

Job No.: Rob Peterson

Address: 9 Tuarangi Road, Netherby, Ashburton 7700, New Zealand **Date:** 29/10/2024

Latitude: -43.898712

Longitude: 171.771235

Elevation: 93.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N0	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	1	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4 m
Wind Region	NZ2	Terrain Category	2.96	Design Wind Speed	34.99 m/s
Wind Pressure	0.73 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 3.75 m $C_{p,e} = -0.9$ $p_e = -0.60$ KPa $p_{net} = -0.60$ KPa

For roof $C_{p,e}$ from 3.75 m To 7.50 m $C_{p,e} = -0.5$ $p_e = -0.33$ KPa $p_{net} = -0.33$ 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 9 m $C_{p,e} = 0.7$ $p_e = 0.46$ KPa $p_{net} = 0.68$ KPa

For side wall $C_{p,e}$ from 0 m To 3.75 m $C_{p,e} =$ $p_e = -0.43$ KPa $p_{net} = -0.43$ KPa

Maximum Upward pressure used in roof member Design = 0.60 KPa

Maximum Downward pressure used in roof member Design = 0.35 KPa

Maximum Wall pressure used in Design = 0.68 KPa

Maximum Racking pressure used in Design = 0.395 KPa

Design Summary

Purlin Design

Purlin Spacing = 1500 mm

Purlin Span = 3850 mm

Try Purlin 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 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 0.53 S1 Downward = 11.27 S1 Upward = 23.16

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

Capacity Checks

M _{1.35D}	0.94 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	237.23 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_{nDn}}	1.89 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	157.14 %
M _{0.9D-W_{nUp}}	-1.04 Kn-m	Capacity	-1.96 Kn-m	Passing Percentage	188.46 %
V _{1.35D}	0.97 Kn	Capacity	9.65 Kn	Passing Percentage	994.85 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.95 Kn	Capacity	12.86 Kn	Passing Percentage	659.49 %
V _{0.9D-WnUp}	-1.08 Kn	Capacity	-16.08 Kn	Passing Percentage	1488.89 %

Deflections

Modulus of Elasticity = 6700 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 = 10.94 mm Limit by Woolcock et al, 1999 Span/240 = 15.83 mm

Deflection under Dead and Service Wind = 12.31 mm Limit by Woolcock et al, 1999 Span/100 = 38.00 mm

Reactions

Maximum downward = 1.95 kn Maximum upward = -1.08 kn

Number of Blocking = 0 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 = 4000 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 = 40.00 mm

Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Girt Design Sides

Girt's Spacing = 0 mm Girt's Span = 4500 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

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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 = 45.00 mm

Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	4000 mm
Area	35448 mm ²	As	26585.7421875 mm ²
I _x	100042702 mm ⁴	Z _x	941578 mm ³
I _y	100042702 mm ⁴	Z _y	941578 mm ³
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 18 m²

Dead	4.50 Kn	Live	4.50 Kn
Wind Down	6.30 Kn	Snow	0.00 Kn
Moment wind	4.73 Kn-m		
Phi	0.8	K ₈	1.00
K ₁ snow	0.8	K ₁ Dead	0.6
K ₁ wind	1		

Material

Peeling	Steaming	Normal	Dry Use
f _b =	36.3 MPa	f _s =	2.96 MPa
f _c =	18 MPa	f _p =	7.2 MPa
f _t =	22 MPa	E =	9257 MPa

Capacities

PhiN _{cx} Wind	510.45 Kn	PhiM _{nx} Wind	27.34 Kn-m	PhiV _{nx} Wind	62.96 Kn
PhiN _{cx} Dead	306.27 Kn	PhiM _{nx} Dead	16.41 Kn-m	PhiV _{nx} Dead	37.77 Kn

Checks

(M_x/PhiM_{nx})+(N/phiN_{cx}) = 0.20 < 1 OK

(M_x/PhiM_{nx})²+(N/phiN_{cx}) = 0.06 < 1 OK

Deflection at top under service lateral loads = 11.48 mm < 40.00 mm

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

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Assumed Soil Properties

Gamma	18 Kn/m ³	Friction angle	30 deg	Cohesion	0 Kn/m ³
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 =	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

Moment Wind =	4.73 Kn-m
Shear Wind =	1.58 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 = 0.59 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3700 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 = 18 m²

Dead	4.50 Kn	Live	4.50 Kn
Wind Down	6.30 Kn	Snow	0.00 Kn
Moment Wind	2.36 Kn-m		
Phi	0.8	K8	0.80
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

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$f_c =$	18 MPa	$f_p =$	7.2 MPa
$f_t =$	22 MPa	$E =$	9257 MPa

Capacities

PhiNcx Wind	406.45 Kn	PhiMnx Wind	21.77 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	243.87 Kn	PhiMnx Dead	13.06 Kn-m	PhiVnx Dead	37.77 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.15 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.05 < 1$ OK

Deflection at top under service lateral loads = 5.72 mm < 39.90 mm

$D_s =$	0.6 mm	Pile Diameter
$L =$	1300 mm	Pile embedment length
$f_1 =$	3000 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 18 m²

Moment Wind =	2.36 Kn-m
Shear Wind =	0.79 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 = 0.29 < 1 OK

Drained Lateral Strength of End pile in cohesionless soils Free Head short pile

Assumed Soil Properties

Gamma	18 Kn/m ³	Friction angle	30 deg	Cohesion	0 Kn/m ³
$K_0 =$	$(1 - \sin(30)) / (1 + \sin(30))$				
$K_p =$	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For End Bay Pole

$D_s =$	0.6 mm	Pile Diameter
$L =$	1300 mm	Pile embedment length
$f_1 =$	3000 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	2.36 Kn-m
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Shear Wind =

0.79 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 = 0.29 < 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(1300) x Ks(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 = 17.02 Kn

Uplift on one Pile = 6.75 Kn

Uplift is ok