

Pole Shed App Ver 01 2022

Job No.: Hillco Ltd
Latitude: -41.51213

Address: 23 Batty's Road, Springlands, New Zealand
Longitude: 173.933691

Date: 19/06/2025
Elevation: 7 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	3	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.025 m
Wind Region	NZ2	Terrain Category	3.0	Design Wind Speed	34.86 m/s
Wind Pressure	0.73 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 = Mono Enclosed

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

For roof $C_{p,e}$ from 0 m To 5.03 m $C_{p,e} = -0.9$ $p_e = -0.59$ KPa $p_{net} = -0.59$ KPa

For roof $C_{p,e}$ from 5.03 m To 10.06 m $C_{p,e} = -0.5$ $p_e = -0.33$ KPa $p_{net} = -0.33$ 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 22 m $C_{p,e} = 0.7$ $p_e = 0.46$ KPa $p_{net} = 0.68$ KPa

For side wall $C_{p,e}$ from 0 m To 5.03 m $C_{p,e} =$ $p_e = -0.43$ KPa $p_{net} = -0.43$ KPa

Maximum Upward pressure used in roof member Design = 0.59 KPa

Maximum Downward pressure used in roof member Design = 0.35 KPa

Maximum Wall pressure used in Design = 0.68 KPa

Maximum Racking pressure used in Design = 0.79 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 6250 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)

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 = 0.22 S1 Downward = 13.82 S1 Upward = 36.27

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

Capacity Checks

M _{1.35D}	1.48 Kn-m	Capacity	9.37 Kn-m	Passing Percentage	633.11 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	3.9 Kn-m	Capacity	12.49 Kn-m	Passing Percentage	320.26 %
M _{0.9D-WnUp}	-1.6 Kn-m	Capacity	-3.72 Kn-m	Passing Percentage	232.50 %
V _{1.35D}	0.95 Kn	Capacity	18.41 Kn	Passing Percentage	1937.89 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.90 Kn	Capacity	24.54 Kn	Passing Percentage	1291.58 %
V _{0.9D-WnUp}	-1.03 Kn	Capacity	-30.68 Kn	Passing Percentage	2978.64 %

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 = 22.51 mm Limit by Woolcock et al, 1999 Span/240 = 25.83 mm

Deflection under Dead and Service Wind = 18.63 mm Limit by Woolcock et al, 1999 Span/100 = 62.00 mm

Reactions

Maximum downward = 1.90 kn Maximum upward = -1.03 kn

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

Rafter Design Internal

Internal Rafter Load Width = 6400 mm Internal Rafter Span = 5100 mm Try Rafter 2x240x45 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 = 6.71 S1 Upward = 6.71

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

Capacity Checks

M _{1.35D}	7.02 Kn-m	Capacity	19.9 Kn-m	Passing Percentage	283.48 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	14.05 Kn-m	Capacity	26.54 Kn-m	Passing Percentage	188.90 %

Pole Shed App Ver 01 2022

M _{0.9D-WnUp}	-7.59 Kn-m	Capacity	-33.18 Kn-m	Passing Percentage	437.15 %
V _{1.35D}	5.51 Kn	Capacity	36.82 Kn	Passing Percentage	668.24 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	11.02 Kn	Capacity	49.08 Kn	Passing Percentage	445.37 %
V _{0.9D-WnUp}	-5.96 Kn	Capacity	-61.36 Kn	Passing Percentage	1029.53 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 14.99 mm Limit by Woolcock et al, 1999 Span/240 = 21.88 mm

Deflection under Dead and Service Wind = 18.735 mm Limit by Woolcock et al, 1999 Span/100 = 52.50 mm

Reactions

Maximum downward = 11.02 kn Maximum upward = -5.96 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 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 = 29.11 Kn > -5.96 Kn

Rafter Design External

External Rafter Load Width = 3200 mm External Rafter Span = 5057 mm Try Rafter 240x45 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 = 0.94

Pole Shed App Ver 01 2022

K8 Upward =0.94 S1 Downward =13.82 S1 Upward =13.82

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

Capacity Checks

M _{1.35D}	3.45 Kn-m	Capacity	9.37 Kn-m	Passing Percentage	271.59 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	6.90 Kn-m	Capacity	12.49 Kn-m	Passing Percentage	181.01 %
M _{0.9D-W_nUp}	-3.73 Kn-m	Capacity	-15.61 Kn-m	Passing Percentage	418.50 %
V _{1.35D}	2.73 Kn	Capacity	18.41 Kn	Passing Percentage	674.36 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.46 Kn	Capacity	24.54 Kn	Passing Percentage	449.45 %
V _{0.9D-W_nUp}	-2.95 Kn	Capacity	-30.68 Kn	Passing Percentage	1040.00 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 16.65 mm Limit by Woolcock et al, 1999 Span/240= 21.88 mm

Deflection under Dead and Service Wind = 18.73 mm Limit by Woolcock et al, 1999 Span/100 = 52.50 mm

Reactions

Maximum downward =5.46 kn Maximum upward = -2.95 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

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 12.6 f_{pj} = 22.7 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) = -30.05 kn > -2.95 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -2.95 Kn

Intermediate Design Front and Back

Intermediate Spacing = 3200 mm Intermediate Span = 4325 mm Try Intermediate 2x240x45 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 =0.94

K8 Upward =1.00 S1 Downward =13.82 S1 Upward =0.96

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

Capacity Checks

M _{Wind+Snow}	5.09 Kn-m	Capacity	9.68 Kn-m	Passing Percentage	190.18 %
V _{0.9D-WnUp}	4.71 Kn	Capacity	-34.74 Kn	Passing Percentage	737.58 %

Deflections

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

Deflection under Snow and Service Wind = 17.705 mm Limit by Woolcock et al, 1999 Span/100 = 43.25 mm

Reactions

Maximum = 4.71 kn

Girt Design Front and Back

Girt's Spacing = 900 mm Girt's Span = 3200 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 =0.53 S1 Downward =12.23 S1 Upward =23.06

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

Capacity Checks

M _{Wind+Snow}	0.78 Kn-m	Capacity	1.61 Kn-m	Passing Percentage	206.41 %
V _{0.9D-WnUp}	0.98 Kn	Capacity	13.75 Kn	Passing Percentage	1403.06 %

Deflections

Pole Shed App Ver 01 2022

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

Deflection under Snow and Service Wind = 4.85 mm Limit by Woolcock et al, 1999 Span/100 = 32.00 mm
Sag during installation = 7.85 mm

Reactions

Maximum = 0.98 kn

Girt Design Sides

Girt's Spacing = 900 mm Girt's Span = 5250 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 = 0.81 S1 Downward = 12.23 S1 Upward = 17.05

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

Capacity Checks

M _{Wind+Snow}	2.11 Kn-m	Capacity	2.46 Kn-m	Passing Percentage	116.59 %
V _{0.9D-WnUp}	1.61 Kn	Capacity	13.75 Kn	Passing Percentage	854.04 %

Deflections

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

Deflection under Snow and Service Wind = 35.13 mm Limit by Woolcock et al. 1999 Span/100 = 52.50 mm
Sag during installation = 56.87 mm

Reactions

Maximum = 1.61 kn

Middle Pole Design

Geometry

250 UNI H5	Dry Use	Height	5060 mm
Area	49063 mm ²	As	36796.875 mm ²
I _x	191650391 mm ⁴	Z _x	1533203 mm ³
I _y	191650391 mm ⁴	Z _y	1533203 mm ³

Pole Shed App Ver 01 2022

Lateral Restraint 5060 mm c/c

Loads

Total Area over Pole = 33.6 m²

Dead	8.40 Kn	Live	8.40 Kn
Wind Down	11.76 Kn	Snow	0.00 Kn
Moment wind	15.92 Kn-m		
Phi	0.8	K8	0.66
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Shaving	Steaming	Normal	Dry Use
fb =	34.325 MPa	fs =	2.96 MPa
fc =	18 MPa	fp =	7.2 MPa
ft =	20.75 MPa	E =	8793 MPa

Capacities

PhiNcx Wind	465.06 Kn	PhiMnx Wind	27.71 Kn-m	PhiVnx Wind	87.14 Kn
PhiNcx Dead	279.04 Kn	PhiMnx Dead	16.63 Kn-m	PhiVnx Dead	52.28 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.64 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.39 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 33.75 \text{ mm} < 50.60 \text{ mm}$$

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 =	1700 mm	Pile embedment length

Pole Shed App Ver 01 2022

f1 =	3769 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	15.92 Kn-m
Shear Wind =	4.22 Kn

Pile Properties

Safety Factory	0.55	
Hu =	8.00 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	17.79 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 UNI H5	Dry Use	Height	4785 mm
Area	39741 mm ²	As	29805.46875 mm ²
Ix	125741821 mm ⁴	Zx	1117705 mm ³
Iy	125741821 mm ⁴	Zx	1117705 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 8.4 m²

Dead	2.10 Kn	Live	2.10 Kn
Wind Down	2.94 Kn	Snow	0.00 Kn
Moment Wind	7.96 Kn-m		
Phi	0.8	K8	0.61
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Shaving	Steaming	Normal	Dry Use
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Pole Shed App Ver 01 2022

fb =	34.325 MPa	fs =	2.96 MPa
fc =	18 MPa	fp =	7.2 MPa
ft =	20.75 MPa	E =	8793 MPa

Capacities

PhiNcx Wind	348.65 Kn	PhiMnx Wind	18.70 Kn-m	PhiVnx Wind	70.58 Kn
PhiNcx Dead	209.19 Kn	PhiMnx Dead	11.22 Kn-m	PhiVnx Dead	42.35 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.45 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.20 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 25.48 \text{ mm} < 50.12 \text{ mm}$$

Ds =	0.6 mm	Pile Diameter
L =	1600 mm	Pile embedment length
f1 =	3769 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

$$\text{Total Area over Pole} = 8.4 \text{ m}^2$$

Moment Wind =	7.96 Kn-m
Shear Wind =	2.11 Kn

Pile Properties

Safety Factory	0.55	
Hu =	6.80 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	15.03 Kn-m	Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.53 < 1 \text{ OK}$$

Drained Lateral Strength of End 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 =	$(1 - \sin(30)) / (1 + \sin(30))$				

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

Geometry For End Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1600 mm	Pile embedment length
f1 =	3769 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	7.96 Kn-m
Shear Wind =	2.11 Kn

Pile Properties

Safety Factory	0.55	
Hu =	6.80 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	15.03 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.53 < 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(1700) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1700)

Skin Friction = 23.34 Kn

Weight of Pile + Pile Skin Friction = 26.99 Kn

Uplift on one Pile = 12.26 Kn

Uplift is ok