

Job No.: EHB 307 - 1**Address:** 9 Ackers Road, New River Ferry 9879, New Zealand**Date:** 17/11/2024**Latitude:** -46.423352**Longitude:** 168.276064**Elevation:** 11 m**General Input**

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N5	Ground Snow Load	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	1	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.3 m
Wind Region	NZ4	Terrain Category	2.35	Design Wind Speed	41.47 m/s
Wind Pressure	1.03 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 = Gable Enclosed

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

For roof $C_{p,e}$ from 0 m To 3.9 m $C_{p,e} = -0.9$ $p_e = -0.84$ KPa $p_{net} = -0.84$ KPa

For roof $C_{p,e}$ from 3.9 m To 7.8 m $C_{p,e} = -0.5$ $p_e = -0.46$ KPa $p_{net} = -0.46$ 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 $C_{p,e} = 0.7$ $p_e = 0.65$ KPa $p_{net} = 0.96$ KPa

For side wall $C_{p,e}$ from 0 m To 3.9 m $C_{p,e} =$ $p_e = -0.60$ KPa $p_{net} = -0.60$ KPa

Maximum Upward pressure used in roof member Design = 0.84 KPa

Maximum Downward pressure used in roof member Design = 0.50 KPa

Maximum Wall pressure used in Design = 0.96 KPa

Maximum Racking pressure used in Design = 0.93 KPa

Design Summary**Rafter Design External**

External Rafter Load Width = 3000 mm

External Rafter Span = 4371 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

$M_{1.35D}$	2.42 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	195.04 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	6.66 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	94.59 %
$M_{0.9D-W_nUp}$	-4.41 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	178.46 %
$V_{1.35D}$	2.21 Kn	Capacity	14.47 Kn	Passing Percentage	654.75 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	6.10 Kn	Capacity	19.30 Kn	Passing Percentage	316.39 %
V _{0.9D-WnUp}	-4.03 Kn	Capacity	-24.12 Kn	Passing Percentage	598.51 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 7.91 mm

Limit by Woolcock et al, 1999 Span/240 = 18.75 mm

Deflection under Dead and Service Wind = 9.89 mm

Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Reactions

Maximum downward = 6.10 kn Maximum upward = -4.03 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 3

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

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 50 mm

For Parallel to grain loading

K₁₁ = 2.0 f_{cj} = 36.1 Mpa for Pole with effective thickness = 100 mm

Eccentric Load check

V = $\phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s$ (Eq 4.12) = -25.20 kn > -4.03 Kn

Single Shear Capacity under short term loads = -16.25 Kn > -4.03 Kn

Intermediate Design Front and Back

Intermediate Spacing = 3000 mm

Intermediate Span = 3349 mm

Try Intermediate 2x190x45 SG8

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 = 0.98

K₈ Upward = 1.00 S₁ Downward = 12.23 S₁ Upward = 0.75

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

Capacity Checks

M _{Wind+Snow}	4.04 Kn-m	Capacity	6.06 Kn-m	Passing Percentage	150.00 %
V _{0.9D-WnUp}	4.82 Kn	Capacity	-27.5 Kn	Passing Percentage	570.54 %

Deflections

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

Deflection under Snow and Service Wind = 32.91 mm

Limit by Woolcock et al, 1999 Span/100 = 33.49 mm

Reactions

Maximum = 4.82 kn

Intermediate Design Sides

Intermediate Spacing = 2250 mm

Intermediate Span = 3750 mm

Try Intermediate 2x240x45 SG8

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 =0.94

K8 Upward =1.00 S1 Downward =13.82 S1 Upward =0.89

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

Capacity Checks

$M_{Wind+Snow}$	1.90 Kn-m	Capacity	9.68 Kn-m	Passing Percentage	509.47 %
$V_{0.9D-WnUp}$	2.02 Kn	Capacity	34.74 Kn	Passing Percentage	1719.80 %

Deflections

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

Deflection under Snow and Service Wind = 19.24 mm

Limit by Woolcock et al, 1999 Span/100 = 37.50 mm

Reactions

Maximum = 2.02 kn

Girt Design Front and Back

Girt's Spacing = 1300 mm

Girt's Span = 3000 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

$M_{Wind+Snow}$	1.40 Kn-m	Capacity	NaN Kn-m	Passing Percentage	NaN %
$V_{0.9D-WnUp}$	1.87 Kn	Capacity	0.00 Kn	Passing Percentage	0.00 %

Deflections

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

Deflection under Snow and Service Wind = Infinity mm

Limit by Woolcock et al, 1999 Span/100 = 30.00 mm

Sag during installation = NaN mm

Reactions

Maximum = 1.87 kn

Girt Design Sides

Girt's Spacing = 1300 mm

Girt's Span = 2250 mm

Try Girt 190x45 SG8

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 =0.98

K8 Upward =0.70 S1 Downward =12.23 S1 Upward =19.33

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

Capacity Checks

M _{Wind+Snow}	0.79 Kn-m	Capacity	2.13 Kn-m	Passing Percentage	269.62 %
V _{0.9D-WnUp}	1.40 Kn	Capacity	13.75 Kn	Passing Percentage	982.14 %

Deflections

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

Deflection under Snow and Service Wind = 4.00 mm

Limit by Woolcock et al. 1999 Span/100 = 22.50 mm

Sag during installation =1.92 mm

Reactions

Maximum = 1.40 kn

End Pole Design

Geometry For End Bay Pole

Geometry

175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	4000 mm
Area	27598 mm ²	As	20698.2421875 mm ²
I _x	60639381 mm ⁴	Z _x	646820 mm ³
I _y	60639381 mm ⁴	Z _y	646820 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 13.5 m²

Dead	3.38 Kn	Live	3.38 Kn
Wind Down	6.75 Kn	Snow	8.51 Kn
Moment Wind	6.43 Kn-m	Moment snow	1.93 Kn-m
Phi	0.8	K8	0.61
K1 snow	0.8	K1 Dead	0.6
K1wind	1		

Material

Peeling	Steaming	Normal	Dry Use
f _b =	36.3 MPa	f _s =	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	240.88 Kn	PhiMnx Wind	11.39 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	144.53 Kn	PhiMnx Dead	6.83 Kn-m	PhiVnx Dead	29.41 Kn
PhiNcx Snow	192.70 Kn	PhiMnx Snow	9.11 Kn-m	PhiVnx Snow	39.21 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.64 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.39 < 1$ OK

Deflection at top under service lateral loads = 29.70 mm < 42.89 mm

$D_s =$	0.6 mm	Pile Diameter
$L =$	1300 mm	Pile embedment length
$f_1 =$	3225 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 = 13.5 m²

Moment Wind =	6.43 Kn-m	Moment Snow =	1.93 Kn-m
Shear Wind =	1.99 Kn	Shear Snow =	1.93 Kn

Pile Properties

Safety Factory	0.55	
$H_u =$	4.33 Kn	Ultimate Lateral Strength of the Pile, Short pile
$M_u =$	8.15 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.79 < 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
$f_1 =$	3225 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

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Moment Wind =	6.43 Kn-m	Moment Snow =	1.93 Kn-m
Shear Wind =	1.99 Kn	Shear Snow =	1.93 Kn

Pile Properties

Safety Factor	0.55	
Hu =	4.33 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.15 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.79 < 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(1600) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1600)

Skin Friction = 20.68 Kn

Weight of Pile + Pile Skin Friction = 24.83 Kn

Uplift on one Pile = 16.61 Kn

Uplift is ok