

Pole Shed App Ver 01 2022

**Job No.:** Apiti Shed - 1

**Address:** 101 Table Flat Rd, Apiti, New Zealand

**Date:** 10/3/2023

**Latitude:** -39.948308

**Longitude:** 175.912963

**Elevation:** 558 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	1.11 KPa	Roof Snow Load	0.75 KPa
Earthquake Zone	3	Subsoil Category	D	Exposure Zone	B
Importance Level	2	Ultimate wind & Earthquake ARI	500 Years	Max Height	5.4 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	48.36 m/s
Wind Pressure	1.4 KPa	Lee Zone	NO	Ultimate Snow ARI	150 Years
Wind Category	Very High	Earthquake ARI	500		

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 6.20 m  $C_{p,e} = -0.9$   $p_e = -1.14$  KPa  $p_{net} = -1.14$  KPa

For roof  $C_{p,e}$  from 6.20 m To 12.40 m  $C_{p,e} = -0.5$   $p_e = -0.63$  KPa  $p_{net} = -0.63$  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 28.8 m  $C_{p,e} = 0.7$   $p_e = 0.88$  KPa  $p_{net} = 1.30$  KPa

For side wall  $C_{p,e}$  from 0 m To 6.20 m  $C_{p,e} =$   $p_e = -0.82$  KPa  $p_{net} = -0.82$  KPa

Maximum Upward pressure used in roof member Design = 1.14 KPa

Maximum Downward pressure used in roof member Design = 0.67 KPa

Maximum Wall pressure used in Design = 1.30 KPa

Maximum Racking pressure used in Design = 1.26 KPa

**Design Summary**

**Girt Design Front and Back**

Girt's Spacing = 600 mm

Girt's Span = 4800 mm

Try Girt 250x50 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 =0.97

K8 Upward =0.64    S1 Downward =12.68    S1 Upward =20.70

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

#### **Capacity Checks**

M <sub>Wind+Snow</sub>	2.25 Kn-m	Capacity	3.71 Kn-m	Passing Percentage	<b>164.89 %</b>
V <sub>0.9D-WnUp</sub>	1.87 Kn-m	Capacity	20.10 Kn-m	Passing Percentage	<b>1074.87 %</b>

#### **Deflections**

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

Deflection under Snow and Service Wind = 19.49 mm    Limit by Woolcock et al, 1999 Span/250 = 19.20 mm  
Sag during installation = 32.19 mm

#### **Reactions**

Maximum = 1.87 kn

#### **Girt Design Sides**

Girt's Spacing = 600 mm                      Girt's Span = 5000 mm                      Try Girt 250x50 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 =0.97

K8 Upward =0.62    S1 Downward =12.68    S1 Upward =21.13

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

#### **Capacity Checks**

M <sub>Wind+Snow</sub>	2.44 Kn-m	Capacity	3.59 Kn-m	Passing Percentage	<b>147.13 %</b>
V <sub>0.9D-WnUp</sub>	1.95 Kn-m	Capacity	20.10 Kn-m	Passing Percentage	<b>1030.77 %</b>

#### **Deflections**

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

Deflection under Snow and Service Wind = 22.95 mm    Limit by Woolcock et al. 1999 Span/100 = 20.00 mm

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Sag during installation = 37.90 mm

**Reactions**

Maximum = 1.95 kn

**Middle Pole Design**

**Geometry**

350 SED H5 (Minimum 375 dia. at Floor Level)	Dry Use	Height	5100 mm
Area	103154 mm <sup>2</sup>	As	77365.4296875 mm <sup>2</sup>
Ix	847191750 mm <sup>4</sup>	Zx	4674161 mm <sup>3</sup>
Iy	847191750 mm <sup>4</sup>	Zx	4674161 mm <sup>3</sup>
Lateral Restraint	5100 mm c/c		

**Loads**

Total Area over Pole = 36 m<sup>2</sup>

Dead	9.00 Kn	Live	9.00 Kn
Wind Down	24.12 Kn	Snow	27.00 Kn
Moment wind	32.98 Kn-m	Moment snow	7.17 Kn-m
Phi	0.8	K8	0.93
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	1385.84 Kn	PhiMnx Wind	126.64 Kn-m	PhiVnx Wind	183.20 Kn
PhiNcx Dead	831.50 Kn	PhiMnx Dead	75.98 Kn-m	PhiVnx Dead	109.92 Kn
PhiNcx Snow	1108.67 Kn	PhiMnx Snow	101.31 Kn-m	PhiVnx Snow	146.56 Kn

**Checks**

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.30 < 1$  OK

$$(M_x/\phi M_{nx})^2 + (N/\phi N_{cx}) = 0.11 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 16.28 mm < 34.00 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>  
K<sub>0</sub> = (1-sin(30)) / (1+sin(30))  
K<sub>p</sub> = (1+sin(30)) / (1-sin(30))

### **Geometry For Middle Bay Pole**

D<sub>s</sub> = 0.6 mm                      Pile Diameter  
L = 2200 mm                      Pile embedment length  
f<sub>1</sub> = 4050 mm                      Distance at which the shear force is applied  
f<sub>2</sub> = 0 mm                      Distance of top soil at rest pressure

### **Loads**

Moment Wind = 32.98 Kn-m                      Moment Snow = Kn-m  
Shear Wind = 8.14 Kn                      Shear Snow = 7.17 Kn

### **Pile Properties**

Safety Factory 0.55  
H<sub>u</sub> = 15.18 Kn                      Ultimate Lateral Strength of the Pile, Short pile  
M<sub>u</sub> = 36.94 Kn-m                      Ultimate Moment Capacity of Pile

### **Checks**

Applied Forces/Capacities = 0.89 < 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

K<sub>s</sub> (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<sub>s</sub>(1.5) x

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

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

$$\text{Weight of Pile} + \text{Pile Skin Friction} = 41.52 \text{ Kn}$$

$$\text{Uplift on one Pile} = 32.94 \text{ Kn}$$

Uplift is ok