



**Job No.:** 1018**Address:** 254 Wall Road, Foxton, New Zealand**Date:** 17/05/2024**Latitude:** -40.438063**Longitude:** 175.330516**Elevation:** 27.5 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	3	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.5 m
Wind Region	NZ2	Terrain Category	2.19	Design Wind Speed	38.65 m/s
Wind Pressure	0.9 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 Pressures**

Shed Type = Mono Enclosed

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

For roof  $C_{p,e}$  from 0 m To 4.05 m  $C_{p,e} = -0.9$   $p_e = -0.73$  KPa  $p_{net} = -0.73$  KPa

For roof  $C_{p,e}$  from 4.05 m To 8.10 m  $C_{p,e} = -0.5$   $p_e = -0.40$  KPa  $p_{net} = -0.40$  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 10 m  $C_{p,e} = 0.7$   $p_e = 0.56$  KPa  $p_{net} = 0.83$  KPa

For side wall  $C_{p,e}$  from 0 m To 4.05 m  $C_{p,e} =$   $p_e = -0.52$  KPa  $p_{net} = -0.52$  KPa

Maximum Upward pressure used in roof member Design = 0.73 KPa

Maximum Downward pressure used in roof member Design = 0.35 KPa

Maximum Wall pressure used in Design = 0.83 KPa

Maximum Racking pressure used in Design = 0.92 KPa

**Design Summary****Purlin Design**

Purlin Spacing = 900 mm

Purlin Span = 7850 mm

Try Purlin 300x45 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 = 0.88

K8 Upward = 0.14 S1 Downward = 15.50 S1 Upward = 45.63

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

**Capacity Checks**

$M_{1.35D}$	2.34 Kn-m	Capacity	13.69 Kn-m	Passing Percentage	<b>585.04 %</b>
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	4.68 Kn-m	Capacity	18.26 Kn-m	Passing Percentage	<b>390.17 %</b>
$M_{0.9D-W_nUp}$	-3.5 Kn-m	Capacity	-3.73 Kn-m	Passing Percentage	<b>106.57 %</b>
$V_{1.35D}$	1.19 Kn	Capacity	23.01 Kn	Passing Percentage	<b>1933.61 %</b>

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$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.38 Kn	Capacity	30.68 Kn	Passing Percentage	<b>1289.08 %</b>
$V_{0.9D-WnUp}$	-1.78 Kn	Capacity	-38.35 Kn	Passing Percentage	<b>2154.49 %</b>

**Deflections**

Modulus of Elasticity = 12100 MPa NZS3603 Amt 4, Table 2.3 considering at least 4 members acting together

$k_2$  for Long Term Loads = 2

Deflection under Dead and Live Load = 21.24 mm                      Limit by Woolcock et al, 1999 Span/240 = 32.50 mm

Deflection under Dead and Service Wind = 23.90 mm                      Limit by Woolcock et al, 1999 Span/100 = 78.00 mm

**Reactions**

Maximum downward = 2.38 kn    Maximum upward = -1.78 kn

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

**Intermediate Design Front and Back**

Intermediate Spacing = 4000 mm                      Intermediate Span = 3449 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)

$K_1$  Short term = 1     $K_4$  = 1     $K_5$  = 1     $K_8$  Downward = 1.00

$K_8$  Upward = 1.00     $S_1$  Downward = 11.27     $S_1$  Upward = 0.70

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

**Capacity Checks**

$M_{Wind+Snow}$	4.94 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	<b>151.01 %</b>
$V_{0.9D-WnUp}$	5.72 Kn	Capacity	-32.16 Kn	Passing Percentage	<b>562.24 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 16.985 mm                      Limit by Woolcock et al, 1999 Span/100 = 34.49 mm

**Reactions**

Maximum = 5.72 kn

**Girt Design Front and Back**

Girt's Spacing = 1300 mm                      Girt's Span = 4000 mm                      Try Girt 200x50 SG8 Dry

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

$K_1$  Short term = 1     $K_4$  = 1     $K_5$  = 1     $K_8$  Downward = 1.00

$K_8$  Upward = 0.82     $S_1$  Downward = 11.27     $S_1$  Upward = 16.80

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

**Capacity Checks**

$M_{Wind+Snow}$	Capacity
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	2.16 Kn-m		3.08 Kn-m	Passing Percentage	<b>142.59 %</b>
V <sub>0.9D-WnUp</sub>	2.16 Kn	Capacity	16.08 Kn	Passing Percentage	<b>744.44 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 16.10 mm

Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Sag during installation = 15.52 mm

**Reactions**

Maximum = 2.16 kn

**Girt Design Sides**

Girt's Spacing = 1300 mm

Girt's Span = 3100 mm

Try Girt 200x50 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 =0.63    S1 Downward =11.27    S1 Upward =20.92

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>	1.30 Kn-m	Capacity	2.33 Kn-m	Passing Percentage	<b>179.23 %</b>
V <sub>0.9D-WnUp</sub>	1.67 Kn	Capacity	16.08 Kn	Passing Percentage	<b>962.87 %</b>

**Deflections**

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

Deflection under Snow and Service Wind = 5.81 mm

Limit by Woolcock et al. 1999 Span/100 = 31.00 mm

Sag during installation =5.60 mm

**Reactions**

Maximum = 1.67 kn

**End Pole Design****Geometry For End Bay Pole****Geometry**

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	4200 mm
Area	35448 mm <sup>2</sup>	As	26585.7421875 mm <sup>2</sup>
I <sub>x</sub>	100042702 mm <sup>4</sup>	Z <sub>x</sub>	941578 mm <sup>3</sup>
I <sub>y</sub>	100042702 mm <sup>4</sup>	Z <sub>y</sub>	941578 mm <sup>3</sup>
Lateral Restraint	mm c/c		

**Loads**

Total Area over Pole = 12.4000248000496 m<sup>2</sup>

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Dead	3.10 Kn	Live	3.10 Kn
Wind Down	4.34 Kn	Snow	0.00 Kn
Moment Wind	6.60 Kn-m		
Phi	0.8	K8	0.68
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	348.03 Kn	PhiMnx Wind	18.64 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	208.82 Kn	PhiMnx Dead	11.19 Kn-m	PhiVnx Dead	37.77 Kn

**Checks**

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.38 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.16 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 20.22 \text{ mm} < 44.89 \text{ mm}$$

Ds =	0.6 mm	Pile Diameter
L =	1400 mm	Pile embedment length
f1 =	3375 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

**Loads**

$$\text{Total Area over Pole} = 12.4000248000496 \text{ m}^2$$

Moment Wind =	6.60 Kn-m
Shear Wind =	1.95 Kn

**Pile Properties**

Safety Factory	0.55	
Hu =	5.12 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	10.12 Kn-m	Ultimate Moment Capacity of Pile

**Checks**

$$\text{Applied Forces/Capacities} = 0.65 < 1 \text{ OK}$$

**Drained Lateral Strength of End 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 =	$(1 - \sin(30)) / (1 + \sin(30))$				

$$K_p = (1 + \sin(30)) / (1 - \sin(30))$$

#### Geometry For End Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1400 mm	Pile embedment length
f1 =	3375 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

#### Loads

Moment Wind =	6.60 Kn-m
Shear Wind =	1.95 Kn

#### Pile Properties

Safety Factor	0.55	
Hu =	5.12 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	10.12 Kn-m	Ultimate Moment Capacity of Pile

#### Checks

Applied Forces/Capacities = 0.65 < 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(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 = 22.07 Kn

Uplift on one Pile = 20.20 Kn

Uplift is ok