

Pole Shed App Ver 01 2022

Job No.: 511-5025142 - 2

Address: 3219 Arundel Rakaia Gorge Road, Cavendish, New Zealand

Date: 25/09/2024

Latitude: -43.720174

Longitude: 171.387041

Elevation: 365.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N4	Ground Snow Load	1.68 KPa	Roof Snow Load	1.06 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.3 m
Wind Region	NZ2	Terrain Category	2.09	Design Wind Speed	50.1 m/s
Wind Pressure	1.51 KPa	Lee Zone	YES	Ultimate Snow ARI	50 Years
Wind Category	extra 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 $C_{p,i} = -0.3$

For roof $C_{p,e}$ from 0 m To 6.05 m $C_{p,e} = -0.9$ $p_e = -1.22$ KPa $p_{net} = -1.22$ KPa

For roof $C_{p,e}$ from 6.05 m To 12.10 m $C_{p,e} = -0.5$ $p_e = -0.68$ KPa $p_{net} = -0.68$ 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 11.50 m $C_{p,e} = 0.7$ $p_e = 0.95$ KPa $p_{net} = 1.40$ KPa

For side wall $C_{p,e}$ from 0 m To 6.05 m $C_{p,e} =$ $p_e = -0.88$ KPa $p_{net} = -0.88$ KPa

Maximum Upward pressure used in roof member Design = 1.22 KPa

Maximum Downward pressure used in roof member Design = 0.59 KPa

Maximum Wall pressure used in Design = 1.40 KPa

Maximum Racking pressure used in Design = 1.36 KPa

Design Summary

Girt Design Front and Back

Girt's Spacing = 1300 mm

Girt's Span = 2667 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 = 0.83 S1 Downward = 9.63 S1 Upward = 16.58

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

Capacity Checks

$M_{Wind+Snow}$	1.62 Kn-m	Capacity	1.75 Kn-m	Passing Percentage	108.02 %
$V_{0.9D-WnUp}$	2.43 Kn	Capacity	12.06 Kn	Passing Percentage	496.30 %

Deflections

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

Deflection under Snow and Service Wind = 22.36 mm

Limit by Woolcock et al, 1999 Span/100 = 26.67 mm

Sag during installation = 3.07 mm

Reactions

Maximum = 2.43 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 2875 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 =0.81 S1 Downward =9.63 S1 Upward =17.22

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

Capacity Checks

M _{Wind+Snow}	1.30 Kn-m	Capacity	1.69 Kn-m	Passing Percentage	130.00 %
V _{0.9D-WnUp}	1.81 Kn	Capacity	12.06 Kn	Passing Percentage	666.30 %

Deflections

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

Deflection under Snow and Service Wind = 20.90 mm

Limit by Woolcock et al. 1999 Span/100 = 28.75 mm

Sag during installation =4.14 mm

Reactions

Maximum = 1.81 kn

End Pole Design

Geometry For End Bay Pole

Geometry

175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	5150 mm
Area	27598 mm ²	As	20698.2421875 mm ²
I _x	60639381 mm ⁴	Z _x	646820 mm ³
I _y	60639381 mm ⁴	Z _y	646820 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 3.8338125 m²

Dead	0.96 Kn	Live	0.96 Kn
Wind Down	2.26 Kn	Snow	4.06 Kn
Moment Wind	3.81 Kn-m	Moment snow	1.18 Kn-m
Phi	0.8	K8	0.38

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K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Peeling	Steaming	Normal	Dry Use
$f_b =$	36.3 MPa	$f_s =$	2.96 MPa
$f_c =$	18 MPa	$f_p =$	7.2 MPa
$f_t =$	22 MPa	$E =$	9257 MPa

Capacities

PhiNcx Wind	152.92 Kn	PhiMnx Wind	7.23 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	91.75 Kn	PhiMnx Dead	4.34 Kn-m	PhiVnx Dead	29.41 Kn
PhiNcx Snow	122.34 Kn	PhiMnx Snow	5.78 Kn-m	PhiVnx Snow	39.21 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.57 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.32 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 26.73 \text{ mm} < 52.87 \text{ mm}$$

$D_s =$	0.6 mm	Pile Diameter
$L =$	1000 mm	Pile embedment length
$f_l =$	3975 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

$$\text{Total Area over Pole} = 3.8338125 \text{ m}^2$$

Moment Wind =	3.81 Kn-m	Moment Snow =	1.18 Kn-m
Shear Wind =	0.96 Kn	Shear Snow =	1.18 Kn

Pile Properties

Safety Factory	0.55	
$H_u =$	1.79 Kn	Ultimate Lateral Strength of the Pile, Short pile
$M_u =$	4.04 Kn-m	Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.94 < 1 \text{ OK}$$

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

Geometry For End Bay Pole

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Ds =	0.6 mm	Pile Diameter
L =	1000 mm	Pile embedment length
f1 =	3975 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	3.81 Kn-m	Moment Snow =	1.18 Kn-m
Shear Wind =	0.96 Kn	Shear Snow =	1.18 Kn

Pile Properties

Safety Factor	0.55	
Hu =	1.79 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	4.04 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.94 < 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(1500) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1500)

Skin Friction = 18.17 Kn

Weight of Pile + Pile Skin Friction = 23.08 Kn

Uplift on one Pile = 15.26 Kn

Uplift is ok