

Job No.: 1018**Address:** 254 Wall Road, Foxton, New Zealand**Date:** 16/05/2024**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	4.05 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	585.04 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	4.68 Kn-m	Capacity	18.26 Kn-m	Passing Percentage	390.17 %
$M_{0.9D-W_nUp}$	-3.5 Kn-m	Capacity	-3.73 Kn-m	Passing Percentage	106.57 %
$V_{1.35D}$	1.19 Kn	Capacity	23.01 Kn	Passing Percentage	1933.61 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.38 Kn	Capacity	30.68 Kn	Passing Percentage	1289.08 %
V _{0.9D-WnUp}	-1.78 Kn	Capacity	-38.35 Kn	Passing Percentage	2154.49 %

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 = 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

Rafter Design External

External Rafter Load Width = 4000 mm External Rafter Span = 4820 mm Try Rafter 300x50 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 K₁ Medium term = 0.8 K₁ Long term = 0.6 K₄ = 1 K₅ = 1 K₈ Downward = 0.94

K₈ Upward = 0.94 S₁ Downward = 13.93 S₁ Upward = 13.93

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

Capacity Checks

M _{1.35D}	3.92 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	120.41 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	7.84 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	80.36 %
M _{0.9D-WnUp}	-5.87 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	134.07 %
V _{1.35D}	3.25 Kn	Capacity	14.47 Kn	Passing Percentage	445.23 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	6.51 Kn	Capacity	19.30 Kn	Passing Percentage	296.47 %
V _{0.9D-WnUp}	-4.87 Kn	Capacity	-24.12 Kn	Passing Percentage	495.28 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 16.08 mm Limit by Woolcock et al, 1999 Span/240 = 20.83 mm

Deflection under Dead and Service Wind = 18.08 mm Limit by Woolcock et al, 1999 Span/100 = 50.00 mm

Reactions

Maximum downward = 6.51 kn Maximum upward = -4.87 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 = J5 Joint Group for Pole = J5

Factor of Safety = 0.7

For Perpendicular to grain loading

$K_{11} = 14.9 \text{ f} \cdot \text{p} \cdot \text{j} = 12.9 \text{ Mpa}$ for Rafter with effective thickness = 50 mm

For Parallel to grain loading

$K_{11} = 2.0 \text{ f} \cdot \text{c} \cdot \text{j} = 36.1 \text{ Mpa}$ for Pole with effective thickness = 100 mm

Eccentric Load check

$V = \phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots (\text{Eq 4.12}) = -25.20 \text{ kn} > -4.87 \text{ Kn}$

Single Shear Capacity under short term loads = -10.84 Kn > -4.87 Kn

Intermediate Design Front and Back

Intermediate Spacing = 4000 mm

Intermediate Span = 2999 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 = 0.65

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

Capacity Checks

$M_{\text{Wind+Snow}}$	3.73 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	200.00 %
$V_{0.9D-WnUp}$	4.98 Kn	Capacity	-32.16 Kn	Passing Percentage	645.78 %

Deflections

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

Deflection under Snow and Service Wind = 9.71 mm

Limit by Wookcock et al, 1999 Span/100 = 29.99 mm

Reactions

Maximum = 4.98 kn

Intermediate Design Sides

Intermediate Spacing = 2500 mm

Intermediate Span = 3675 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 = 0.72

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

Capacity Checks

$M_{\text{Wind+Snow}}$	1.75 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	426.29 %
$V_{0.9D-WnUp}$	1.91 Kn	Capacity	32.16 Kn	Passing Percentage	1683.77 %

Deflections

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

Deflection under Snow and Service Wind = 13.685 mm

Limit by Woolcock et al, 1999 Span/100 = 36.75 mm

Reactions

Maximum = 1.91 kn

Girt Design Front and Back

Girt's Spacing = 900 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)

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

K8 Upward =0.50 S1 Downward =11.27 S1 Upward =23.76

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

Capacity Checks

M _{Wind+Snow}	1.49 Kn-m	Capacity	1.87 Kn-m	Passing Percentage	125.50 %
V _{0.9D-WnUp}	1.49 Kn	Capacity	16.08 Kn	Passing Percentage	1079.19 %

Deflections

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

Deflection under Snow and Service Wind = 11.15 mm

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

Sag during installation = 15.52 mm

Reactions

Maximum = 1.49 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 2500 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 =0.96 S1 Downward =11.27 S1 Upward =13.28

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

Capacity Checks

M _{Wind+Snow}	0.58 Kn-m	Capacity	3.57 Kn-m	Passing Percentage	615.52 %
V _{0.9D-WnUp}	0.93 Kn	Capacity	16.08 Kn	Passing Percentage	1729.03 %

Deflections

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

Deflection under Snow and Service Wind = 1.70 mm

Limit by Woolcock et al. 1999 Span/100 = 25.00 mm

Sag during installation =2.37 mm

Reactions

Maximum = 0.93 kn

End Pole Design

Geometry For End Bay Pole

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3750 mm
Area	35448 mm ²	As	26585.7421875 mm ²
Ix	100042702 mm ⁴	Zx	941578 mm ³
Iy	100042702 mm ⁴	Zx	941578 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 20 m²

Dead	5.00 Kn	Live	5.00 Kn
Wind Down	7.00 Kn	Snow	0.00 Kn
Moment Wind	7.53 Kn-m		
Phi	0.8	K8	0.79
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	400.77 Kn	PhiMnx Wind	21.47 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	240.46 Kn	PhiMnx Dead	12.88 Kn-m	PhiVnx Dead	37.77 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.39 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.17 < 1$ OK

Deflection at top under service lateral loads = 18.68 mm < 40.40 mm

Ds =	0.6 mm	Pile Diameter
L =	1400 mm	Pile embedment length
f1 =	3037 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 20 m²

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Moment Wind = 7.53 Kn-m
Shear Wind = 2.48 Kn

Pile Properties

Safety Factor 0.55
Hu = 5.51 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 9.89 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.76 < 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 = 1400 mm Pile embedment length
f1 = 3037 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 7.53 Kn-m
Shear Wind = 2.48 Kn

Pile Properties

Safety Factor 0.55
Hu = 5.51 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 9.89 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.76 < 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 = 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