

Pole Shed App Ver 01 2022

**Job No.:** 623026 - 2      **Address:** 187 Awaroa River Rd, Whangarei, New Zealand      **Date:** 11/30/2023  
**Latitude:** -35.725772      **Longitude:** 174.366538      **Elevation:** 18 m

**General Input**

|                  |          |                                |           |                      |          |
|------------------|----------|--------------------------------|-----------|----------------------|----------|
| Roof Live Load   | 0.25 KPa | Roof Dead Load                 | 0.25 KPa  | Roof Live Point Load | 1.1 Kn   |
| Snow Zone        | N0       | Ground Snow Load               | 0 KPa     | Roof Snow Load       | 0 KPa    |
| Earthquake Zone  | 1        | Subsoil Category               | D         | Exposure Zone        | C        |
| Importance Level | 1        | Ultimate wind & Earthquake ARI | 100 Years | Max Height           | 3.5 m    |
| Wind Region      | NZ1      | Terrain Category               | 2.68      | Design Wind Speed    | 39.3 m/s |
| Wind Pressure    | 0.93 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  $C_{p,i} = -0.5842$

For roof  $C_{p,e}$  from 0 m To 3.13 m  $C_{p,e} = -0.9$   $p_e = -0.65$  KPa  $p_{net} = -1.02$  KPa

For roof  $C_{p,e}$  from 3.13 m To 6.26 m  $C_{p,e} = -0.5$   $p_e = -0.36$  KPa  $p_{net} = -0.73$  KPa

For wall Windward  $C_{p,i} = 0.4652$  side Wall  $C_{p,i} = -0.5842$

For wall Windward and Leeward  $C_{p,e}$  from 0 m To 10.40 m  $C_{p,e} = 0.7$   $p_e = 0.58$  KPa  $p_{net} = 1.04$  KPa

For side wall  $C_{p,e}$  from 0 m To 3.13 m  $C_{p,e} =$   $p_e = -0.54$  KPa  $p_{net} = -0.08$  KPa

Maximum Upward pressure used in roof member Design = 1.02 KPa

Maximum Downward pressure used in roof member Design = 0.63 KPa

Maximum Wall pressure used in Design = 1.04 KPa

Maximum Racking pressure used in Design = 0.99 KPa

**Design Summary**

**Purlin Design**

Purlin Spacing = 600 mm      Purlin Span = 4850 mm      Try Purlin 150x50 SG8 Dry

### Pole Shed App Ver 01 2022

Moisture Condition = Dry (Moisture in timber is less than 16% and 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 = 0.56    S1 Downward = 9.63    S1 Upward = 22.25

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>  | 0.6 Kn-m  | Capacity | 1.26 Kn-m  | Passing Percentage | <b>210.00 %</b>  |
| M <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub> | 1.86 Kn-m | Capacity | 1.68 Kn-m  | Passing Percentage | <b>90.32 %</b>   |
| M <sub>0.9D-W<sub>n</sub>Up</sub>   | -1.4 Kn-m | Capacity | -1.18 Kn-m | Passing Percentage | <b>84.29 %</b>   |
| V <sub>1.35D</sub>  | 0.49 Kn   | Capacity | 7.24 Kn    | Passing Percentage | <b>1477.55 %</b> |
| V <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub> | 1.35 Kn   | Capacity | 9.65 Kn    | Passing Percentage | <b>714.81 %</b>  |
| V <sub>0.9D-W<sub>n</sub>Up</sub>   | -1.16 Kn  | Capacity | -12.06 Kn  | Passing Percentage | <b>1039.66 %</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 = 26.41 mm    Limit by Woolcock et al, 1999 Span/240 = 20.00 mm

Deflection under Dead and Service Wind = 35.87 mm    Limit by Woolcock et al, 1999 Span/100 = 48.00 mm

#### **Reactions**

Maximum downward = 1.35 kn    Maximum upward = -1.16 kn

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

#### **Rafter Design Internal**

Internal Rafter Load Width = 5000 mm    Internal Rafter Span = 4250.067693349129 mm    Try Rafter 2x300x50 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    K1 Medium term = 0.8    K1 Long term = 0.6    K4 = 1    K5 = 1    K8 Downward = 1.00

K8 Upward = 1.00    S1 Downward = 6.81    S1 Upward = 6.81

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

#### **Capacity Checks**

Second page

Pole Shed App Ver 01 2022

|  |            |          |            |                    |                 |
|--|------------|----------|------------|--------------------|-----------------|
| M <sub>1.35D</sub>                       | 3.81 Kn-m  | Capacity | 10.08 Kn-m | Passing Percentage | <b>264.57 %</b> |
| M <sub>1.2D+1.5L 1.2D+Sn 1.2D+WnDn</sub> | 10.50 Kn-m | Capacity | 13.44 Kn-m | Passing Percentage | <b>128.00 %</b> |
| M <sub>0.9D-WnUp</sub>                   | -8.98 Kn-m | Capacity | -16.8 Kn-m | Passing Percentage | <b>187.08 %</b> |
| V <sub>1.35D</sub>                       | 3.59 Kn    | Capacity | 28.94 Kn   | Passing Percentage | <b>806.13 %</b> |
| V <sub>1.2D+1.5L 1.2D+Sn 1.2D+WnDn</sub> | 9.88 Kn    | Capacity | 38.6 Kn    | Passing Percentage | <b>390.69 %</b> |
| V <sub>0.9D-WnUp</sub>                   | -8.45 Kn   | Capacity | -48.24 Kn  | Passing Percentage | <b>570.89 %</b> |

**Deflections**

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

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

Deflection under Dead and Live Load = 5.425 mm      Limit by Woolcock et al, 1999 Span/240 = 18.33 mm

Deflection under Dead and Service Wind = 8.185 mm      Limit by Woolcock et al, 1999 Span/100 = 44.00 mm

**Reactions**

Maximum downward = 9.88 kn    Maximum upward = -8.45 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 = J5 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> = 14.9 f<sub>pj</sub> = 12.9 Mpa for Rafter with effective thickness = 100 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 = 32.51 Kn > -8.45 Kn

**Rafter Design External**

External Rafter Load Width = 2500 mm      External Rafter Span = 4211 mm      Try Rafter 300x50 SG8 Dry

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

Pole Shed App Ver 01 2022

K1 Short term = 1    K1 Medium term = 0.8    K1 Long term = 0.6    K4 = 1    K5 = 1    K8 Downward = 0.94

K8 Upward = 0.94    S1 Downward = 13.93    S1 Upward = 13.93

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>  | 1.87 Kn-m  | Capacity | 4.72 Kn-m  | Passing Percentage | <b>252.41 %</b> |
| M <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub> | 5.15 Kn-m  | Capacity | 6.30 Kn-m  | Passing Percentage | <b>122.33 %</b> |
| M <sub>0.9D-W<sub>n</sub>Up</sub>   | -4.41 Kn-m | Capacity | -7.87 Kn-m | Passing Percentage | <b>178.46 %</b> |
| V <sub>1.35D</sub>  | 1.78 Kn    | Capacity | 14.47 Kn   | Passing Percentage | <b>812.92 %</b> |
| V <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub> | 4.90 Kn    | Capacity | 19.30 Kn   | Passing Percentage | <b>393.88 %</b> |
| V <sub>0.9D-W<sub>n</sub>Up</sub>   | -4.18 Kn   | Capacity | -24.12 Kn  | Passing Percentage | <b>577.03 %</b> |

**Deflections**

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

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

Deflection under Dead and Live Load = 6.03 mm      Limit by Woolcock et al, 1999 Span/240 = 18.33 mm  
Deflection under Dead and Service Wind = 8.18 mm      Limit by Woolcock et al, 1999 Span/100 = 44.00 mm

**Reactions**

Maximum downward = 4.90 kn    Maximum upward = -4.18 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 = J5 Joint Group for Pole = J5

Factor of Safety = 0.7

For Perpendicular to grain loading

K<sub>11</sub> = 14.9 f<sub>pj</sub> = 12.9 Mpa for Rafter with effective thickness = 50 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) = -25.20 kn > -4.18 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -4.18 Kn

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

Girt's Spacing = 900 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

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> | 0.73 Kn-m | Capacity | 1.80 Kn-m  | Passing Percentage | <b>246.58 %</b>  |
| V <sub>0.9D-WnUp</sub> | 1.17 Kn-m | Capacity | 12.06 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 = 5.05 mm    Limit by Woolcock et al, 1999 Span/100 = 25.00 mm

Sag during installation = 2.37 mm

#### **Reactions**

Maximum = 1.17 kn

### **Girt Design Sides**

Girt's Spacing = 900 mm

Girt's Span = 2200 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

K8 Upward =0.90    S1 Downward =9.63    S1 Upward =15.06

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> | 0.57 Kn-m | Capacity | 1.89 Kn-m | Passing Percentage | <b>331.58 %</b> |
|------------------------|-----------|----------|-----------|--------------------|-----------------|

V<sub>0.9D-WnUp</sub>      1.03 Kn-m      Capacity      12.06 Kn-m      Passing Percentage      **1170.87 %**

### **Deflections**

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

Deflection under Snow and Service Wind = 3.03 mm      Limit by Woolcock et al. 1999 Span/100 = 22.00 mm

Sag during installation = 1.42 mm

### **Reactions**

Maximum = 1.03 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(1450) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1450)

Skin Friction = 16.98 Kn

Weight of Pile + Pile Skin Friction = 21.22 Kn

Uplift on one Pile = 17.49 Kn

Uplift is ok