

Pole Shed App Ver 01 2022

**Job No.:** 283 North Manakau    **Address:** 283 North Manakau Road, Manakau, New Zealand    **Date:** 18/12/2023  
**Latitude:** -40.716241    **Longitude:** 175.244816    **Elevation:** 90 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	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.1 m
Wind Region	NZ2	Terrain Category	1.77	Design Wind Speed	42.03 m/s
Wind Pressure	1.06 KPa	Lee Zone	NO	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  $C_{p,i} = 0.6815$

For roof  $C_{p,e}$  from 0 m To 4.30 m  $C_{p,e} = -0.9$   $p_e = -0.58$  KPa  $p_{net} = -1.10$  KPa

For roof  $C_{p,e}$  from 4.30 m To 8.60 m  $C_{p,e} = -0.5$   $p_e = -0.32$  KPa  $p_{net} = -0.84$  KPa

For wall Windward  $C_{p,i} = 0.6815$  side Wall  $C_{p,i} = -0.4735$

For wall Windward and Leeward  $C_{p,e}$  from 0 m To 9 m  $C_{p,e} = 0.7$   $p_e = 0.67$  KPa  $p_{net} = 1.24$  KPa

For side wall  $C_{p,e}$  from 0 m To 4.30 m  $C_{p,e} =$   $p_e = -0.62$  KPa  $p_{net} = -0.05$  KPa

Maximum Upward pressure used in roof member Design = 1.10 KPa

Maximum Downward pressure used in roof member Design = 0.67 KPa

Maximum Wall pressure used in Design = 1.24 KPa

Maximum Racking pressure used in Design = 1.15 KPa

**Design Summary**

**Rafter Design Internal**

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

### Pole Shed App Ver 01 2022

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 = 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>	42.73 Kn-m	Capacity	81.1 Kn-m	Passing Percentage	<b>189.80 %</b>
M <sub>0.9D-W<sub>n</sub>Up</sub>	-38.55 Kn-m	Capacity	-101.38 Kn-m	Passing Percentage	<b>262.98 %</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>	19.32 Kn	Capacity	103.08 Kn	Passing Percentage	<b>533.54 %</b>
V <sub>0.9D-W<sub>n</sub>Up</sub>	-17.42 Kn	Capacity	-128.86 Kn	Passing Percentage	<b>739.72 %</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 = 29.785 mm      Limit by Woolcock et al, 1999 Span/100 = 90.00 mm

#### **Reactions**

Maximum downward = 19.32 kn    Maximum upward = -17.42 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

Pole Shed App Ver 01 2022

$K_{11} = 2.0 \text{ fcj} = 36.1 \text{ MPa}$  for Pole with effective thickness = 100 mm

Capacity under short term loads = 43.67 Kn > -17.42 Kn

**Girt Design Front and Back**

Girt's Spacing = 600 mm

Girt's Span = 4500 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)

$K_1$  Short term = 1     $K_4 = 1$      $K_5 = 1$      $K_8$  Downward = 1.00

$K_8$  Upward = 0.98     $S_1$  Downward = 9.63     $S_1$  Upward = 12.44

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

**Capacity Checks**

$M_{\text{Wind+Snow}}$	1.88 Kn-m	Capacity	2.05 Kn-m	Passing Percentage	<b>109.04 %</b>
$V_{0.9D-WnUp}$	1.67 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	<b>722.16 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 42.16 mm    Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Sag during installation = 24.86 mm

**Reactions**

Maximum = 1.67 kn

**Girt Design Sides**

Girt's Spacing = 600 mm

Girt's Span = 4500 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)

$K_1$  Short term = 1     $K_4 = 1$      $K_5 = 1$      $K_8$  Downward = 1.00

$K_8$  Upward = 0.98     $S_1$  Downward = 9.63     $S_1$  Upward = 12.44

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

**Capacity Checks**

Pole Shed App Ver 01 2022

M <sub>Wind+Snow</sub>	1.88 Kn-m	Capacity	2.05 Kn-m	Passing Percentage	<b>109.04 %</b>
V <sub>0.9D-WnUp</sub>	1.67 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	<b>722.16 %</b>

### Deflections

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

Deflection under Snow and Service Wind = 42.16 mm    Limit by Woolcock et al. 1999 Span/100 = 45.00 mm  
Sag during installation = 24.86 mm

### Reactions

Maximum = 1.67 kn

### Middle Pole Design

#### Geometry

225 SED H5 (Minimum 250 dia. at Floor Level)	Dry Use	Height	3740 mm
Area	44279 mm <sup>2</sup>	As	33209.1796875 mm <sup>2</sup>
I <sub>x</sub>	156100441 mm <sup>4</sup>	Z <sub>x</sub>	1314530 mm <sup>3</sup>
I <sub>y</sub>	156100441 mm <sup>4</sup>	Z <sub>y</sub>	1314530 mm <sup>3</sup>
Lateral Restraint	1300 mm c/c		

#### Loads

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

Dead	5.06 Kn	Live	5.06 Kn
Wind Down	13.57 Kn	Snow	0.00 Kn
Moment wind	16.27 Kn-m		
Phi	0.8	K <sub>8</sub>	1.00
K <sub>1</sub> snow	0.8	K <sub>1</sub> Dead	0.6
K <sub>1</sub> wind	1		

#### Material

Peeling	Steaming	Normal	Dry Use
f <sub>b</sub> =	36.3 MPa	f <sub>s</sub> =	2.96 MPa
f <sub>c</sub> =	18 MPa	f <sub>p</sub> =	7.2 MPa
f <sub>t</sub> =	22 MPa	E =	9257 MPa

#### Capacities

Pole Shed App Ver 01 2022

PhiNcx Wind	637.62 Kn	PhiMnx Wind	38.17 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	382.57 Kn	PhiMnx Dead	22.90 Kn-m	PhiVnx Dead	47.18 Kn

**Checks**

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.46 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.22 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 24.26 \text{ mm} < 37.40 \text{ mm}$$

**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 <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 =	1700 mm	Pile embedment length
f <sub>1</sub> =	3075 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 =	16.27 Kn-m
Shear Wind =	5.29 Kn

**Pile Properties**

Safety Factory	0.55	
H <sub>u</sub> =	9.17 Kn	Ultimate Lateral Strength of the Pile, Short pile
M <sub>u</sub> =	16.97 Kn-m	Ultimate Moment Capacity of Pile

**Checks**

$$\text{Applied Forces/Capacities} = 0.96 < 1 \text{ OK}$$

**Uplift Check**

$$\text{Density of Concrete} = 24 \text{ Kn/m}^3$$

Pole Shed App Ver 01 2022

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(1700) x Ks(1.5) x  $0.5 \times \tan(30)$  x  $\pi$  x Dia of Pile(0.6) x Height of Pile(1700)

Skin Friction = 23.34 Kn

Weight of Pile + Pile Skin Friction = 27.24 Kn

Uplift on one Pile = 17.72 Kn

Uplift is ok