



Pole Shed App Ver 01 2022

**Job No.:** EHB 311-1

**Address:** 248D Bay Road, West Plains 9879, New Zealand

**Date:** 23/06/2025

**Latitude:** -46.386669

**Longitude:** 168.327914

**Elevation:** 1 m

**General Input**

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N5	Ground Snow Load	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	1	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	3.2 m
Wind Region	NZ4	Terrain Category	2.53	Design Wind Speed	40.78 m/s
Wind Pressure	1 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  $C_{p,i} = -0.3$

For roof  $C_{p,e}$  from 0 m To 3.30 m  $C_{p,e} = -0.9$   $p_e = -0.79$  KPa  $p_{net} = -0.79$  KPa

For roof  $C_{p,e}$  from 3.3 m To 6.6 m  $C_{p,e} = 0.5$   $p_e = -0.44$  KPa  $p_{net} = -0.44$  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 5 m  $C_{p,e} = 0.7$   $p_e = 0.63$  KPa  $p_{net} = 0.93$  KPa

For side wall  $C_{p,e}$  from 0 m To 3.3 m  $C_{p,e} =$   $p_e = -0.58$  KPa  $p_{net} = -0.58$  KPa

Maximum Upward pressure used in roof member Design = 0.79 KPa

Maximum Downward pressure used in roof member Design = 0.38 KPa

Maximum Wall pressure used in Design = 0.93 KPa

Maximum Racking pressure used in Design = 0.90 KPa

**Design Summary**

**Rafter Design External**

External Rafter Load Width = 4500 mm External Rafter Span = 4825 mm Try Rafter 300x45 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 = 0.88

K8 Upward = 0.88    S1 Downward = 15.50    S1 Upward = 15.50

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>	4.42 Kn-m	Capacity	13.69 Kn-m	Passing Percentage	<b>309.73 %</b>
M <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	12.18 Kn-m	Capacity	18.26 Kn-m	Passing Percentage	<b>149.92 %</b>
M <sub>0.9D-W<sub>n</sub>Up</sub>	-7.40 Kn-m	Capacity	-22.82 Kn-m	Passing Percentage	<b>308.38 %</b>
V <sub>1.35D</sub>	3.66 Kn	Capacity	23.01 Kn	Passing Percentage	<b>628.69 %</b>
V <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	10.10 Kn	Capacity	30.68 Kn	Passing Percentage	<b>303.76 %</b>
V <sub>0.9D-W<sub>n</sub>Up</sub>	-6.13 Kn	Capacity	-38.35 Kn	Passing Percentage	<b>625.61 %</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 = 9.86 mm    Limit by Woolcock et al, 1999 Span/240 = 20.83 mm

Deflection under Dead and Service Wind = 11.34 mm    Limit by Woolcock et al, 1999 Span/100 = 50.00 mm

#### **Reactions**

Maximum downward = 10.10 kn    Maximum upward = -6.13 kn

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

Bolt Size = M12 Number of Bolts = 2

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Joint Group for Rafters = J2 Joint Group for Pole = J5

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 = 45 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

Eccentric Load check

V =  $\phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s$  ..... (Eq 4.12) = -40.07 kn > -6.13 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -6.13 Kn

### Intermediate Design Front and Back

Intermediate Spacing = 4500 mm    Intermediate Span = 2550 mm    Try Intermediate 2x200x50 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 =1.00

K8 Upward =1.00    S1 Downward =11.27    S1 Upward =0.60

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>	3.40 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	<b>219.41 %</b>
V <sub>0.9D-WnUp</sub>	5.34 Kn	Capacity	-32.16 Kn	Passing Percentage	<b>602.25 %</b>

#### Deflections

Modulus of Elasticity = 5400 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 12.595 mm    Limit by Woolcock et al, 1999 Span/100 = 25.50 mm

#### Reactions

Maximum = 5.34 kn

### Intermediate Design Sides

Intermediate Spacing = 2500 mm    Intermediate Span = 2800 mm    Try Intermediate 2x200x50 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 =1.00

K8 Upward =1.00    S1 Downward =11.27    S1 Upward =0.63

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>	1.14 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	<b>654.39 %</b>
V <sub>0.9D-WnUp</sub>	1.63 Kn	Capacity	32.16 Kn	Passing Percentage	<b>1973.01 %</b>

### **Deflections**

Modulus of Elasticity = 5400 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 10.17 mm Limit by Woolcock et al, 1999 Span/100 = 28.00 mm

### **Reactions**

Maximum = 1.63 kn

### **Girt Design Front and Back**

Girt's Spacing = 900 mm

Girt's Span = 4500 mm

Try Girt 200x50 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 =1.00

K8 Upward =0.78 S1 Downward =11.27 S1 Upward =17.82

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>	2.12 Kn-m	Capacity	2.90 Kn-m	Passing Percentage	<b>136.79 %</b>
V <sub>0.9D-WnUp</sub>	1.88 Kn	Capacity	16.08 Kn	Passing Percentage	<b>855.32 %</b>

### **Deflections**

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

Deflection under Snow and Service Wind = 33.57 mm Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Sag during installation = 24.86 mm

### **Reactions**

Maximum = 1.88 kn

### **Girt Design Sides**

Girt's Spacing = 1300 mm

Girt's Span = 2500 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

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K8 Upward =0.86    S1 Downward =9.63    S1 Upward =16.05

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>	0.94 Kn-m	Capacity	1.80 Kn-m	Passing Percentage	<b>191.49 %</b>
V <sub>0.9D-WnUp</sub>	1.51 Kn	Capacity	12.06 Kn	Passing Percentage	<b>798.68 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 10.95 mm    Limit by Woolcock et al. 1999 Span/100 = 25.00 mm  
Sag during installation =2.37 mm

**Reactions**

Maximum = 1.51 kn

**End Pole Design**

**Geometry For End Bay Pole**

**Geometry**

175x175 SG8 Dry	Dry Use	Height	2900 mm
Area	30625 mm <sup>2</sup>	As	22968.75 mm <sup>2</sup>
I <sub>x</sub>	78157552 mm <sup>4</sup>	Z <sub>x</sub>	893229 mm <sup>3</sup>
I <sub>y</sub>	78157552 mm <sup>4</sup>	Z <sub>y</sub>	893229 mm <sup>3</sup>
Lateral Restraint	mm c/c		

**Loads**

Total Area over Pole = 11.25 m<sup>2</sup>

Dead	2.81 Kn	Live	2.81 Kn
Wind Down	4.28 Kn	Snow	7.09 Kn
Moment Wind	7.76 Kn-m	Moment snow	3.23 Kn-m
Phi	0.8	K8	0.83
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

**Material**

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Shaving	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	368.17 Kn	PhiMnx Wind	21.66 Kn-m	PhiVnx Wind	54.39 Kn
PhiNcx Dead	220.90 Kn	PhiMnx Dead	12.99 Kn-m	PhiVnx Dead	32.63 Kn
PhiNcx Snow	294.53 Kn	PhiMnx Snow	17.32 Kn-m	PhiVnx Snow	43.51 Kn

**Checks**

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.40 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.17 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 15.39 \text{ mm} < 31.92 \text{ mm}$$

$D_s =$	0.6 mm	Pile Diameter
$L =$	1500 mm	Pile embedment length
$f_1 =$	2400 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

**Loads**

$$\text{Total Area over Pole} = 11.25 \text{ m}^2$$

Moment Wind =	7.76 Kn-m	Moment Snow =	3.23 Kn-m
Shear Wind =	3.23 Kn	Shear Snow =	3.23 Kn

**Pile Properties**

Safety Factory	0.55	
$H_u =$	7.71 Kn	Ultimate Lateral Strength of the Pile, Short pile
$M_u =$	11.31 Kn-m	Ultimate Moment Capacity of Pile

**Checks**

$$\text{Applied Forces/Capacities} = 0.69 < 1 \text{ OK}$$

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

**Assumed Soil Properties**

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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 End Bay Pole**

Ds = 0.6 mm Pile Diameter

L = 1500 mm Pile embedment length

f1 = 2400 mm Distance at which the shear force is applied

f2 = 0 mm Distance of top soil at rest pressure

**Loads**

Moment Wind = 7.76 Kn-m Moment Snow = 3.23 Kn-m

Shear Wind = 3.23 Kn Shear Snow = 3.23 Kn

**Pile Properties**

Safety Factory 0.55

Hu = 7.71 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 11.31 Kn-m Ultimate Moment Capacity of Pile

**Checks**

Applied Forces/Capacities = 0.69 < 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(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 = 12.71 Kn

Uplift is ok



