

Job No.: Grant Woods**Address:** 697 One Tree Point Road, One Tree Point, New Zealand**Date:** 30/05/2024**Latitude:** -35.843289**Longitude:** 174.445118**Elevation:** 12 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	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.103 m
Wind Region	NZ1	Terrain Category	2.1	Design Wind Speed	37.96 m/s
Wind Pressure	0.86 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 5.10 m $C_{p,e} = -0.9$ $p_e = -0.66$ KPa $p_{net} = -0.66$ KPa

For roof $C_{p,e}$ from 5.10 m To 10.21 m $C_{p,e} = -0.5$ $p_e = -0.37$ KPa $p_{net} = -0.37$ 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 12 m $C_{p,e} = 0.7$ $p_e = 0.54$ KPa $p_{net} = 0.80$ KPa

For side wall $C_{p,e}$ from 0 m To 5.10 m $C_{p,e} =$ $p_e = -0.51$ KPa $p_{net} = -0.51$ KPa

Maximum Upward pressure used in roof member Design = 0.66 KPa

Maximum Downward pressure used in roof member Design = 0.40 KPa

Maximum Wall pressure used in Design = 0.80 KPa

Maximum Racking pressure used in Design = 0.77 KPa

Design Summary**Purlin Design**

Purlin Spacing = 900 mm

Purlin Span = 4350 mm

Try Purlin 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 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 0.98

K8 Upward = 0.41 S1 Downward = 12.23 S1 Upward = 26.73

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

Capacity Checks

$M_{1.35D}$	0.72 Kn-m	Capacity	1.79 Kn-m	Passing Percentage	248.61 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	1.83 Kn-m	Capacity	2.38 Kn-m	Passing Percentage	130.05 %
$M_{0.9D-W_nUp}$	-0.93 Kn-m	Capacity	-1.23 Kn-m	Passing Percentage	132.26 %
$V_{1.35D}$	0.66 Kn	Capacity	8.25 Kn	Passing Percentage	1250.00 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.37 Kn	Capacity	11.00 Kn	Passing Percentage	802.92 %
V _{0.9D-WnUp}	-0.85 Kn	Capacity	-13.75 Kn	Passing Percentage	1617.65 %

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 = 13.95 mm Limit by Woolcock et al, 1999 Span/240 = 17.92 mm

Deflection under Dead and Service Wind = 16.27 mm Limit by Woolcock et al, 1999 Span/100 = 43.00 mm

Reactions

Maximum downward = 1.37 kn Maximum upward = -0.85 kn

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

Rafter Design Internal

Internal Rafter Load Width = 4500 mm Internal Rafter Span = 5850 mm Try Rafter 2x290x45 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 = 1.00 S₁ Downward = 7.47 S₁ Upward = 7.47

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

Capacity Checks

M _{1.35D}	6.50 Kn-m	Capacity	8.48 Kn-m	Passing Percentage	130.46 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	13.48 Kn-m	Capacity	11.3 Kn-m	Passing Percentage	83.83 %
M _{0.9D-WnUp}	-8.37 Kn-m	Capacity	-14.12 Kn-m	Passing Percentage	168.70 %
V _{1.35D}	4.44 Kn	Capacity	25.18 Kn	Passing Percentage	567.12 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	9.21 Kn	Capacity	33.58 Kn	Passing Percentage	364.60 %
V _{0.9D-WnUp}	-5.73 Kn	Capacity	-41.96 Kn	Passing Percentage	732.29 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 20.755 mm Limit by Woolcock et al, 1999 Span/240 = 25.00 mm

Deflection under Dead and Service Wind = 26.91 mm Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward = 9.21 kn Maximum upward = -5.73 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

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 60 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K11 = 14.9 fpj = 12.9 Mpa for Rafter with effective thickness = 90 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 = 19.50 Kn > -5.73 Kn

Intermediate Design Sides

Intermediate Spacing = 3000 mm

Intermediate Span = 4150 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 = 0.83

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

Capacity Checks

M _{Wind+Snow}	2.58 Kn-m	Capacity	6.06 Kn-m	Passing Percentage	234.88 %
V _{0.9D-WnUp}	2.49 Kn	Capacity	27.5 Kn	Passing Percentage	1104.42 %

Deflections

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

Deflection under Snow and Service Wind = 33.36 mm

Limit by Woolcock et al, 1999 Span/100 = 41.50 mm

Reactions

Maximum = 2.49 kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 4500 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}	1.82 Kn-m	Capacity	2.13 Kn-m	Passing Percentage	117.03 %
V _{0.9D-WnUp}	1.62 Kn	Capacity	13.75 Kn	Passing Percentage	848.77 %

Deflections

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

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Deflection under Snow and Service Wind = 22.31 mm

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

Sag during installation = 30.70 mm

Reactions

Maximum = 1.62 kn

Girt Design Sides

Girt's Spacing = 1300 mm

Girt's Span = 3000 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 =0.56 S1 Downward =12.23 S1 Upward =22.32

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

Capacity Checks

$M_{Wind+Snow}$	1.17 Kn-m	Capacity	1.70 Kn-m	Passing Percentage	145.30 %
$V_{0.9D-WnUp}$	1.56 Kn	Capacity	13.75 Kn	Passing Percentage	881.41 %

Deflections

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

Deflection under Snow and Service Wind = 6.36 mm

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

Sag during installation =6.06 mm

Reactions

Maximum = 1.56 kn

Middle Pole Design

Geometry

225 SED H5 HIGH DENSITY (Minimum 250 dia. at Floor Level)	Dry Use	Height	4803 mm
Area	44279 mm ²	As	33209.1796875 mm ²
I _x	156100441 mm ⁴	Z _x	1314530 mm ³
I _y	156100441 mm ⁴	Z _y	1314530 mm ³
Lateral Restraint	4803 mm c/c		

Loads

Total Area over Pole = 27 m²

Dead	6.75 Kn	Live	6.75 Kn
Wind Down	10.80 Kn	Snow	0.00 Kn
Moment wind	11.25 Kn-m		
Phi	0.8	K8	0.66
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

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Peeling	Steaming	Normal	Dry Use
fb =	49.725 MPa	fs =	2.84 MPa
fc =	28.125 MPa	fp =	8.66 MPa
ft =	29.64 MPa	E =	12874 MPa

Capacities

PhiNcx Wind	656.63 Kn	PhiMnx Wind	34.47 Kn-m	PhiVnx Wind	75.45 Kn
PhiNcx Dead	393.98 Kn	PhiMnx Dead	20.68 Kn-m	PhiVnx Dead	45.27 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.36 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.14 < 1$ OK

Deflection at top under service lateral loads = 19.28 mm < 48.03 mm

Drained Lateral Strength of Middle 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
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 =	3000 mm	Pile embedment length
f1 =	3827 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	11.25 Kn-m
Shear Wind =	2.94 Kn

Pile Properties

Safety Factory	0.55	
Hu =	35.24 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	85.23 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.13 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

225 SED H5 HIGH DENSITY (Minimum 250 dia. at Floor Level)	Dry Use	Height	4903 mm
Area	44279 mm ²	As	33209.1796875 mm ²

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Ix	156100441 mm ⁴	Zx	1314530 mm ³
Iy	156100441 mm ⁴	Zy	1314530 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	5.40 Kn	Snow	0.00 Kn
Moment Wind	5.63 Kn-m		
Phi	0.8	K8	0.64
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Peeling	Steaming	Normal	Dry Use
fb =	49.725 MPa	fs =	2.84 MPa
fc =	28.125 MPa	fp =	8.66 MPa
ft =	29.64 MPa	E =	12874 MPa

Capacities

PhiNcx Wind	636.53 Kn	PhiMnx Wind	33.41 Kn-m	PhiVnx Wind	75.45 Kn
PhiNcx Dead	381.92 Kn	PhiMnx Dead	20.05 Kn-m	PhiVnx Dead	45.27 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.19 < 1$ OK

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

Deflection at top under service lateral loads = 10.22 mm < 50.90 mm

Ds =	0.6 mm	Pile Diameter
L =	3000 mm	Pile embedment length
f1 =	3827 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 13.5 m²

Moment Wind =	5.63 Kn-m
Shear Wind =	1.47 Kn

Pile Properties

Safety Factory	0.55	
Hu =	35.24 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	85.23 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.07 < 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
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 =	3000 mm	Pile embedment length
f1 =	3827 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	5.63 Kn-m
Shear Wind =	1.47 Kn

Pile Properties

Safety Factory	0.55	
Hu =	35.24 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	85.23 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.07 < 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(3000) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(3000)

Skin Friction = 72.69 Kn

Weight of Pile + Pile Skin Friction = 79.56 Kn

Uplift on one Pile = 11.75 Kn

Uplift is ok