



**Job No.:** Joyce Shed-2**Address:** 276A Cape Hill Rd, Pukekohe, New Zealand**Date:** 17/05/2024**Latitude:** -37.174073**Longitude:** 174.910227**Elevation:** 78.5 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	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	3 m
Wind Region	NZ1	Terrain Category	1.96	Design Wind Speed	44.61 m/s
Wind Pressure	1.19 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	Very 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 3.35 m  $C_{p,e} = -0.9$   $p_e = -0.97$  KPa  $p_{net} = -0.97$  KPa

For roof  $C_{p,e}$  from 3.35 m To 6.70 m  $C_{p,e} = -0.5$   $p_e = -0.54$  KPa  $p_{net} = -0.54$  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 9 m  $C_{p,e} = 0.7$   $p_e = 0.75$  KPa  $p_{net} = 1.11$  KPa

For side wall  $C_{p,e}$  from 0 m To 3.35 m  $C_{p,e} =$   $p_e = -0.70$  KPa  $p_{net} = -0.70$  KPa

Maximum Upward pressure used in roof member Design = 0.97 KPa

Maximum Downward pressure used in roof member Design = 0.57 KPa

Maximum Wall pressure used in Design = 1.11 KPa

Maximum Racking pressure used in Design = 1.29 KPa

**Design Summary****Girt Design Front and Back**

Girt's Spacing = 900 mm

Girt's Span = 1876 mm

Try Girt 140x45 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 = 1.00

K8 Upward = 0.90 S1 Downward = 10.36 S1 Upward = 14.96

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

**Capacity Checks**

$M_{Wind+Snow}$	0.44 Kn-m	Capacity	1.48 Kn-m	Passing Percentage	<b>336.36 %</b>
$V_{0.9D-WnUp}$	0.94 Kn	Capacity	10.13 Kn	Passing Percentage	<b>1077.66 %</b>

**Deflections**

Pole Shed App Ver 01 2022

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

Deflection under Snow and Service Wind = 2.34 mm

Limit by Woolcock et al, 1999 Span/100 = 18.76 mm

Sag during installation = 0.93 mm

**Reactions**

Maximum = 0.94 kn

**Girt Design Sides**

Girt's Spacing = 600 mm

Girt's Span = 1970 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 =0.97    S1 Downward =12.23    S1 Upward =12.79

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

**Capacity Checks**

$M_{Wind+Snow}$	0.32 Kn-m	Capacity	2.94 Kn-m	Passing Percentage	<b>918.75 %</b>
$V_{0.9D-WnUp}$	0.66 Kn	Capacity	13.75 Kn	Passing Percentage	<b>2083.33 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 0.76 mm

Limit by Woolcock et al. 1999 Span/100 = 19.70 mm

Sag during installation =1.13 mm

**Reactions**

Maximum = 0.66 kn

**Middle Pole Design**

**Geometry**

125x125 SG8 Dry	Dry Use	Height	2850 mm
Area	15625 mm <sup>2</sup>	As	11718.75 mm <sup>2</sup>
I <sub>x</sub>	20345052 mm <sup>4</sup>	Z <sub>x</sub>	325521 mm <sup>3</sup>
I <sub>y</sub>	20345052 mm <sup>4</sup>	Z <sub>y</sub>	325521 mm <sup>3</sup>
Lateral Restraint	1300 mm c/c		

**Loads**

Total Area over Pole = 7.3922942206655 m<sup>2</sup>

Dead	1.85 Kn	Live	1.85 Kn
Wind Down	4.21 Kn	Snow	0.00 Kn
Moment wind	2.48 Kn-m		
Phi	0.8	K8	1.00
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

**Material**

Shaving	Steaming	Normal	Dry Use
fb =	14 MPa	fs =	3 MPa
fc =	18 MPa	fp =	8.9 MPa
ft =	6 MPa	E =	8000 MPa

**Capacities**

PhiNcx Wind	225.07 Kn	PhiMnx Wind	3.65 Kn-m	PhiVnx Wind	28.13 Kn
PhiNcx Dead	135.04 Kn	PhiMnx Dead	2.19 Kn-m	PhiVnx Dead	16.88 Kn

**Checks**

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

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

Deflection at top under service lateral loads = 18.31 mm < 28.50 mm

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

**Assumed Soil Properties**

Gamma	18 Kn/m <sup>3</sup>	Friction angle	30 deg	Cohesion	0 Kn/m <sup>3</sup>
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 =	1300 mm	Pile embedment length
f1 =	2250 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

**Loads**

Moment Wind =	2.48 Kn-m
Shear Wind =	1.10 Kn

**Pile Properties**

Safety Factory	0.55	
Hu =	5.51 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	7.51 Kn-m	Ultimate Moment Capacity of Pile

**Checks**

Applied Forces/Capacities = 0.33 < 1 OK

**End Pole Design**

**Geometry For End Bay Pole**

**Geometry**

Pole Shed App Ver 01 2022

125x125 SG8 Dry	Dry Use	Height	2850 mm
Area	15625 mm <sup>2</sup>	As	11718.75 mm <sup>2</sup>
I <sub>x</sub>	20345052 mm <sup>4</sup>	Z <sub>x</sub>	325521 mm <sup>3</sup>
I <sub>y</sub>	20345052 mm <sup>4</sup>	Z <sub>y</sub>	325521 mm <sup>3</sup>
Lateral Restraint	mm c/c		

**Loads**

Total Area over Pole = 3.69614711033275 m<sup>2</sup>

Dead	0.92 Kn	Live	0.92 Kn
Wind Down	2.11 Kn	Snow	0.00 Kn
Moment Wind	1.24 Kn-m		
Phi	0.8	K <sub>8</sub>	0.54
K <sub>1</sub> snow	0.8	K <sub>1</sub> Dead	0.6
K <sub>1</sub> wind	1		

**Material**

Shaving	Steaming	Normal	Dry Use
f <sub>b</sub> =	14 MPa	f <sub>s</sub> =	3 MPa
f <sub>c</sub> =	18 MPa	f <sub>p</sub> =	8.9 MPa
f <sub>t</sub> =	6 MPa	E =	8000 MPa

**Capacities**

PhiN <sub>c</sub> Wind	121.63 Kn	PhiM <sub>n</sub> Wind	1.97 Kn-m	PhiV <sub>n</sub> Wind	28.13 Kn
PhiN <sub>c</sub> Dead	72.98 Kn	PhiM <sub>n</sub> Dead	1.18 Kn-m	PhiV <sub>n</sub> Dead	16.88 Kn

**Checks**

$(M_x/\Phi M_n) + (N/\Phi N_c) = 0.66 < 1$  OK

$(M_x/\Phi M_n)^2 + (N/\Phi N_c) = 0.43 < 1$  OK

Deflection at top under service lateral loads = 9.61 mm < 29.93 mm

D <sub>s</sub> =	0.6 mm	Pile Diameter
L =	700 mm	Pile embedment length
f <sub>1</sub> =	2250 mm	Distance at which the shear force is applied
f <sub>2</sub> =	0 mm	Distance of top soil at rest pressure

**Loads**

Total Area over Pole = 3.69614711033275 m<sup>2</sup>

Moment Wind =	1.24 Kn-m
Shear Wind =	0.55 Kn

**Pile Properties**

Safety Factory	0.55	
H <sub>u</sub> =	1.04 Kn	Ultimate Lateral Strength of the Pile, Short pile
M <sub>u</sub> =	1.34 Kn-m	Ultimate Moment Capacity of Pile

#### Checks

Applied Forces/Capacities =  $0.93 < 1$  OK

### Drained Lateral Strength of End pile in cohesionless soils Free Head short pile

#### Assumed Soil Properties

Gamma	18 Kn/m <sup>3</sup>	Friction angle	30 deg	Cohesion	0 Kn/m <sup>3</sup>
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 =	700 mm	Pile embedment length
f1 =	2250 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

#### Loads

Moment Wind =	1.24 Kn-m
Shear Wind =	0.55 Kn

#### Pile Properties

Safety Factory	0.55	
Hu =	1.04 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	1.34 Kn-m	Ultimate Moment Capacity of Pile

#### Checks

Applied Forces/Capacities =  $0.93 < 1$  OK

### Uplift Check

Density of Concrete = 24 Kn/m<sup>3</sup>

Density of Timber Pole = 5 Kn/m<sup>3</sup>

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(1300) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1300)

Skin Friction = 13.65 Kn

Weight of Pile + Pile Skin Friction = 18.65 Kn

Uplift on one Pile = 5.51 Kn

Uplift is ok