| | | | | | |
|---|---|---|---|---|---|
| **Job No.:** | Buildright - 1 | **Address:** | 222 Maskells Road, Balcairn, New Zealand | **Date:** | 23/09/2024 |
| **Latitude:** | -43.178115 | **Longitude:** | 172.675338 | **Elevation:** | 95 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 | 0.9 KPa | Roof Snow Load | 0.63 KPa |
| Earthquake Zone | 3 | Subsoil Category | D | Exposure Zone | B |
| Importance Level | 1 | Ultimate wind & Earthquake ARI | 100 Years | Max Height | 3.6 m |
| Wind Region | NZ2 | Terrain Category | 2.0 | Design Wind Speed | 41.3 m/s |
| Wind Pressure | 1.02 KPa | Lee Zone | NO | Ultimate Snow ARI | 50 Years |
| Wind Category | 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 = 0.6941

For roof CP,e from 0 m To 1.65 m Cpe = -0.94 pe = -0.6 KPa pnet = -1.13 KPa

For roof CP,e from 1.65 m To 3.3 m Cpe = -0.88 pe = -0.56 KPa pnet = -1.09 KPa

For wall Windward Cp,i = 0.6941 side Wall Cp,i = -0.6389

For wall Windward and Leeward CP,e from 0 m To 6 m Cpe = 0.7 pe = 0.55 KPa pnet = 1.03 KPa

For side wall CP,e from 0 m To 3.3 m Cpe = pe = -0.51 KPa pnet = -0.03 KPa

Maximum Upward pressure used in roof member Design = 1.13 KPa

Maximum Downward pressure used in roof member Design = 0.64 KPa

Maximum Wall pressure used in Design = 1.03 KPa

Maximum Racking pressure used in Design = 0.94 KPa

**Design Summary**

**Rafter Design Internal**

Internal Rafter Load Width = 4800 mm    Internal Rafter Span = 5850 mm    Try Rafter 2x240x63 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 =1.00

K8 Upward =1.00  S1 Downward =4.59  S1 Upward =4.59

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{1.35D}$ | 6.93 Kn-m | Capacity | 27.86 Kn-m | Passing Percentage | **402.02 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 19.30 Kn-m | Capacity | 37.16 Kn-m | Passing Percentage | **192.54 %** |
| $M_{0.9D-WnUp}$ | -18.58 Kn-m | Capacity | -46.44 Kn-m | Passing Percentage | **249.95 %** |
| $V_{1.35D}$ | 4.74 Kn | Capacity | 51.54 Kn | Passing Percentage | **1087.34 %** |

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| | | | | | |
|---|---|---|---|---|---|
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 13.20 Kn | Capacity | 68.72 Kn | Passing Percentage | **520.61 %** |
| $V_{0.9D\text{-}WnUp}$ | -12.71 Kn | Capacity | -85.9 Kn | Passing Percentage | **675.85 %** |

**Deflections**

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

k2 for Long Term Loads = 2

| | |
|---|---|
| Deflection under Dead and Live Load = 13.695 mm | Limit by Woolcock et al, 1999 Span/240 = 25.00 mm |
| Deflection under Dead and Service Wind = 20.8 mm | Limit by Woolcock et al, 1999 Span/100 = 60.00 mm |

**Reactions**

Maximum downward =13.20 kn   Maximum upward = -12.71 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 =J2 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 = 12.6 fpj = 22.7 Mpa for Rafter with effective thickness = 126 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 = 29.11 Kn > -12.71 Kn

## Intermediate Design Front and Back

| | | |
|---|---|---|
| Intermediate Spacing = 2400 mm | Intermediate Span = 2849 mm | Try Intermediate 2x150x50 SG8 Dry |

Moisture Condition = Dry (Moisture in timber is less than 16% and 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 =9.63   S1 Upward =0.54

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 2.51 Kn-m | Capacity | 4.2 Kn-m | Passing Percentage | **167.33 %** |
| $V_{0.9D\text{-}WnUp}$ | 3.52 Kn | Capacity | -24.12 Kn | Passing Percentage | **685.23 %** |

**Deflections**

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

| | |
|---|---|
| Deflection under Snow and Service Wind = 26.165 mm | Limit byWoolcock et al, 1999 Span/100 = 28.49 mm |

**Reactions**

Maximum = 3.52 kn

## Intermediate Design Sides

Intermediate Spacing = 3000 mm          Intermediate Span = 3150 mm          Try Intermediate 2x200x50 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     K4 =1     K5 =1     K8 Downward =1.00

K8 Upward =1.00     S1 Downward =11.27     S1 Upward =0.67

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 1.92 Kn-m | Capacity | 7.46 Kn-m | Passing Percentage | **388.54 %** |
| $V_{0.9D-WnUp}$ | 2.43 Kn | Capacity | 32.16 Kn | Passing Percentage | **1323.46 %** |

**Deflections**

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

Deflection under Snow and Service Wind = 20.605 mm          Limit by Woolcock et al, 1999 Span/100 = 31.50 mm

**Reactions**

Maximum = 2.43 kn

## Girt Design Front and Back

Girt's Spacing = 1300 mm          Girt's Span = 2400 mm          Try Girt 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and does not remain in continuous wet condition after installation)

K1 Short term = 1     K4 =1     K5 =1     K8 Downward =1.00

K8 Upward =0.87     S1 Downward =9.63     S1 Upward =15.73

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 0.96 Kn-m | Capacity | 1.83 Kn-m | Passing Percentage | **190.63 %** |
| $V_{0.9D-WnUp}$ | 1.61 Kn | Capacity | 12.06 Kn | Passing Percentage | **749.07 %** |

**Deflections**

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

Deflection under Snow and Service Wind = 9.89 mm          Limit by Woolcock et al, 1999 Span/100 = 24.00 mm
Sag during installation = 2.01 mm

**Reactions**

Maximum = 1.61 kn

## Girt Design Sides

Girt's Spacing = 1300 mm    Girt's Span = 3000 mm    Try Girt 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and does not remain in continuous wet condition after installation)

K1 Short term = 1    K4 =1    K5 =1    K8 Downward =1.00

K8 Upward =0.79    S1 Downward =9.63    S1 Upward =17.59

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

#### Capacity Checks

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 1.51 Kn-m | Capacity | 1.65 Kn-m | Passing Percentage | **109.27 %** |
| $V_{0.9D\text{-}WnUp}$ | 2.01 Kn | Capacity | 12.06 Kn | Passing Percentage | **600.00 %** |

#### Deflections

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

Deflection under Snow and Service Wind = 24.16 mm    Limit by Woolcock et al. 1999 Span/100 = 30.00 mm
Sag during installation =4.91 mm

#### Reactions

Maximum = 2.01 kn

## Middle Pole Design

#### Geometry

| | | | |
|---|---|---|---|
| 175 SED H5 (Minimum 200 dia. at Floor Level) | Dry Use | Height | 3450 mm |
| Area | 27598 mm2 | As | 20698.2421875 mm2 |
| Ix | 60639381 mm4 | Zx | 646820 mm3 |
| Iy | 60639381 mm4 | Zx | 646820 mm3 |
| Lateral Restraint | 3450 mm c/c | | |

#### Loads

Total Area over Pole = 14.4 m2

| | | | |
|---|---|---|---|
| Dead | 3.60 Kn | Live | 3.60 Kn |
| Wind Down | 9.22 Kn | Snow | 9.07 Kn |
| Moment wind | 10.94 Kn-m | Moment snow | 3.88 Kn-m |
| Phi | 0.8 | K8 | 0.75 |
| 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 | 297.50 Kn | PhiMnx Wind | 14.06 Kn-m | PhiVnx Wind | 49.01 Kn |
| PhiNcx Dead | 178.50 Kn | PhiMnx Dead | 8.44 Kn-m | PhiVnx Dead | 29.41 Kn |
| PhiNcx Snow | 238.00 Kn | PhiMnx Snow | 11.25 Kn-m | PhiVnx Snow | 39.21 Kn |

**Checks**

(Mx/PhiMnx)+(N/phiNcx) = 0.84 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.67 < 1 OK

Deflection at top under service lateral loads = 34.00 mm < 34.50 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 = | 1500 mm | Pile embedment length |
| f1 = | 2700 mm | Distance at which the shear force is applied |
| f2 = | 0 mm | Distance of top soil at rest pressure |

**Loads**

| | | | |
|---|---|---|---|
| Moment Wind = | 10.94 Kn-m | Moment Snow = | Kn-m |
| Shear Wind = | 4.05 Kn | Shear Snow = | 3.88 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 7.16 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 11.65 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.94 < 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(1500) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1500)

Skin Friction = 18.17 Kn

Weight of Pile + Pile Skin Friction = 22.56 Kn

Uplift on one Pile = 13.03 Kn

Uplift is ok