Pole Shed App Ver 01 2022

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**Job No.:** Melzavin Trust **Address:** 202 Seales Road, Oropi 3173, New Zealand **Date:** 02/12/2024

**Latitude:** -37.870661 **Longitude:** 176.211935 **Elevation:** 411.5 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 | B |
| Importance Level | 1 | Ultimate wind & Earthquake ARI | 100 Years | Max Height | 4 m |
| Wind Region | NZ1 | Terrain Category | 3.0 | Design Wind Speed | 52.31 m/s |
| Wind Pressure | 1.64 KPa | Lee Zone | NO | Ultimate Snow ARI | 50 Years |
| Wind Category | extra 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 = Gable Open

For roof Cp,i = 0.6712

For roof CP,e from 0 m To 3.75 m Cpe = -0.9 pe = -1.33 KPa pnet = -2.53 KPa

For roof CP,e from 3.75 m To 7.5 m Cpe = -0.5 pe = -0.74 KPa pnet = -1.94 KPa

For wall Windward Cp,i = 0.6712 side Wall Cp,i = -0.5966

For wall Windward and Leeward CP,e from 0 m To 7 m Cpe = 0.7 pe = 1.03 KPa pnet = 2.09 KPa

For side wall CP,e from 0 m To 3.75 m Cpe = pe = -0.96 KPa pnet = 0.10 KPa

Maximum Upward pressure used in roof member Design = 2.53 KPa

Maximum Downward pressure used in roof member Design = 1.03 KPa

Maximum Wall pressure used in Design = 2.09 KPa

Maximum Racking pressure used in Design = 1.77 KPa

**Design Summary**

**Girt Design Front and Back**

Girt's Spacing = 650 mm Girt's Span = 4200 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)

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K1 Short term = 1 K4 =1 K5 =1 K8 Downward =0.94

K8 Upward =0.80 S1 Downward =13.82 S1 Upward =17.23

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 3.00 Kn-m | Capacity | 3.89 Kn-m | Passing Percentage | **129.67 %** |
| $V_{0.9D-WnUp}$ | 2.85 Kn | Capacity | 17.37 Kn | Passing Percentage | **609.47 %** |

**Deflections**

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

Deflection under Snow and Service Wind = 15.85 mm Limit by Woolcock et al, 1999 Span/100 = 42.00 mm
Sag during installation = 23.29 mm

**Reactions**

Maximum = 2.85 kn

## Girt Design Sides

Girt's Spacing = 900 mm Girt's Span = 3500 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 =0.71 S1 Downward =13.82 S1 Upward =19.27

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 2.88 Kn-m | Capacity | 3.42 Kn-m | Passing Percentage | **118.75 %** |
| $V_{0.9D-WnUp}$ | 3.29 Kn | Capacity | 17.37 Kn | Passing Percentage | **527.96 %** |

**Deflections**

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

Deflection under Snow and Service Wind = 10.58 mm Limit by Woolcock et al. 1999 Span/100 = 35.00 mm
Sag during installation =11.23 mm

**Reactions**

Maximum = 3.29 kn

## Middle Pole Design

**Geometry**

| | | | |
|---|---|---|---|
| 225 UNI H5 | Dry Use | Height | 3710 mm |
| Area | 39741 mm2 | As | 29805.46875 mm2 |
| Ix | 125741821 mm4 | Zx | 1117705 mm3 |
| Iy | 125741821 mm4 | Zx | 1117705 mm3 |
| Lateral Restraint | 1300 mm c/c | | |

**Loads**

Total Area over Pole = 14.7 m2

| | | | |
|---|---|---|---|
| Dead | 3.67 Kn | Live | 3.67 Kn |
| Wind Down | 15.14 Kn | Snow | 0.00 Kn |
| Moment wind | 14.83 Kn-m | | |
| Phi | 0.8 | K8 | 1.00 |
| K1 snow | 0.8 | K1 Dead | 0.6 |
| K1wind | 1 | | |

**Material**

| | | | |
|---|---|---|---|
| Shaving | Steaming | Normal | Dry Use |
| fb = | 34.325 MPa | fs = | 2.96 MPa |
| fc = | 18 MPa | fp = | 7.2 MPa |
| ft = | 20.75 MPa | E = | 8793 MPa |

**Capacities**

| | | | | | |
|---|---|---|---|---|---|
| PhiNcx Wind | 572.26 Kn | PhiMnx Wind | 30.69 Kn-m | PhiVnx Wind | 70.58 Kn |
| PhiNcx Dead | 343.36 Kn | PhiMnx Dead | 18.42 Kn-m | PhiVnx Dead | 42.35 Kn |

**Checks**

(Mx/PhiMnx)+(N/phiNcx) = 0.52 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.27 < 1 OK

Deflection at top under service lateral loads = 27.97 mm < 37.10 mm

# Drained Lateral Strength of Middle 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 Middle Bay Pole**

| | | |
|---|---|---|
| Ds = | 0.6 mm | Pile Diameter |
| L = | 2100 mm | Pile embedment length |
| f1 = | 3000 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

**Loads**

| | |
|---|---|
| Moment Wind = | 14.83 Kn-m |
| Shear Wind = | 4.94 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 16.18 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 30.14 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.49 < 1 OK

## End Pole Design

**Geometry For End Bay Pole**

**Geometry**

| | | | |
|---|---|---|---|
| 200 UNI H5 | Dry Use | Height | 3800 mm |
| Area | 31400 mm2 | As | 23550 mm2 |
| Ix | 78500000 mm4 | Zx | 785000 mm3 |
| Iy | 78500000 mm4 | Zx | 785000 mm3 |
| Lateral Restraint | mm c/c | | |

**Loads**

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Total Area over Pole = 7.35 m2

| | | | |
|---|---|---|---|
| Dead | 1.84 Kn | Live | 1.84 Kn |
| Wind Down | 7.57 Kn | Snow | 0.00 Kn |
| Moment Wind | 7.42 Kn-m | | |
| Phi | 0.8 | K8 | 0.72 |
| K1 snow | 0.8 | K1 Dead | 0.6 |
| K1wind | 1 | | |

**Material**

| | | | |
|---|---|---|---|
| Shaving | Steaming | Normal | Dry Use |
| fb = | 34.325 MPa | fs = | 2.96 MPa |
| fc = | 18 MPa | fp = | 7.2 MPa |
| ft = | 20.75 MPa | E = | 8793 MPa |

**Capacities**

| | | | | | |
|---|---|---|---|---|---|
| PhiNcx Wind | 325.30 Kn | PhiMnx Wind | 15.51 Kn-m | PhiVnx Wind | 55.77 Kn |
| PhiNcx Dead | 195.18 Kn | PhiMnx Dead | 9.31 Kn-m | PhiVnx Dead | 33.46 Kn |

**Checks**

(Mx/PhiMnx)+(N/phiNcx) = 0.51 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.26 < 1 OK

Deflection at top under service lateral loads = 24.09 mm < 39.90 mm

| | | |
|---|---|---|
| Ds = | 0.6 mm | Pile Diameter |
| L = | 1500 mm | Pile embedment length |
| f1 = | 3000 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

**Loads**

Total Area over Pole = 7.35 m2

| | |
|---|---|
| Moment Wind = | 7.42 Kn-m |
| Shear Wind = | 2.47 Kn |

**Pile Properties**

| | |
|---|---|
| Safety Factory | 0.55 |

| | | |
|---|---|---|
| Hu = | 6.68 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 11.94 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.62 < 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 = | 1500 mm | Pile embedment length |
| f1 = | 3000 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

**Loads**

| | |
|---|---|
| Moment Wind = | 7.42 Kn-m |
| Shear Wind = | 2.47 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 6.68 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 11.94 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.62 < 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(2100) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(2100)

Skin Friction = 35.62 Kn

Weight of Pile + Pile Skin Friction = 40.74 Kn

Uplift on one Pile = 33.88 Kn

Uplift is ok