



Pole Shed App Ver 01 2022

**Job No.:** 511-5025142 - 1

**Address:** 3219 Arundel Rakaia Gorge Road, Cavendish, New Zealand

**Date:** 18/09/2024

**Latitude:** -43.720174

**Longitude:** 171.387041

**Elevation:** 365.5 m

**General Input**

|                  |            |                                |           |                      |          |
|------------------|------------|--------------------------------|-----------|----------------------|----------|
| Roof Live Load   | 0.25 KPa   | Roof Dead Load                 | 0.25 KPa  | Roof Live Point Load | 1.1 Kn   |
| Snow Zone        | N4         | Ground Snow Load               | 1.68 KPa  | Roof Snow Load       | 1.06 KPa |
| Earthquake Zone  | 2          | Subsoil Category               | D         | Exposure Zone        | B        |
| Importance Level | 1          | Ultimate wind & Earthquake ARI | 100 Years | Max Height           | 5.3 m    |
| Wind Region      | NZ2        | Terrain Category               | 2.09      | Design Wind Speed    | 50.1 m/s |
| Wind Pressure    | 1.51 KPa   | Lee Zone                       | YES       | 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 Pressures**

Shed Type = Mono Enclosed

For roof  $C_{p,i} = -0.3$

For roof  $C_{p,e}$  from 0 m To 6.05 m  $C_{p,e} = -0.9$   $p_e = -1.22$  KPa  $p_{net} = -1.22$  KPa

For roof  $C_{p,e}$  from 6.05 m To 12.10 m  $C_{p,e} = -0.5$   $p_e = -0.68$  KPa  $p_{net} = -0.68$  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 11.50 m  $C_{p,e} = 0.7$   $p_e = 0.95$  KPa  $p_{net} = 1.40$  KPa

For side wall  $C_{p,e}$  from 0 m To 6.05 m  $C_{p,e} =$   $p_e = -0.88$  KPa  $p_{net} = -0.88$  KPa

Maximum Upward pressure used in roof member Design = 1.22 KPa

Maximum Downward pressure used in roof member Design = 0.59 KPa

Maximum Wall pressure used in Design = 1.40 KPa

Maximum Racking pressure used in Design = 1.36 KPa

**Design Summary**

**Intermediate Design Sides**

Intermediate Spacing = 2875 mm

Intermediate Span = 4400 mm

Try Intermediate 2x140x45 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 = 1.00 S1 Downward = 10.36 S1 Upward = 0.72

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

**Capacity Checks**

|                 |           |          |          |                    |          |
|-----------------|-----------|----------|----------|--------------------|----------|
| $M_{Wind+Snow}$ | 5.84 Kn-m | Capacity | 3.3 Kn-m | Passing Percentage | 56.51 %  |
| $V_{0.9D-WnUp}$ | 5.31 Kn   | Capacity | 20.26 Kn | Passing Percentage | 381.54 % |

**Deflections**

Second page

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

Deflection under Snow and Service Wind = 388.69 mm

Limit by Woolcock et al, 1999 Span/100 = 44.00 mm

#### Reactions

Maximum = 5.31 kn

#### Girt Design Front and Back

Girt's Spacing = 1300 mm

Girt's Span = 2667 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 =0.00    S1 Downward =10.36    S1 Upward =Infinity

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

#### Capacity Checks

|                        |           |          |           |                    |                 |
|------------------------|-----------|----------|-----------|--------------------|-----------------|
| M <sub>Wind+Snow</sub> | 1.62 Kn-m | Capacity | 0.00 Kn-m | Passing Percentage | <b>0.00 %</b>   |
| V <sub>0.9D-WnUp</sub> | 2.43 Kn   | Capacity | 10.13 Kn  | Passing Percentage | <b>416.87 %</b> |

#### Deflections

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

Deflection under Snow and Service Wind = 30.53 mm

Limit by Woolcock et al, 1999 Span/100 = 26.66 mm

Sag during installation = 3.78 mm

#### Reactions

Maximum = 2.43 kn

#### Girt Design Sides

Girt's Spacing = 1300 mm

Girt's Span = 2875 mm

Try Girt SG8 Dry

Moisture Condition = Wet (Moisture in timber is less than 18% and timber does not remain in continuous wet condition after installation)

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

K8 Upward =NaN    S1 Downward =NaN    S1 Upward =NaN

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

#### Capacity Checks

|                        |           |          |          |                    |               |
|------------------------|-----------|----------|----------|--------------------|---------------|
| M <sub>Wind+Snow</sub> | 1.88 Kn-m | Capacity | NaN Kn-m | Passing Percentage | <b>NaN %</b>  |
| V <sub>0.9D-WnUp</sub> | 2.62 Kn   | Capacity | 0.00 Kn  | Passing Percentage | <b>0.00 %</b> |

#### Deflections

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

Deflection under Snow and Service Wind = Infinity mm

Limit by Woolcock et al. 1999 Span/100 = 28.75 mm

Sag during installation =NaN mm

### Reactions

Maximum = 2.62 kn

### Middle Pole Design

#### Geometry

|  |                           |        |                               |
|--|---------------------------|--------|-------------------------------|
| 300 SED H5 (Minimum 325 dia. at Floor Level) | Dry Use                   | Height | 6500 mm                       |
| Area   | 76660 mm <sup>2</sup>     | As     | 57495.1171875 mm <sup>2</sup> |
| Ix   | 467896461 mm <sup>4</sup> | Zx     | 2994537 mm <sup>3</sup>       |
| Iy   | 467896461 mm <sup>4</sup> | Zy     | 2994537 mm <sup>3</sup>       |
| Lateral Restraint                            | 6500 mm c/c               |        |                               |

#### Loads

Total Area over Pole = 30.66475 m<sup>2</sup>

|             |            |             |            |
|-------------|------------|-------------|------------|
| Dead        | 7.67 Kn    | Live        | 7.67 Kn    |
| Wind Down   | 18.09 Kn   | Snow        | 32.50 Kn   |
| Moment wind | 38.10 Kn-m | Moment snow | 11.84 Kn-m |
| Phi         | 0.8        | K8          | 0.63       |
| K1 snow     | 0.8        | K1 Dead     | 0.6        |
| K1 wind     | 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 | 696.74 Kn | PhiMnx Wind | 54.89 Kn-m | PhiVnx Wind | 136.15 Kn |
| PhiNcx Dead | 418.04 Kn | PhiMnx Dead | 32.93 Kn-m | PhiVnx Dead | 81.69 Kn  |
| PhiNcx Snow | 557.39 Kn | PhiMnx Snow | 43.91 Kn-m | PhiVnx Snow | 108.92 Kn |

#### Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.77 < 1$  OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.56 < 1$  OK

Deflection at top under service lateral loads = 42.58 mm < 65.00 mm

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

#### Assumed Soil Properties

|       |                                   |                |        |          |                     |
|-------|-----------------------------------|----------------|--------|----------|---------------------|
| Gamma | 18 Kn/m <sup>3</sup>              | Friction angle | 30 deg | Cohesion | 0 Kn/m <sup>3</sup> |
| 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 =  | 2300 mm | Pile embedment length                        |
| f1 = | 3975 mm | Distance at which the shear force is applied |
| f2 = | 0 mm    | Distance of top soil at rest pressure        |

**Loads**

|               |            |               |          |
|---------------|------------|---------------|----------|
| Moment Wind = | 38.10 Kn-m | Moment Snow = | Kn-m     |
| Shear Wind =  | 9.59 Kn    | Shear Snow =  | 11.84 Kn |

**Pile Properties**

|                |            |   |
|----------------|------------|---|
| Safety Factory | 0.55       |   |
| Hu =           | 17.28 Kn   | Ultimate Lateral Strength of the Pile, Short pile |
| Mu =           | 41.57 Kn-m | Ultimate Moment Capacity of Pile                  |

**Checks**

Applied Forces/Capacities = 0.92 < 1 OK

**Uplift Check**

Density of Concrete = 24 Kn/m<sup>3</sup>

Density of Timber Pole = 5 Kn/m<sup>3</sup>

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(2300) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(2300)

Skin Friction = 42.72 Kn

Weight of Pile + Pile Skin Friction = 46.20 Kn

Uplift on one Pile = 30.51 Kn

Uplift is ok