

Job No.: Sb 043 Makarewa shed**Address:** 308 Flora Road East, Makarewa, New Zealand**Date:** 27/09/2024**Latitude:** -46.329891**Longitude:** 168.380614**Elevation:** 20.5 m**General Input**

| | | | | | |
|------------------|----------|--------------------------------|-----------|----------------------|-----------|
| Roof Live Load | 0.25 KPa | Roof Dead Load | 0.25 KPa | Roof Live Point Load | 1.1 Kn |
| Snow Zone | 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 | 3.6 m |
| Wind Region | NZ4 | Terrain Category | 2.0 | Design Wind Speed | 40.63 m/s |
| Wind Pressure | 0.99 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 $C_{p,i} = 0.6649$

For roof $C_{p,e}$ from 0 m To 1.65 m $C_{p,e} = -0.94$ $p_e = -0.52$ KPa $p_{net} = -0.97$ KPa

For roof $C_{p,e}$ from 1.65 m To 3.3 m $C_{p,e} = -0.88$ $p_e = -0.49$ KPa $p_{net} = -0.94$ KPa

For wall Windward $C_{p,i} = 0.6649$ side Wall $C_{p,i} = -0.5849$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 18 m $C_{p,e} = 0.7$ $p_e = 0.59$ KPa $p_{net} = 1.18$ KPa

For side wall $C_{p,e}$ from 0 m To 3.3 m $C_{p,e} =$ $p_e = -0.55$ KPa $p_{net} = 0.04$ KPa

Maximum Upward pressure used in roof member Design = 0.97 KPa

Maximum Downward pressure used in roof member Design = 0.76 KPa

Maximum Wall pressure used in Design = 1.18 KPa

Maximum Racking pressure used in Design = 1.07 KPa

Design Summary**Rafter Design Internal**

Internal Rafter Load Width = 4500 mm

Internal Rafter Span = 5850 mm

Try Rafter 2x240x63 LVL13

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 = 4.59 S1 Upward = 4.59

Shear Capacity of timber = 5.3 MPa Bending Capacity of timber = 48 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

| | | | | | |
|--------------------------------------|-------------|----------|-------------|--------------------|------------------|
| $M_{1.35D}$ | 6.50 Kn-m | Capacity | 27.86 Kn-m | Passing Percentage | 428.62 % |
| $M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$ | 20.41 Kn-m | Capacity | 37.16 Kn-m | Passing Percentage | 182.07 % |
| $M_{0.9D-W_nUp}$ | -14.34 Kn-m | Capacity | -46.44 Kn-m | Passing Percentage | 323.85 % |
| $V_{1.35D}$ | 4.44 Kn | Capacity | 51.54 Kn | Passing Percentage | 1160.81 % |

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| | | | | | |
|--|----------|----------|----------|--------------------|-----------------|
| V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn} | 13.95 Kn | Capacity | 68.72 Kn | Passing Percentage | 492.62 % |
| V _{0.9D-WnUp} | -9.81 Kn | Capacity | -85.9 Kn | Passing Percentage | 875.64 % |

Deflections

Modulus of Elasticity = 11000 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 12.84 mm

Limit by Woolcock et al, 1999 Span/240 = 25.00 mm

Deflection under Dead and Service Wind = 20.925 mm

Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward = 13.95 kn Maximum upward = -9.81 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 = J2 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 = 12.6 f_{pj} = 22.7 Mpa for Rafter with effective thickness = 126 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 = 43.67 Kn > -9.81 Kn

Girt Design Front and Back

Girt's Spacing = 1200 mm

Girt's Span = 2250 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 = 0.89 S₁ Downward = 9.63 S₁ Upward = 15.23

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

Capacity Checks

| | | | | | |
|------------------------|-----------|----------|-----------|--------------------|-----------------|
| M _{Wind+Snow} | 0.90 Kn-m | Capacity | 1.87 Kn-m | Passing Percentage | 207.78 % |
| V _{0.9D-WnUp} | 1.59 Kn | Capacity | 12.06 Kn | Passing Percentage | 758.49 % |

Deflections

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

Deflection under Snow and Service Wind = 7.69 mm

Limit by Woolcock et al, 1999 Span/100 = 22.50 mm

Sag during installation = 1.55 mm

Reactions

Maximum = 1.59 kn

Girt Design Sides

Girt's Spacing = 1200 mm

Girt's Span = 3000 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 =0.79 S1 Downward =9.63 S1 Upward =17.59

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

Capacity Checks

| | | | | | |
|-----------------|-----------|----------|-----------|--------------------|-----------------|
| $M_{Wind+Snow}$ | 1.59 Kn-m | Capacity | 1.65 Kn-m | Passing Percentage | 103.77 % |
| $V_{0.9D-WnUp}$ | 2.12 Kn | Capacity | 12.06 Kn | Passing Percentage | 568.87 % |

Deflections

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

Deflection under Snow and Service Wind = 24.31 mm

Limit by Woolcock et al. 1999 Span/100 = 30.00 mm

Sag during installation =4.91 mm

Reactions

Maximum = 2.12 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

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(1650) x Ks(1.5) x 0.5 x tan(30) x π x Dia of Pile(0.6) x Height of Pile(1650)

Skin Friction = 21.99 Kn

Weight of Pile + Pile Skin Friction = 26.27 Kn

Uplift on one Pile = 10.06 Kn

Uplift is ok