



**Job No.:** Matt Donachie 483-215279C

**Address:** 47 Wolseley Road, Tanners Point 3173, New Zealand

**Date:** 04/12/2024

**Latitude:** -37.488044

**Longitude:** 175.924756

**Elevation:** 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        | N1       | 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 m       |
| Wind Region      | NZ1      | Terrain Category               | 2.5       | Design Wind Speed    | 36.54 m/s |
| Wind Pressure    | 0.8 KPa  | Lee Zone                       | NO        | Ultimate Snow ARI    | 50 Years  |
| Wind Category    | Medium   | 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 Free

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

For roof  $C_{p,e}$  from 0 m To 1.93 m  $C_{p,e} = -1.1417$   $p_e = -0.82$  KPa  $p_{net} = -0.82$  KPa

For roof  $C_{p,e}$  from 1.93 m To 3.85 m  $C_{p,e} = -0.7792$   $p_e = -0.56$  KPa  $p_{net} = -0.56$  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 4.8 m  $C_{p,e} = 0.7$   $p_e = 0.50$  KPa  $p_{net} = 0.74$  KPa

For side wall  $C_{p,e}$  from 0 m To 3.85 m  $C_{p,e} =$   $p_e = -0.47$  KPa  $p_{net} = -0.47$  KPa

Maximum Upward pressure used in roof member Design = 0.82 KPa

Maximum Downward pressure used in roof member Design = 0.20 KPa

Maximum Wall pressure used in Design = 0.74 KPa

Maximum Racking pressure used in Design = 0.43 KPa

### Design Summary

#### Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 6750 mm

Try Purlin 240x45 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 = 0.94

K8 Upward = 0.59 S1 Downward = 13.82 S1 Upward = 21.77

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

#### Capacity Checks

|                                     |            |          |            |                    |                  |
|-------------------------------------|------------|----------|------------|--------------------|------------------|
| $M_{1.35D}$                         | 1.73 Kn-m  | Capacity | 9.37 Kn-m  | Passing Percentage | <b>541.62 %</b>  |
| $M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nDn}$ | 3.46 Kn-m  | Capacity | 12.49 Kn-m | Passing Percentage | <b>360.98 %</b>  |
| $M_{0.9D-W_nUp}$                    | -3.05 Kn-m | Capacity | -9.72 Kn-m | Passing Percentage | <b>318.69 %</b>  |
| $V_{1.35D}$                         | 1.03 Kn    | Capacity | 18.41 Kn   | Passing Percentage | <b>1787.38 %</b> |
| $V_{1.2D+1.5L 1.2D+S_n 1.2D+W_nDn}$ | 2.05 Kn    | Capacity | 24.54 Kn   | Passing Percentage | <b>1197.07 %</b> |
| $V_{0.9D-W_nUp}$                    | -1.81 Kn   | Capacity | -30.68 Kn  | Passing Percentage | <b>1695.03 %</b> |

#### Deflections

Modulus of Elasticity = 12100 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 = 22.59 mm

Limit by Woolcock et al, 1999 Span/240 = 27.92 mm

Deflection under Dead and Service Wind = 22.59 mm

Limit by Woolcock et al, 1999 Span/100 = 67.00 mm

#### Reactions

Second page

Maximum downward = 2.05 kn Maximum upward = -1.81 kn

Number of Blocking = 2 if 0 then no blocking required, if 1 then one midspan blocking required

### Girt Design Front and Back

Girt's Spacing = 0 mm

Girt's Span = 3450 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

|                 |           |          |          |                    |       |
|-----------------|-----------|----------|----------|--------------------|-------|
| $M_{Wind+Snow}$ | 0.00 Kn-m | Capacity | NaN Kn-m | Passing Percentage | NaN % |
| $V_{0.9D-WnUp}$ | 0.00 Kn   | Capacity | 0.00 Kn  | Passing Percentage | NaN % |

### Deflections

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

Deflection under Snow and Service Wind = NaN mm

Limit by Woolcock et al, 1999 Span/100 = 34.50 mm

Sag during installation = NaN mm

### Reactions

Maximum = 0.00 kn

### Girt Design Sides

Girt's Spacing = 0 mm

Girt's Span = 2400 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

|                 |           |          |          |                    |       |
|-----------------|-----------|----------|----------|--------------------|-------|
| $M_{Wind+Snow}$ | 0.00 Kn-m | Capacity | NaN Kn-m | Passing Percentage | NaN % |
| $V_{0.9D-WnUp}$ | 0.00 Kn   | Capacity | 0.00 Kn  | Passing Percentage | NaN % |

### Deflections

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

Deflection under Snow and Service Wind = NaN mm

Limit by Woolcock et al. 1999 Span/100 = 24.00 mm

Sag during installation = NaN mm

### Reactions

Maximum = 0.00 kn

### End Pole Design

#### Geometry For End Bay Pole

#### Geometry

|                   |                          |        |                             |
|-------------------|--------------------------|--------|-----------------------------|
| 175 UNI H5        | Dry Use                  | Height | 3800 mm                     |
| Area              | 24041 mm <sup>2</sup>    | As     | 18030.46875 mm <sup>2</sup> |
| Ix                | 46015259 mm <sup>4</sup> | Zx     | 525889 mm <sup>3</sup>      |
| Iy                | 46015259 mm <sup>4</sup> | Zy     | 525889 mm <sup>3</sup>      |
| Lateral Restraint | mm c/c                   |        |                             |

**Loads**

Total Area over Pole = 16.56 m2

|             |           |         |         |
|-------------|-----------|---------|---------|
| Dead        | 4.14 Kn   | Live    | 4.14 Kn |
| Wind Down   | 3.31 Kn   | Snow    | 0.00 Kn |
| Moment Wind | 4.44 Kn-m |         |         |
| Phi         | 0.8       | K8      | 0.59    |
| K1 snow     | 0.8       | K1 Dead | 0.6     |
| K1 wind     | 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 | 203.71 Kn | PhiMnx Wind | 8.50 Kn-m | PhiVnx Wind | 42.70 Kn |
| PhiNcx Dead | 122.23 Kn | PhiMnx Dead | 5.10 Kn-m | PhiVnx Dead | 25.62 Kn |

**Checks**

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.58 < 1$  OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.33 < 1$  OK

Deflection at top under service lateral loads = 24.60 mm < 39.90 mm

|      |         |  |
|------|---------|--|
| Ds = | 0.6 mm  | Pile Diameter                                |
| L =  | 1300 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 = 16.56 m2

|               |           |
|---------------|-----------|
| Moment Wind = | 4.44 Kn-m |
| Shear Wind =  | 1.48 Kn   |

**Pile Properties**

|                |           |   |
|----------------|-----------|---|
| Safety Factory | 0.55      |   |
| Hu =           | 4.55 Kn   | Ultimate Lateral Strength of the Pile, Short pile |
| Mu =           | 8.02 Kn-m | Ultimate Moment Capacity of Pile                  |

**Checks**

Applied Forces/Capacities = 0.55 < 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 =  | 1300 mm | Pile embedment length                        |
| f1 = | 3000 mm | Distance at which the shear force is applied |

$f_2 =$  0 mm Distance of top soil at rest pressure

**Loads**

Moment Wind = 4.44 Kn-m

Shear Wind = 1.48 Kn

**Pile Properties**

Safety Factor 0.55

$H_u =$  4.55 Kn Ultimate Lateral Strength of the Pile, Short pile

$M_u =$  8.02 Kn-m Ultimate Moment Capacity of Pile

**Checks**

Applied Forces/Capacities = 0.55 < 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

$K_s$  (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(1300) x  $K_s$ (1.5) x 0.5 x  $\tan(30)$  x  $\pi$  x Dia of Pile(0.6) x Height of Pile(1300)

Skin Friction = 13.65 Kn

Weight of Pile + Pile Skin Friction = 17.68 Kn

Uplift on one Pile = 9.85 Kn

Uplift is ok