

Pole Shed App Ver 01 2022

Job No.: SB 048 Shed House **Address:** 164 Birchwood Road, Ohai, New Zealand **Date:** 3/13/2025
Latitude: -45.934481 **Longitude:** 167.946016 **Elevation:** 206 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 | 1.1 KPa | Roof Snow Load | 0.77 KPa |
| Earthquake Zone | 2 | Subsoil Category | D | Exposure Zone | B |
| Importance Level | 2 | Ultimate wind & Earthquake ARI | 500 Years | Max Height | 3.72 m |
| Wind Region | NZ2 | Terrain Category | 1.77 | Design Wind Speed | 43.72 m/s |
| Wind Pressure | 1.15 KPa | Lee Zone | NO | Ultimate Snow ARI | 150 Years |
| Wind Category | High | Earthquake ARI | 500 | | |

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 3.57 m $C_{p,e} = -0.9$ $p_e = -0.93$ KPa $p_{net} = -0.93$ KPa

For roof $C_{p,e}$ from 3.57 m To 7.13 m $C_{p,e} = -0.5$ $p_e = -0.52$ KPa $p_{net} = -0.52$ 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 10.53 m $C_{p,e} = 0.7$ $p_e = 0.72$ KPa $p_{net} = 1.06$ KPa

For side wall $C_{p,e}$ from 0 m To 3.57 m $C_{p,e} =$ $p_e = -0.67$ KPa $p_{net} = -0.67$ KPa

Maximum Upward pressure used in roof member Design = 0.93 KPa

Maximum Downward pressure used in roof member Design = 0.44 KPa

Maximum Wall pressure used in Design = 1.06 KPa

Maximum Racking pressure used in Design = 1.20 KPa

Design Summary

Rafter Design Internal

Internal Rafter Load Width = 3739 mm Internal Rafter Span = 4850 mm Try Rafter 2x290x45 SG8 Dry

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 = 1.00

K8 Upward = 1.00 S1 Downward = 7.47 S1 Upward = 7.47

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

Capacity Checks

| | | | | | |
|---|------------|----------|-------------|--------------------|-----------------|
| M _{1.35D} | 3.71 Kn-m | Capacity | 8.48 Kn-m | Passing Percentage | 228.57 % |
| M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n} | 11.76 Kn-m | Capacity | 11.3 Kn-m | Passing Percentage | 96.09 % |
| M _{0.9D-W_nUp} | -7.75 Kn-m | Capacity | -14.12 Kn-m | Passing Percentage | 182.19 % |
| V _{1.35D} | 3.06 Kn | Capacity | 25.18 Kn | Passing Percentage | 822.88 % |
| V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n} | 9.70 Kn | Capacity | 33.58 Kn | Passing Percentage | 346.19 % |
| V _{0.9D-W_nUp} | -6.39 Kn | Capacity | -41.96 Kn | Passing Percentage | 656.65 % |

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 8.315 mm Limit by Woolcock et al, 1999 Span/360 = 13.89 mm

Deflection under Dead and Service Wind = 11.09 mm Limit by Woolcock et al, 1999 Span/250 = 33.33 mm

Reactions

Maximum downward = 9.70 kn Maximum upward = -6.39 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 = 90 mm

For Parallel to grain loading

K₁₁ = 2.0 f_{cj} = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 19.50 Kn > -6.39 Kn

Intermediate Design Front and Back

Intermediate Spacing = 1869.5 mm Intermediate Span = 3255 mm Try Intermediate 2x240x45 SG8

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 =0.94

K8 Upward =1.00 S1 Downward =13.82 S1 Upward =0.83

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

Capacity Checks

| | | | | | |
|------------------------|-----------|----------|-----------|--------------------|------------------|
| M _{Wind+Snow} | 2.72 Kn-m | Capacity | 9.68 Kn-m | Passing Percentage | 355.88 % |
| V _{0.9D-WnUp} | 3.35 Kn | Capacity | -34.74 Kn | Passing Percentage | 1037.01 % |

Deflections

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

Deflection under Snow and Service Wind = 10.55 mm Limit by Woolcock et al, 1999 Span/250 = 13.02 mm

Reactions

Maximum = 3.35 kn

Intermediate Design Sides

Intermediate Spacing = 1760.5633802816903 mm Intermediate Span = 3531 mm Try Intermediate 2x240x45 SG8

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 =0.94

K8 Upward =1.00 S1 Downward =13.82 S1 Upward =0.87

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

Capacity Checks

| | | | | | |
|------------------------|-----------|----------|-----------|--------------------|------------------|
| M _{Wind+Snow} | 1.51 Kn-m | Capacity | 9.68 Kn-m | Passing Percentage | 641.06 % |
| V _{0.9D-WnUp} | 1.71 Kn | Capacity | 34.74 Kn | Passing Percentage | 2031.58 % |

Deflections

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

Deflection under Snow and Service Wind = 13.745 mm Limit by Woolcock et al, 1999 Span/250 = 14.12 mm

Reactions

Maximum = 1.71 kn

Girt Design Front and Back

Girt's Spacing = 600 mm

Girt's Span = 1870 mm

Try Girt 140x45 SG8

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 = 0.90 S1 Downward = 10.36 S1 Upward = 14.94

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

Capacity Checks

| | | | | | |
|------------------------|-----------|----------|-----------|--------------------|------------------|
| M _{Wind+Snow} | 0.28 Kn-m | Capacity | 1.49 Kn-m | Passing Percentage | 532.14 % |
| V _{0.9D-WnUp} | 0.59 Kn | Capacity | 10.13 Kn | Passing Percentage | 1716.95 % |

Deflections

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

Deflection under Snow and Service Wind = 2.53 mm Limit by Woolcock et al, 1999 Span/250 = 7.48 mm

Sag during installation = 0.91 mm

Reactions

Maximum = 0.59 kn

Girt Design Sides

Girt's Spacing = 600 mm

Girt's Span = 1761 mm

Try Girt 140x45 SG8

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 = 0.92 S1 Downward = 10.36 S1 Upward = 14.49

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

Capacity Checks

| | | | | | |
|-----------------|-----------|----------|-----------|--------------------|------------------|
| $M_{Wind+Snow}$ | 0.25 Kn-m | Capacity | 1.51 Kn-m | Passing Percentage | 604.00 % |
| $V_{0.9D-WnUp}$ | 0.56 Kn | Capacity | 10.13 Kn | Passing Percentage | 1808.93 % |

Deflections

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

Deflection under Snow and Service Wind = 1.99 mm Limit by Woolcock et al. 1999 Span/100 = 7.04 mm
Sag during installation = 0.72 mm

Reactions

Maximum = 0.56 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

K_s (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 K_s (1.5) x $0.5 \times \tan(30) \times \pi \times \text{Dia of Pile}(0.6) \times \text{Height of Pile}(1500)$

Skin Friction = 18.17 Kn

Weight of Pile + Pile Skin Friction = 21.61 Kn

Uplift on one Pile = 6.59 Kn

Uplift is ok