Pole Shed App Ver 01 2022

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| | | | | | |
|---|---|---|---|---|---|
| **Job No.:** | 2409031 | **Address:** | 21 Hill View Road, Motupipi, New Zealand | **Date:** | 16/12/2024 |
| **Latitude:** | -40.884582 | **Longitude:** | 172.839328 | **Elevation:** | 113.5 m |

**General Input**

| | | | | | |
|---|---|---|---|---|---|
| Roof Live Load | 0.25 KPa | Roof Dead Load | 0.25 KPa | Roof Live Point Load | 1.1 Kn |
| Snow Zone | N0 | Ground Snow Load | 0 KPa | Roof Snow Load | 0 KPa |
| Earthquake Zone | 2 | Subsoil Category | D | Exposure Zone | C |
| Importance Level | 1 | Ultimate wind & Earthquake ARI | 100 Years | Max Height | 3.8 m |
| Wind Region | NZ2 | Terrain Category | 2.24 | Design Wind Speed | 44.74 m/s |
| Wind Pressure | 1.2 KPa | Lee Zone | NO | Ultimate Snow ARI | 50 Years |
| Wind Category | Very High | Earthquake ARI | 100 | | |

Note: Wind lateral loads are governing over Earthquake loads, So only wind loads are considered in calculations

**Pressure Coefficients and Pressues**

Shed Type = Mono   Enclosed

For roof Cp,i = -0.3

For roof   CP,e   from 0 m   To 3.10 m   Cpe = -0.9   pe = -0.97 KPa   pnet = -0.97 KPa

For roof   CP,e   from 3.10 m   To 6.20 m   Cpe = -0.5   pe = -0.54 KPa   pnet = -0.54 KPa

For wall Windward Cp,i = -0.3   side Wall Cp,i = -0.3

For wall Windward and Leeward   CP,e   from 0 m   To 8 m   Cpe = 0.7   pe = 0.76 KPa   pnet = 1.12 KPa

For side wall   CP,e   from 0 m   To 3.10 m   Cpe =    pe = -0.70 KPa   pnet = -0.70 KPa

Maximum Upward pressure used in roof member Design = 0.97 KPa

Maximum Downward pressure used in roof member Design = 0.58 KPa

Maximum Wall pressure used in Design = 1.12 KPa

Maximum Racking pressure used in Design = 1.30 KPa

**Design Summary**

**Rafter Design External**

External Rafter Load Width = 5000 mm   External Rafter Span = 7922 mm   Try Rafter 450x63 LVL13

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 =0.95

K8 Upward =0.95     S1 Downward =13.57     S1 Upward =13.57

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{1.35D}$ | 13.24 Kn-m | Capacity | 43.42 Kn-m | Passing Percentage | **327.95 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 34.52 Kn-m | Capacity | 57.89 Kn-m | Passing Percentage | **167.70 %** |
| $M_{0.9D\text{-}WnUp}$ | -29.22 Kn-m | Capacity | -72.37 Kn-m | Passing Percentage | **247.67 %** |
| $V_{1.35D}$ | 6.68 Kn | Capacity | 48.32 Kn | Passing Percentage | **723.35 %** |
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 17.43 Kn | Capacity | 64.43 Kn | Passing Percentage | **369.65 %** |
| $V_{0.9D\text{-}WnUp}$ | -14.75 Kn | Capacity | -80.54 Kn | Passing Percentage | **546.03 %** |

**Deflections**

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

k2 for Long Term Loads = 2

| | |
|---|---|
| Deflection under Dead and Live Load = 15.20 mm | Limit by Woolcock et al, 1999 Span/240= 33.33 mm |
| Deflection under Dead and Service Wind = 20.02 mm | Limit by Woolcock et al, 1999 Span/100 = 80.00 mm |

**Reactions**

Maximum downward =17.43 kn   Maximum upward = -14.75 kn

**Rafter to Pole Connection check**

Bolt Size = M16 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

Factor of Safety = 0.7

For Perpendicular to grain loading

K11 = 12.6 fpj = 22.7 Mpa for Rafter with effective thickness = 63 mm

For Parallel to grain loading

K11 = 2.0 fcj = 36.1 Mpa for Pole with effective thickness = 100 mm

Eccentric Load check

V = phi x k1 x k4 x k5 x fs x b x ds ........... (Eq 4.12) = -86.48 kn > -14.75 Kn

Single Shear Capacity under short term loads = -38.81 Kn > -14.75 Kn

## Intermediate Design Front and Back

Intermediate Spacing = 5000 mm    Intermediate Span = 3650 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 =0.88

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

### Capacity Checks

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 9.33 Kn-m | Capacity | 9.68 Kn-m | Passing Percentage | **103.75 %** |
| $V_{0.9D-WnUp}$ | 10.22 Kn | Capacity | -34.74 Kn | Passing Percentage | **339.92 %** |

### Deflections

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

Deflection under Snow and Service Wind = 23.115 mm    Limit byWoolcock et al, 1999 Span/100 = 36.50 mm

### Reactions

Maximum = 10.22 kn

## Intermediate Design Sides

Intermediate Spacing = 4000 mm    Intermediate Span = 2950 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 =0.79

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

### Capacity Checks

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 2.44 Kn-m | Capacity | 9.68 Kn-m | Passing Percentage | **396.72 %** |
| $V_{0.9D-WnUp}$ | 3.30 Kn | Capacity | 34.74 Kn | Passing Percentage | **1052.73 %** |

**Deflections**

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

Deflection under Snow and Service Wind = 7.89 mm     Limit by Woolcock et al, 1999 Span/100 = 29.50 mm

**Reactions**

Maximum = 3.30 kn

## Girt Design Front and Back

Girt's Spacing = 700 mm     Girt's Span = 5000 mm     Try Girt 240x45 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 =0.53     S1 Downward =13.82     S1 Upward =23.03

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 2.45 Kn-m | Capacity | 2.57 Kn-m | Passing Percentage | **104.90 %** |
| $V_{0.9D-WnUp}$ | 1.96 Kn | Capacity | 17.37 Kn | Passing Percentage | **886.22 %** |

**Deflections**

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

Deflection under Snow and Service Wind = 18.37 mm     Limit by Woolcock et al, 1999 Span/100 = 50.00 mm
Sag during installation = 46.79 mm

**Reactions**

Maximum = 1.96 kn

## Girt Design Sides

Girt's Spacing = 700 mm     Girt's Span = 4000 mm     Try Girt 240x45 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 =0.34 S1 Downward =13.82 S1 Upward =29.13

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

#### Capacity Checks

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 1.57 Kn-m | Capacity | 1.66 Kn-m | Passing Percentage | **105.73 %** |
| $V_{0.9D-WnUp}$ | 1.57 Kn | Capacity | 17.37 Kn | Passing Percentage | **1106.37 %** |

#### Deflections

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

Deflection under Snow and Service Wind = 7.52 mm Limit by Woolcock et al. 1999 Span/100 = 40.00 mm
Sag during installation =19.16 mm

#### Reactions

Maximum = 1.57 kn

### End Pole Design

#### Geometry For End Bay Pole

#### Geometry

| | | | |
|---|---|---|---|
| 225 SED H5 (Minimum 250 dia. at Floor Level) | Dry Use | Height | 3600 mm |
| Area | 44279 mm2 | As | 33209.1796875 mm2 |
| Ix | 156100441 mm4 | Zx | 1314530 mm3 |
| Iy | 156100441 mm4 | Zx | 1314530 mm3 |
| Lateral Restraint | mm c/c | | |

#### Loads

Total Area over Pole = 40 m2

| | | | |
|---|---|---|---|
| Dead | 10.00 Kn | Live | 10.00 Kn |
| Wind Down | 23.20 Kn | Snow | 0.00 Kn |
| Moment Wind | 17.55 Kn-m | | |
| Phi | 0.8 | K8 | 0.89 |
| K1 snow | 0.8 | K1 Dead | 0.6 |
| K1wind | 1 | | |

#### Material

| | | | |
|---|---|---|---|
| Peeling | Steaming | Normal | Dry Use |
| fb = | 36.3 MPa | fs = | 2.96 MPa |
| fc = | 18 MPa | fp = | 7.2 MPa |
| ft = | 22 MPa | E = | 9257 MPa |

**Capacities**

| | | | | | |
|---|---|---|---|---|---|
| PhiNcx Wind | 570.09 Kn | PhiMnx Wind | 34.13 Kn-m | PhiVnx Wind | 78.64 Kn |
| PhiNcx Dead | 342.05 Kn | PhiMnx Dead | 20.48 Kn-m | PhiVnx Dead | 47.18 Kn |

**Checks**

(Mx/PhiMnx)+(N/phiNcx) = 0.59 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.34 < 1 OK

Deflection at top under service lateral loads = 24.59 mm < 37.90 mm

| | | |
|---|---|---|
| Ds = | 0.6 mm | Pile Diameter |
| L = | 1800 mm | Pile embedment length |
| f1 = | 2850 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

**Loads**

Total Area over Pole = 40 m2

| | |
|---|---|
| Moment Wind = | 17.55 Kn-m |
| Shear Wind = | 6.16 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 11.17 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 19.49 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.90 < 1 OK

## Drained Lateral Strength of End pile in cohesionless soils Free Head short pile

**Assumed Soil Properties**

| | | | | | |
|---|---|---|---|---|---|
| Gamma | 18 Kn/m3 | Friction angle | 30 deg | Cohesion | 0 Kn/m3 |

| | |
|---|---|
| K0 = | (1-sin(30)) / (1+sin(30)) |
| Kp = | (1+sin(30)) / (1-sin(30)) |

**Geometry For End Bay Pole**

| | | |
|---|---|---|
| Ds = | 0.6 mm | Pile Diameter |
| L = | 1800 mm | Pile embedment length |
| f1 = | 2850 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

**Loads**

| | |
|---|---|
| Moment Wind = | 17.55 Kn-m |
| Shear Wind = | 6.16 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 11.17 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 19.49 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.90 < 1 OK

## 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 = Safecty factor (0.55) x Density of Soil(18) x Height of Pile(2600) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(2600)

Skin Friction = 54.60 Kn

Weight of Pile + Pile Skin Friction = 59.82 Kn

Uplift on one Pile = 29.80 Kn

Uplift is ok

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