



Pole Shed App Ver 01 2022

**Job No.:** Hamish Meyrick - 1      **Address:** 21 Flax Cutter Lane, Woodside, New Zealand      **Date:** 17/11/2024  
**Latitude:** -41.069646      **Longitude:** 175.412849      **Elevation:** 81 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	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	4.2 m
Wind Region	NZ2	Terrain Category	2.5	Design Wind Speed	39.58 m/s
Wind Pressure	0.94 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 Pressures**

Shed Type = Mono Enclosed

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

For roof  $C_{p,e}$  from 0 m To 4.8 m  $C_{p,e} = -0.9$   $p_e = -0.76$  KPa  $p_{net} = -0.76$  KPa

For roof  $C_{p,e}$  from 4.8 m To 9.60 m  $C_{p,e} = -0.5$   $p_e = -0.42$  KPa  $p_{net} = -0.42$  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  $C_{p,e} = 0.7$   $p_e = 0.59$  KPa  $p_{net} = 0.87$  KPa

For side wall  $C_{p,e}$  from 0 m To 4.8 m  $C_{p,e} =$   $p_e = -0.55$  KPa  $p_{net} = -0.55$  KPa

Maximum Upward pressure used in roof member Design = 0.76 KPa

Maximum Downward pressure used in roof member Design = 0.45 KPa

Maximum Wall pressure used in Design = 0.87 KPa

Maximum Racking pressure used in Design = 0.84 KPa

**Design Summary**

**Rafter Design Internal**

Internal Rafter Load Width = 4500 mm      Internal Rafter Span = 8850 mm      Try Rafter 2x360x63 LVL13

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

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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 = 5.90    S1 Upward = 5.90

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

#### **Capacity Checks**

M <sub>1.35D</sub>	14.87 Kn-m	Capacity	60.82 Kn-m	Passing Percentage	<b>409.01 %</b>
M <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	33.04 Kn-m	Capacity	81.1 Kn-m	Passing Percentage	<b>245.46 %</b>
M <sub>0.9D-W<sub>n</sub>Up</sub>	-23.57 Kn-m	Capacity	-101.38 Kn-m	Passing Percentage	<b>430.12 %</b>
V <sub>1.35D</sub>	6.72 Kn	Capacity	77.32 Kn	Passing Percentage	<b>1150.60 %</b>
V <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	14.93 Kn	Capacity	103.08 Kn	Passing Percentage	<b>690.42 %</b>
V <sub>0.9D-W<sub>n</sub>Up</sub>	-10.65 Kn	Capacity	-128.86 Kn	Passing Percentage	<b>1209.95 %</b>

#### **Deflections**

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

k<sub>2</sub> for Long Term Loads = 2

Deflection under Dead and Live Load = 19.26 mm    Limit by Woolcock et al, 1999 Span/240 = 37.50 mm

Deflection under Dead and Service Wind = 25.86 mm    Limit by Woolcock et al, 1999 Span/100 = 90.00 mm

#### **Reactions**

Maximum downward = 14.93 kn    Maximum upward = -10.65 kn

#### **Rafter to Pole Connection check**

Bolt Size = M12 Number of Bolts = 3

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

K<sub>11</sub> = 12.6 f<sub>pj</sub> = 22.7 Mpa for Rafter with effective thickness = 126 mm

For Parallel to grain loading

K<sub>11</sub> = 2.0 f<sub>cj</sub> = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 43.67 Kn > -10.65 Kn

## Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 4500 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 =0.70    S1 Downward =12.23    S1 Upward =19.33

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>	1.98 Kn-m	Capacity	2.13 Kn-m	Passing Percentage	<b>107.58 %</b>
V <sub>0.9D-WnUp</sub>	1.76 Kn	Capacity	13.75 Kn	Passing Percentage	<b>781.25 %</b>

### Deflections

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

Deflection under Snow and Service Wind = 24.26 mm    Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Sag during installation = 30.70 mm

### Reactions

Maximum = 1.76 kn

## Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 4500 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 =0.70    S1 Downward =12.23    S1 Upward =19.33

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### Capacity Checks

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### Deflections

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Maximum = 1.76 kn

### Middle Pole Design

#### Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	4500 mm
Area	35448 mm <sup>2</sup>	As	26585.7421875 mm <sup>2</sup>
Ix	100042702 mm <sup>4</sup>	Zx	941578 mm <sup>3</sup>
Iy	100042702 mm <sup>4</sup>	Zx	941578 mm <sup>3</sup>
Lateral Restraint	4500 mm c/c		

#### Loads

Total Area over Pole = 20.25 m<sup>2</sup>

Dead	5.06 Kn	Live	5.06 Kn
Wind Down	9.11 Kn	Snow	0.00 Kn
Moment wind	12.47 Kn-m		
Phi	0.8	K8	0.61
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	313.02 Kn	PhiMnx Wind	16.77 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	187.81 Kn	PhiMnx Dead	10.06 Kn-m	PhiVnx Dead	37.77 Kn

#### Checks

$$(M_x/\phi M_{nx}) + (N/\phi N_c) = 0.81 < 1 \text{ OK}$$

$$(M_x/\phi M_{nx})^2 + (N/\phi N_c) = 0.61 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 35.76 \text{ mm} < 45.00 \text{ mm}$$

### **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>

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

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

#### Geometry For Middle Bay Pole

Ds = 0.6 mm Pile Diameter

L = 1600 mm Pile embedment length

f1 = 3150 mm Distance at which the shear force is applied

f2 = 0 mm Distance of top soil at rest pressure

#### Loads

Moment Wind = 12.47 Kn-m

Shear Wind = 3.96 Kn

#### Pile Properties

Safety Factor 0.55

Hu = 7.68 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 14.44 Kn-m Ultimate Moment Capacity of Pile

#### Checks

$$\text{Applied Forces/Capacities} = 0.86 < 1 \text{ OK}$$

### **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

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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(1600) x Ks(1.5) x  $0.5 \times \tan(30)$  x  $\pi$  x Dia of Pile(0.6) x Height of Pile(1600)

Skin Friction = 20.68 Kn

Weight of Pile + Pile Skin Friction = 24.83 Kn

Uplift on one Pile = 10.83 Kn

Uplift is ok