Pole Shed App Ver 01 2022 by RnH Consulting Engineers

**Job No.:** Andrew Duff **Address:** 178 Mangakahia Rd, Mangakahia, New Zealand **Date:** 9/7/2022

**Latitude:** -35.753158 **Longitude:** 174.188538 **Elevation:** 143 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 | 4.6 m |
| Wind Region | NZ1 | Terrain Category | 2.06 | Design Wind Speed | 38.03 m/s |
| Wind Pressure | 0.87 KPa | Lee Zone | NO | Ultimate Snow ARI | 50 Years |
| Wind Category | High | | | | |

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

**Pressure Coefficients and Pressues**

Shed Type = Mono Free

For roof Cp,i = -0.3

For roof CP,e from 0 m To 2.23 m Cpe = -1.2 pe = -0.95 KPa pnet = -0.95 KPa

For roof CP,e from 2.23 m To 4.45 m Cpe = -0.74 pe = -0.58 KPa pnet = -0.58 KPa

For wall Windward Cp,i = 0 side Wall Cp,i = 0

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

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

Maximum Upward pressure used in roof member Design = 0.95 KPa

Maximum Downward pressure used in roof member Design = 0.3 KPa

Maximum Wall pressure used in Design = 0 KPa

Maximum Racking pressure used in Design = 0.47 KPa

**Design Summary**

**Purlin Design**

Purlin Spacing = 900 mm Purlin Span = 5800 mm Try Purlin 250x50 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 =0.97

K8 Upward =0.54 S1 Downward =12.68 S1 Upward =22.76

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{1.35D}$ | 1.28 Kn-m | Capacity | 3.51 Kn-m | Passing Percentage | **274.22 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 2.73 Kn-m | Capacity | 4.67 Kn-m | Passing Percentage | **171.06 %** |
| $M_{0.9D-WnUp}$ | -2.74 Kn-m | Capacity | -3.26 Kn-m | Passing Percentage | **118.98 %** |
| $V_{1.35D}$ | 0.88 Kn | Capacity | 12.06 Kn | Passing Percentage | **1370.45 %** |
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 1.76 Kn | Capacity | 16.08 Kn | Passing Percentage | **913.64 %** |
| $V_{0.9D-WnUp}$ | -1.89 Kn | Capacity | -20.10 Kn | Passing Percentage | **1063.49 %** |

**Deflections**

Modulus of Elasticity = 8000 MPa NZS3603 Amt 4, Table 2.3 considering at least 4 members acting together

k2 for Long Term Loads = 2

| | |
|---|---|
| Deflection under Dead and Live Load = 15.28 mm | Limit by AS1170.0 Table C1 Span/250 = 23.20 mm |
| Deflection under Dead and Service Wind = 16.55 mm | Limit by AS1170.0 Table C1 Span/120 = 48.33 mm |

**Reactions**

Maximum downward =1.76 kn Maximum upward = -1.89 kn

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

## Rafter Design Internal

Internal Rafter Load Width = 6000 mm Internal Rafter Span = 4850 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**

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| | | | | | |
|---|---|---|---|---|---|
| $M_{1.35D}$ | 5.95 Kn-m | Capacity | 11.32 Kn-m | Passing Percentage | **190.25 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 11.91 Kn-m | Capacity | 15.08 Kn-m | Passing Percentage | **126.62 %** |
| $M_{0.9D-WnUp}$ | -12.79 Kn-m | Capacity | -18.86 Kn-m | Passing Percentage | **147.46 %** |
| $V_{1.35D}$ | 4.91 Kn | Capacity | 28.94 Kn | Passing Percentage | **589.41 %** |
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 9.82 Kn | Capacity | 38.6 Kn | Passing Percentage | **393.08 %** |
| $V_{0.9D-WnUp}$ | -10.55 Kn | Capacity | -48.24 Kn | Passing Percentage | **457.25 %** |

**Deflections**

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

k2 for Long Term Loads = 2

| | |
|---|---|
| Deflection under Dead and Live Load = 10.85 mm | Limit by AS1170.0 Table C1 Span/250 = 20.00 mm |
| Deflection under Dead and Service Wind = 13.06 mm | Limit by AS1170.0 Table C1 Span/120 = 41.67 mm |

**Reactions**

Maximum downward =9.82 kn Maximum upward = -10.55 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 fpj = 12.9 Mpa for Rafter with effective thickness = 100 mm

For Parallel to grain loading

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

Capacity under short term loads = 21.67 Kn > -10.55 Kn

## Rafter Design External

External Rafter Load Width = 3000 mm External Rafter Span = 4809 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)

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**

| | | | | | |
|---|---|---|---|---|---|
| $M_{1.35D}$ | 2.93 Kn-m | Capacity | 4.72 Kn-m | Passing Percentage | **161.09 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 5.85 Kn-m | Capacity | 6.30 Kn-m | Passing Percentage | **107.69 %** |
| $M_{0.9D-WnUp}$ | -6.29 Kn-m | Capacity | -7.87 Kn-m | Passing Percentage | **125.12 %** |
| $V_{1.35D}$ | 2.43 Kn | Capacity | 14.47 Kn | Passing Percentage | **595.47 %** |
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 4.87 Kn | Capacity | 19.30 Kn | Passing Percentage | **396.30 %** |
| $V_{0.9D-WnUp}$ | -5.23 Kn | Capacity | -24.12 Kn | Passing Percentage | **461.19 %** |

**Deflections**

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

k2 for Long Term Loads = 2

| | |
|---|---|
| Deflection under Dead and Live Load = 12.06 mm | Limit by AS1170.0 Table C1 Span/250 = 20.00 mm |
| Deflection under Dead and Service Wind = 13.06 mm | Limit by AS1170.0 Table C1 Span/120 = 41.67 mm |

**Reactions**

Maximum downward =4.87 kn Maximum upward = -5.23 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

K11 = 14.9 fpj = 12.9 Mpa for Rafter with effective thickness = 50 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) = -25.20 kn > -5.23 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -5.23 Kn

## End Pole Design

#### Geometry For End Bay Pole

| | | |
|---|---|---|
| Ds = | 600 mm | Pile Diameter |
| L = | 1600 mm | Pile embedment length |
| f1 = | 3450 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

#### Loads

Total Area over Pole = 7.5 m2

| | |
|---|---|
| Moment Wind = | 5.58 Kn-m |
| Shear Wind = | 1.62 Kn |

#### Pile Properties

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 7.23 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 14.74 Kn-m | Ultimate Moment Capacity of Pile |

#### Checks

Applied Forces/Capacities = 0.38 < 1 OK

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

#### 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 = | 600 mm | Pile Diameter |
| L = | 1600 mm | Pile embedment length |
| f1 = | 3450 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

**Loads**

| | |
|---|---|
| Moment Wind = | 5.58 Kn-m |
| Shear Wind = | 1.62 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 7.23 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 14.74 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.38 < 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(1600) x Ks(1.5) x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1600)

Skin Friction = 20.68 Kn

Weight of Pile + Pile Skin Friction = 23.68 Kn

Uplift on one Pile = 10.88 Kn

Uplift is ok