Pole Shed App Ver 01 2022

Job No.:	412 Park	**Address:**	6966A State Highway 27,Matamata,New Zealand	**Date:**	08/05/2024
Latitude:	-37.782337	**Longitude:**	175.759352	**Elevation:**	56.5 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	1	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.7 m
Wind Region	NZ1	Terrain Category	2.2	Design Wind Speed	43.28 m/s
Wind Pressure	1.12 KPa	Lee Zone	YES	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 Pressues

Shed Type = Gable Open

For roof Cp,i = 0.648

For roof CP,e from 0 m To 5.70 m Cpe = -0.9 pe = -0.91 KPa pnet = -1.70 KPa

For roof CP,e from 5.70 m To 11.40 m Cpe = -0.5 pe = -0.51 KPa pnet = -1.30 KPa

For wall Windward Cp,i = 0.648 side Wall Cp,i = -0.5534

For wall Windward and Leeward CP,e from 0 m To 12 m Cpe = 0.7 pe = 0.71 KPa pnet = 1.38 KPa

For side wall CP,e from 0 m To 5.70 m Cpe = pe = -0.66 KPa pnet = 0.01 KPa

Maximum Upward pressure used in roof member Design = 1.70 KPa

Maximum Downward pressure used in roof member Design = 0.77 KPa

Maximum Wall pressure used in Design = 1.38 KPa

Maximum Racking pressure used in Design = 1.22 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm   Purlin Span = 4850 mm   Try Purlin 300x50 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 =0.94

K8 Upward =0.54   S1 Downward =13.93   S1 Upward =22.75

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

Capacity Checks

$M_{1.35D}$	0.89 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	**530.34 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.83 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	**222.61 %**
$M_{0.9D-WnUp}$	-3.9 Kn-m	Capacity	-4.56 Kn-m	Passing Percentage	**116.92 %**
$V_{1.35D}$	0.74 Kn	Capacity	14.47 Kn	Passing Percentage	**1955.41 %**

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$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.34 Kn	Capacity	19.30 Kn	Passing Percentage	**824.79 %**
$V_{0.9D\text{-}WnUp}$	-3.22 Kn	Capacity	-24.12 Kn	Passing Percentage	**749.07 %**

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 = 4.95 mm Limit by Woolcock et al, 1999 Span/240 = 20.00 mm

Deflection under Dead and Service Wind = 7.30 mm Limit by Woolcock et al, 1999 Span/100 = 48.00 mm

Reactions

Maximum downward =2.34 kn Maximum upward = -3.22 kn

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

Intermediate Design Sides

Intermediate Spacing = 3000 mm Intermediate Span = 5250 mm Try Intermediate 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 K4 =1 K5 =1 K8 Downward =0.94

K8 Upward =1.00 S1 Downward =13.93 S1 Upward =1.06

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

Capacity Checks

$M_{Wind+Snow}$	7.13 Kn-m	Capacity	16.8 Kn-m	Passing Percentage	**235.62 %**
$V_{0.9D\text{-}WnUp}$	5.43 Kn	Capacity	48.24 Kn	Passing Percentage	**888.40 %**

Deflections

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

Deflection under Snow and Service Wind = 33.695 mm Limit by Woolcock et al, 1999 Span/100 = 52.50 mm

Reactions

Maximum = 5.43 kn

Girt Design Front and Back

Girt's Spacing = 600 mm Girt's Span = 5000 mm Try Girt 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 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.73 S1 Downward =11.27 S1 Upward =18.79

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

Capacity Checks

$M_{Wind+Snow}$ Capacity

	2.59 Kn-m		2.72 Kn-m	Passing Percentage	**105.02 %**
$V_{0.9D\text{-}WnUp}$	2.07 Kn	Capacity	16.08 Kn	Passing Percentage	**776.81 %**

Deflections

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

Deflection under Snow and Service Wind = 30.17 mm Limit by Woolcock et al, 1999 Span/100 = 50.00 mm
Sag during installation = 37.90 mm

Reactions

Maximum = 2.07 kn

Girt Design Sides

Girt's Spacing = 600 mm Girt's Span = 3000 mm Try Girt 300x50 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 K4 =1 K5 =1 K8 Downward =0.94

K8 Upward =0.77 S1 Downward =13.93 S1 Upward =17.99

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

Capacity Checks

$M_{Wind+Snow}$	0.93 Kn-m	Capacity	6.46 Kn-m	Passing Percentage	**694.62 %**
$V_{0.9D\text{-}WnUp}$	1.24 Kn	Capacity	24.12 Kn	Passing Percentage	**1945.16 %**

Deflections

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

Deflection under Snow and Service Wind = 1.16 mm Limit by Woolcock et al. 1999 Span/100 = 30.00 mm
Sag during installation =4.91 mm

Reactions

Maximum = 1.24 kn

Middle Pole Design

Geometry

275 SED H5 (Minimum 300 dia. at Floor Level)	Dry Use	Height	5370 mm
Area	64885 mm2	As	48663.8671875 mm2
Ix	335197731 mm4	Zx	2331810 mm3
Iy	335197731 mm4	Zx	2331810 mm3
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 30 m2

Dead	7.50 Kn	Live	7.50 Kn

Wind Down	23.10 Kn	Snow	0.00 Kn
Moment wind	37.07 Kn-m		
Phi	0.8	K8	1.00
K1 snow	0.8	K1 Dead	0.6
K1wind	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	934.35 Kn	PhiMnx Wind	67.72 Kn-m	PhiVnx Wind	115.24 Kn
PhiNcx Dead	560.61 Kn	PhiMnx Dead	40.63 Kn-m	PhiVnx Dead	69.14 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.59 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.34 < 1 OK

Deflection at top under service lateral loads = 51.38 mm < 53.70 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
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 =	2200 mm	Pile embedment length
f1 =	4275 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	37.07 Kn-m
Shear Wind =	8.67 Kn

Pile Properties

Safety Factory	0.55	
Hu =	14.65 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	37.42 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.99 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

250 SED H5 (Minimum 275 dia. at Floor Level)	Dry Use	Height	5550 mm
Area	54091 mm2	As	40568.5546875 mm2
Ix	232952248 mm4	Zx	1774874 mm3
Iy	232952248 mm4	Zx	1774874 mm3
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 15 m2

Dead	3.75 Kn	Live	3.75 Kn
Wind Down	11.55 Kn	Snow	0.00 Kn
Moment Wind	12.36 Kn-m		
Phi	0.8	K8	0.62
K1 snow	0.8	K1 Dead	0.6
K1wind	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	479.09 Kn	PhiMnx Wind	31.70 Kn-m	PhiVnx Wind	96.07 Kn
PhiNcx Dead	287.46 Kn	PhiMnx Dead	19.02 Kn-m	PhiVnx Dead	57.64 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.43 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.19 < 1 OK

Deflection at top under service lateral loads = 26.09 mm < 56.86 mm

Ds =	0.6 mm	Pile Diameter
L =	1750 mm	Pile embedment length
f1 =	4275 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 15 m2

Moment Wind =	12.36 Kn-m
Shear Wind =	2.89 Kn

Pile Properties

Safety Factory	0.55	
Hu =	7.93 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	19.81 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.62 < 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))				
Kp =	(1+sin(30)) / (1-sin(30))				

Geometry For End Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1750 mm	Pile embedment length
f1 =	4275 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	12.36 Kn-m
Shear Wind =	2.89 Kn

Pile Properties

Safety Factory	0.55	
Hu =	7.93 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	19.81 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.62 < 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 = Safecty factor (0.55) x Density of Soil(18) x Height of Pile(2200) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(2200)

Skin Friction = 39.09 Kn

Weight of Pile + Pile Skin Friction = 42.94 Kn

Uplift on one Pile = 44.25 Kn

Uplift is ok