

Pole Shed App Ver 01 2022

Job No.: Mark Green - 1

Address: 42 Pukeora Scenic Road, Waipukurau, New Zealand **Date:** 10/11/2023

Latitude: -39.990392

Longitude: 176.515553

Elevation: 140.5 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 | 2.7 m |
| Wind Region | NZ2 | Terrain Category | 2.33 | Design Wind Speed | 37.11 m/s |
| Wind Pressure | 0.83 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 Open

For roof $C_{p,i} = 0.6564$

For roof $C_{p,e}$ from 0 m To 3.55 m $C_{p,e} = -0.9$ $p_e = -0.58$ KPa $p_{net} = -1.09$ KPa

For roof $C_{p,e}$ from 3.55 m To 7.10 m $C_{p,e} = -0.5$ $p_e = -0.32$ KPa $p_{net} = -0.83$ KPa

For wall Windward $C_{p,i} = 0.6564$ side Wall $C_{p,i} = -0.569$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 13.80 m $C_{p,e} = 0.7$ $p_e = 0.52$ KPa $p_{net} = 1.03$ KPa

For side wall $C_{p,e}$ from 0 m To 3.55 m $C_{p,e} =$ $p_e = -0.48$ KPa $p_{net} = 0.03$ KPa

Maximum Upward pressure used in roof member Design = 1.09 KPa

Maximum Downward pressure used in roof member Design = 0.66 KPa

Maximum Wall pressure used in Design = 1.03 KPa

Maximum Racking pressure used in Design = 0.89 KPa

Design Summary

Rafter Design Internal

Internal Rafter Load Width = 4800 mm Internal Rafter Span = 5850 mm Try Rafter 2x300x50 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 = 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

| | | | | | |
|---|-----------|----------|------------|--------------------|-----------------|
| M _{1.35D} | 1.87 Kn-m | Capacity | 10.08 Kn-m | Passing Percentage | 539.04 % |
| M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n} | 3.51 Kn-m | Capacity | 13.44 Kn-m | Passing Percentage | 382.91 % |
| M _{0.9D-W_nUp} | 4.92 Kn-m | Capacity | -16.8 Kn-m | Passing Percentage | 341.46 % |
| V _{1.35D} | 3.01 Kn | Capacity | 28.94 Kn | Passing Percentage | 961.46 % |
| V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n} | 5.63 Kn | Capacity | 38.6 Kn | Passing Percentage | 685.61 % |
| V _{0.9D-W_nUp} | 10.8 Kn | Capacity | -48.24 Kn | Passing Percentage | 446.67 % |

Deflections

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

k₂ for Long Term Loads = 2

| | |
|--|---|
| Deflection under Dead and Live Load = 4 mm | Limit by Woolcock et al, 1999 Span/240 = 25.00 mm |
| Deflection under Dead and Service Wind = 17 mm | Limit by Woolcock et al, 1999 Span/100 = 60.00 mm |

Reactions

Maximum downward = 5.63 kn Maximum upward = 10.8 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

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 60 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 100 mm

For Parallel to grain loading

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

Capacity under short term loads = 21.67 Kn > 10.8 Kn

Prop on Sides = 2 2/SG815050Dry 700mm Reaction Prop = 3.31 Kn down 12.50 Kn Up

Prop Combined axial and bending ratios $(M_y/\Phi \times M_{ny}) + (N_c/\Phi \times N_{cy})$ should be less than or equal to 1

For Short Term Load = $0.53 < 1$ OK

For Medium Term Load = $0.18 < 1$ OK

For Long Term Load = $0.13 < 1$ OK

Prop Connection check

Effective width of Pole used in Calculations = 150 mm -20mm (Margin for chamfer)

Bolt Size = M12 Number of Bolts = 2

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 60 mm

Angle of prop = 45 degree

Prop Connection Capacity under Short term loads: 24.85 Kn > 12.5 Kn OK

Prop Connection Capacity under Medium term loads: 19.88 Kn > 3.31 Kn OK

Prop Connection Capacity under Long term loads: 14.91 Kn > 1.78 Kn OK

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 2400 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 = 0.87 S_1 Downward = 9.63 S_1 Upward = 15.73

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

Capacity Checks

| | | | | | |
|------------------------|-----------|----------|------------|--------------------|------------------|
| $M_{\text{Wind+Snow}}$ | 0.67 Kn-m | Capacity | 1.83 Kn-m | Passing Percentage | 273.13 % |
| $V_{0.9D-WnUp}$ | 1.11 Kn-m | Capacity | 12.06 Kn-m | Passing Percentage | 1086.49 % |

Deflections

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

Deflection under Snow and Service Wind = 4.25 mm Limit by Woolcock et al, 1999 Span/100 = 24.00 mm

Sag during installation = 2.01 mm

Reactions

Maximum = 1.11 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 4000 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 = 0.92 S1 Downward = 9.63 S1 Upward = 14.36

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

Capacity Checks

| | | | | | |
|------------------------|-----------|----------|------------|--------------------|-----------------|
| M _{Wind+Snow} | 1.85 Kn-m | Capacity | 1.94 Kn-m | Passing Percentage | 104.86 % |
| V _{0.9D-WnUp} | 1.85 Kn-m | Capacity | 12.06 Kn-m | Passing Percentage | 651.89 % |

Deflections

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

Deflection under Snow and Service Wind = 32.80 mm Limit by Woolcock et al. 1999 Span/100 = 40.00 mm

Sag during installation = 15.52 mm

Reactions

Maximum = 1.85 kn

Uplift Check

Density of Concrete = 24 Kn/m³

Density of Timber Pole = 5 Kn/m³

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(1300) x Ks(1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1300)

Skin Friction = 13.65 Kn

Weight of Pile + Pile Skin Friction = 17.91 Kn

Uplift on one Pile = 24.91 Kn

Uplift is ok