

Job No.: Jeremy Croft
Latitude: -35.645642

Address: 477 Crane Rd, Kauri, New Zealand
Longitude: 174.277507

Date: 12/01/2024
Elevation: 150.5 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	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.35 m
Wind Region	NZ1	Terrain Category	2.59	Design Wind Speed	39.46 m/s
Wind Pressure	0.93 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 4.35 m $C_{p,e} = -0.9$ $p_e = -0.76$ KPa $p_{net} = -0.76$ KPa

For roof $C_{p,e}$ from 4.35 m To 8.70 m $C_{p,e} = -0.5$ $p_e = -0.42$ KPa $p_{net} = -0.42$ 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 11 m $C_{p,e} = 0.7$ $p_e = 0.59$ KPa $p_{net} = 0.87$ KPa

For side wall $C_{p,e}$ from 0 m To 4.35 m $C_{p,e} =$ $p_e = -0.55$ KPa $p_{net} = -0.55$ KPa

Maximum Upward pressure used in roof member Design = 0.76 KPa

Maximum Downward pressure used in roof member Design = 0.43 KPa

Maximum Wall pressure used in Design = 0.87 KPa

Maximum Racking pressure used in Design = 1.01 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 5850 mm

Try Purlin 250x50 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 = 0.97

K8 Upward = 0.54 S1 Downward = 12.68 S1 Upward = 22.76

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

Capacity Checks

$M_{1.35D}$	1.3 Kn-m	Capacity	3.40 Kn-m	Passing Percentage	261.54 %
$M_{1.2D+1.5L\ 1.2D+S_n\ 1.2D+W_nDn}$	2.81 Kn-m	Capacity	4.53 Kn-m	Passing Percentage	161.21 %
$M_{0.9D-W_nUp}$	-2.06 Kn-m	Capacity	-3.16 Kn-m	Passing Percentage	153.40 %

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V _{1.35D}	0.89 Kn	Capacity	12.06 Kn	Passing Percentage	1355.06 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.92 Kn	Capacity	16.08 Kn	Passing Percentage	837.50 %
V _{0.9D-W_nUp}	-1.41 Kn	Capacity	-20.10 Kn	Passing Percentage	1425.53 %

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 = 18.24 mm

Limit by Woolcock et al, 1999 Span/240 = 24.17 mm

Deflection under Dead and Service Wind = 21.74 mm

Limit by Woolcock et al, 1999 Span/100 = 58.00 mm

Reactions

Maximum downward = 1.92 kn Maximum upward = -1.41 kn

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

Rafter Design Internal

Internal Rafter Load Width = 6000 mm

Internal Rafter Span = 4850 mm

Try Rafter 2x300x50 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 = 6.81 S₁ Upward = 6.81

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

Capacity Checks

M _{1.35D}	5.95 Kn-m	Capacity	10.08 Kn-m	Passing Percentage	169.41 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	12.88 Kn-m	Capacity	13.44 Kn-m	Passing Percentage	104.35 %
M _{0.9D-W_nUp}	-9.44 Kn-m	Capacity	-16.8 Kn-m	Passing Percentage	177.97 %
V _{1.35D}	4.91 Kn	Capacity	28.94 Kn	Passing Percentage	589.41 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	10.62 Kn	Capacity	38.6 Kn	Passing Percentage	363.47 %
V _{0.9D-W_nUp}	-7.78 Kn	Capacity	-48.24 Kn	Passing Percentage	620.05 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 10.85 mm

Limit by Woolcock et al, 1999 Span/240 = 20.83 mm

Deflection under Dead and Service Wind = 14.365 mm

Limit by Woolcock et al, 1999 Span/100 = 50.00 mm

Reactions

Maximum downward = 10.62 kn Maximum upward = -7.78 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 2

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Second page

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

$K_{11} = 14.9$ $f_{pj} = 12.9$ Mpa for Rafter with effective thickness = 100 mm

For Parallel to grain loading

$K_{11} = 2.0$ $f_{cj} = 36.1$ Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 21.67 Kn > -7.78 Kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 6000 mm

Try Girt 250x50 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 = 0.97

K_8 Upward = 0.72 S_1 Downward = 12.68 S_1 Upward = 18.90

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

Capacity Checks

$M_{Wind+Snow}$	3.52 Kn-m	Capacity	4.22 Kn-m	Passing Percentage	119.89 %
$V_{0.9D-WnUp}$	2.35 Kn-m	Capacity	20.10 Kn-m	Passing Percentage	855.32 %

Deflections

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

Deflection under Snow and Service Wind = 30.29 mm

Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Sag during installation = 78.58 mm

Reactions

Maximum = 2.35 kn

Girt Design Sides

Girt's Spacing = 1300 mm

Girt's Span = 5000 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 = 0.96 S_1 Downward = 11.27 S_1 Upward = 13.28

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

Capacity Checks

$M_{Wind+Snow}$	3.53 Kn-m	Capacity	3.57 Kn-m	Passing Percentage	101.13 %
$V_{0.9D-WnUp}$	2.83 Kn-m	Capacity	16.08 Kn-m	Passing Percentage	568.20 %

Deflections

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

Deflection under Snow and Service Wind = 41.21 mm

Limit by Woolcock et al. 1999 Span/100 = 50.00 mm

Sag during installation = 37.90 mm

Reactions

Maximum = 2.83 kn

Middle Pole Design

Geometry

275 UNI H5	Dry Use	Height	4400 mm
Area	59366 mm ²	As	44524.21875 mm ²
Ix	280595337 mm ⁴	Zx	2040693 mm ³
Iy	280595337 mm ⁴	Zy	2040693 mm ³
Lateral Restraint	4400 mm c/c		

Loads

Total Area over Pole = 30 m²

Dead	7.50 Kn	Live	7.50 Kn
Wind Down	12.90 Kn	Snow	0.00 Kn
Moment wind	14.30 Kn-m		
Phi	0.8	K8	0.86
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Shaving	Steaming	Normal	Dry Use
fb =	34.325 MPa	fs =	2.96 MPa
fc =	18 MPa	fp =	7.2 MPa
ft =	20.75 MPa	E =	8793 MPa

Capacities

PhiNcx Wind	734.84 Kn	PhiMnx Wind	48.17 Kn-m	PhiVnx Wind	105.43 Kn
PhiNcx Dead	440.91 Kn	PhiMnx Dead	28.90 Kn-m	PhiVnx Dead	63.26 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.33 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.13 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 15.58 mm < 44.00 mm

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

Assumed Soil Properties

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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 =	1600 mm	Pile embedment length
f1 =	3262 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	14.30 Kn-m
Shear Wind =	4.38 Kn

Pile Properties

Safety Factory	0.55	
Hu =	7.51 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	14.55 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.98 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	4050 mm
Area	35448 mm ²	As	26585.7421875 mm ²
Ix	100042702 mm ⁴	Zx	941578 mm ³
Iy	100042702 mm ⁴	Zy	941578 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 15 m²

Dead	3.75 Kn	Live	3.75 Kn
Wind Down	6.45 Kn	Snow	0.00 Kn
Moment Wind	7.15 Kn-m		
Phi	0.8	K8	0.72
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	365.76 Kn	PhiMnx Wind	19.59 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	219.46 Kn	PhiMnx Dead	11.76 Kn-m	PhiVnx Dead	37.77 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.40 < 1$ OK

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

Deflection at top under service lateral loads = 20.47 mm < 43.39 mm

Ds =	0.6 mm	Pile Diameter
L =	1300 mm	Pile embedment length
f1 =	3262 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 15 m²

Moment Wind =	7.15 Kn-m
Shear Wind =	2.19 Kn

Pile Properties

Safety Factor	0.55	
Hu =	4.29 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.17 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.88 < 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 =	1300 mm	Pile embedment length
f1 =	3262 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	7.15 Kn-m
Shear Wind =	2.19 Kn

Pile Properties

Safety Factor	0.55	
$H_u =$	4.29 Kn	Ultimate Lateral Strength of the Pile, Short pile
$M_u =$	8.17 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.88 < 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

K_s (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 $K_s(1.5)$ x 0.5 x $\tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1600)

Skin Friction = 20.68 Kn

Weight of Pile + Pile Skin Friction = 23.68 Kn

Uplift on one Pile = 16.05 Kn

Uplift is ok