

Pole Shed App Ver 01 2022

**Job No.:** EHB 13 - 1      **Address:** 167 B Taiepa Road Otatara, Invercargill, New Zealand      **Date:** 9/14/2023  
**Latitude:** -46.439506      **Longitude:** 168.296114      **Elevation:** 16 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	3.925 m
Wind Region	NZ4	Terrain Category	2.46	Design Wind Speed	41.03 m/s
Wind Pressure	1.01 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 3.93 m  $C_{p,e} = -0.9$   $p_e = -0.82$  KPa  $p_{net} = -0.82$  KPa

For roof  $C_{p,e}$  from 3.93 m To 7.85 m  $C_{p,e} = -0.5$   $p_e = -0.45$  KPa  $p_{net} = -0.45$  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 24 m  $C_{p,e} = 0.7$   $p_e = 0.64$  KPa  $p_{net} = 0.94$  KPa

For side wall  $C_{p,e}$  from 0 m To 3.93 m  $C_{p,e} =$   $p_e = -0.59$  KPa  $p_{net} = -0.59$  KPa

Maximum Upward pressure used in roof member Design = 0.82 KPa

Maximum Downward pressure used in roof member Design = 0.48 KPa

Maximum Wall pressure used in Design = 0.94 KPa

Maximum Racking pressure used in Design = 0.92 KPa

**Design Summary**

**Purlin Design**

Purlin Spacing = 900 mm      Purlin Span = 4650 mm      Try Purlin 250x50 SG8 Dry

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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 = 0.97

K8 Upward = 0.35    S1 Downward = 12.68    S1 Upward = 28.66

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

#### **Capacity Checks**

M <sub>1.35D</sub>	0.82 Kn-m	Capacity	3.40 Kn-m	Passing Percentage	<b>414.63 %</b>
M <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	2.26 Kn-m	Capacity	4.53 Kn-m	Passing Percentage	<b>200.44 %</b>
M <sub>0.9D-W<sub>n</sub>Up</sub>	-1.45 Kn-m	Capacity	-2.07 Kn-m	Passing Percentage	<b>142.76 %</b>
V <sub>1.35D</sub>	0.71 Kn	Capacity	12.06 Kn	Passing Percentage	<b>1698.59 %</b>
V <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	1.95 Kn	Capacity	16.08 Kn	Passing Percentage	<b>824.62 %</b>
V <sub>0.9D-W<sub>n</sub>Up</sub>	-1.25 Kn	Capacity	-20.10 Kn	Passing Percentage	<b>1608.00 %</b>

#### **Deflections**

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3 considering at least 4 members acting together

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

Deflection under Dead and Live Load = 7.22 mm    Limit by Woolcock et al, 1999 Span/240 = 19.17 mm

Deflection under Dead and Service Wind = 8.90 mm    Limit by Woolcock et al, 1999 Span/100 = 46.00 mm

#### **Reactions**

Maximum downward = 1.95 kn    Maximum upward = -1.25 kn

Number of Blocking = 0    if 0 then no blocking required, if 1 then one midspan blocking required

#### **Intermediate Design Front and Back**

Intermediate Spacing = 2400 mm    Intermediate Span = 3775 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 = 0.73

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

#### **Capacity Checks**

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$M_{Wind+Snow}$	4.02 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	<b>185.57 %</b>
$V_{0.9D-WnUp}$	4.26 Kn-m	Capacity	-32.16 Kn-m	Passing Percentage	<b>754.93 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 32.435 mm    Limit by Woolcock et al, 1999 Span/100 = 37.75 mm

**Reactions**

Maximum = 4.26 kn

**Intermediate Design Sides**

Intermediate Spacing = 2250 mm    Intermediate Span = 3150 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 = 0.67

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

**Capacity Checks**

$M_{Wind+Snow}$	1.31 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	<b>569.47 %</b>
$V_{0.9D-WnUp}$	1.67 Kn-m	Capacity	32.16 Kn-m	Passing Percentage	<b>1925.75 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 14.74 mm    Limit by Woolcock et al, 1999 Span/100 = 31.50 mm

**Reactions**

Maximum = 1.67 kn

**Girt Design Front and Back**

Girt's Spacing = 1300 mm    Girt's Span = 2400 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 =0.75    S1 Downward =11.27    S1 Upward =18.41

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>	0.88 Kn-m	Capacity	2.79 Kn-m	Passing Percentage	<b>317.05 %</b>
V <sub>0.9D-WnUp</sub>	1.47 Kn-m	Capacity	16.08 Kn-m	Passing Percentage	<b>1093.88 %</b>

#### **Deflections**

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

Deflection under Snow and Service Wind = 3.95 mm    Limit by Woolcock et al, 1999 Span/100 = 24.00 mm

Sag during installation = 2.01 mm

#### **Reactions**

Maximum = 1.47 kn

#### **Girt Design Sides**

Girt's Spacing = 1300 mm                      Girt's Span = 2250 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>	0.77 Kn-m	Capacity	2.90 Kn-m	Passing Percentage	<b>376.62 %</b>
V <sub>0.9D-WnUp</sub>	1.37 Kn-m	Capacity	16.08 Kn-m	Passing Percentage	<b>1173.72 %</b>

#### **Deflections**

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

Deflection under Snow and Service Wind = 3.05 mm    Limit by Woolcock et al. 1999 Span/100 = 22.50 mm

Sag during installation = 1.55 mm

#### **Reactions**

Maximum = 1.37 kn

#### **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(2100) x Ks(1.5) x  $0.5 \times \tan(30)$  x  $\pi$  x Dia of Pile(0.6) x Height of Pile(2100)

Skin Friction = 35.62 Kn

Weight of Pile + Pile Skin Friction = 40.43 Kn

Uplift on one Pile = 16.06 Kn

Uplift is ok