit by Woolcock et al, 1999 Span/100 = 30.95 mm
Sag during installation = 6.87 mm

Reactions

Maximum = 1.09 kn

Girt Design Sides

Girt's Spacing = 900 mm Girt's Span = 4100 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 =0.75 S1 Downward =12.23 S1 Upward =18.45

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	2.26 Kn-m	Passing Percentage	152.70 %
V _{0.9D-WnUp}	1.44 Kn	Capacity	13.75 Kn	Passing Percentage	954.86 %

Deflections

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

Deflection under Snow and Service Wind = 14.99 mm Limit by Woolcock et al. 1999 Span/100 = 41.00 mm
Sag during installation =21.15 mm

Reactions

Maximum = 1.44 kn

Middle Pole Design

Geometry

275 SED H5 (Minimum 300 dia. at Floor Level)	Dry Use	Height	5500 mm
Area	64885 mm ²	As	48663.8671875 mm ²
Ix	335197731 mm ⁴	Zx	2331810 mm ³
Iy	335197731 mm ⁴	Zy	2331810 mm ³
Lateral Restraint	5500 mm c/c		

Loads

Total Area over Pole = 25.379 m²

Dead	6.34 Kn	Live	6.34 Kn
Wind Down	8.38 Kn	Snow	0.00 Kn
Moment wind	33.13 Kn-m		
Phi	0.8	K8	0.71
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	665.98 Kn	PhiMnx Wind	48.27 Kn-m	PhiVnx Wind	115.24 Kn
PhiNcx Dead	399.59 Kn	PhiMnx Dead	28.96 Kn-m	PhiVnx Dead	69.14 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.72 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.50 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 46.78 \text{ mm} < 55.00 \text{ mm}$$

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

Pole Shed App Ver 01 2022

Assumed Soil Properties

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

Geometry For Middle Bay Pole

D_s = 0.6 mm Pile Diameter
L = 2200 mm Pile embedment length
f₁ = 4252 mm Distance at which the shear force is applied
f₂ = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 33.13 Kn-m
Shear Wind = 7.79 Kn

Pile Properties

Safety Factory 0.55
H_u = 14.70 Kn Ultimate Lateral Strength of the Pile, Short pile
M_u = 37.37 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.89 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

225 SED H5 (Minimum 250 dia. at Floor Level)	Dry Use	Height	5470 mm
Area	44279 mm ²	A _s	33209.1796875 mm ²
I _x	156100441 mm ⁴	Z _x	1314530 mm ³
I _y	156100441 mm ⁴	Z _y	1314530 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 12.6895 m²

Pole Shed App Ver 01 2022

Dead	3.17 Kn	Live	3.17 Kn
Wind Down	4.19 Kn	Snow	0.00 Kn
Moment Wind	11.04 Kn-m		
Phi	0.8	K8	0.53
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	338.54 Kn	PhiMnx Wind	20.27 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	203.12 Kn	PhiMnx Dead	12.16 Kn-m	PhiVnx Dead	47.18 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.58 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.33 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 34.43 \text{ mm} < 56.56 \text{ mm}$$

Ds =	0.6 mm	Pile Diameter
L =	1500 mm	Pile embedment length
f1 =	4252 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

$$\text{Total Area over Pole} = 12.6895 \text{ m}^2$$

Moment Wind =	11.04 Kn-m
Shear Wind =	2.60 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.23 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	12.86 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.86 < 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 = $(1 - \sin(30)) / (1 + \sin(30))$
K_p = $(1 + \sin(30)) / (1 - \sin(30))$

Geometry For End Bay Pole

D_s = 0.6 mm Pile Diameter
L = 1500 mm Pile embedment length
f₁ = 4252 mm Distance at which the shear force is applied
f₂ = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 11.04 Kn-m
Shear Wind = 2.60 Kn

Pile Properties

Safety Factory 0.55
H_u = 5.23 Kn Ultimate Lateral Strength of the Pile, Short pile
M_u = 12.86 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.86 < 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

K_s (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(2200) x K_s(1.5) x

Pole Shed App Ver 01 2022

$$0.5 \times \tan(30) \times \pi \times \text{Dia of Pile}(0.6) \times \text{Height of Pile}(2200)$$

$$\text{Skin Friction} = 39.09 \text{ Kn}$$

$$\text{Weight of Pile} + \text{Pile Skin Friction} = 42.94 \text{ Kn}$$

$$\text{Uplift on one Pile} = 13.83 \text{ Kn}$$

Uplift is ok