

Job No.: 525toms**Address:** 821 MATARANGI DRIVE, Coromandel, New Zealand**Date:** 01/05/2024**Latitude:** -36.727457**Longitude:** 175.640995**Elevation:** 8 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	3.9 m
Wind Region	NZ1	Terrain Category	1.54	Design Wind Speed	40.32 m/s
Wind Pressure	0.98 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 $C_{p,i} = 0.6882$

For roof $C_{p,e}$ from 0 m To 3.90 m $C_{p,e} = -0.9$ $p_e = -0.76$ KPa $p_{net} = -1.46$ KPa

For roof $C_{p,e}$ from 3.90 m To 7.80 m $C_{p,e} = -0.5$ $p_e = -0.42$ KPa $p_{net} = -1.12$ KPa

For wall Windward $C_{p,i} = 0.6882$ side Wall $C_{p,i} = -0.628$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 9 m $C_{p,e} = 0.7$ $p_e = 0.61$ KPa $p_{net} = 0.95$ KPa

For side wall $C_{p,e}$ from 0 m To 3.90 m $C_{p,e} =$ $p_e = -0.57$ KPa $p_{net} = -0.23$ KPa

Maximum Upward pressure used in roof member Design = 1.46 KPa

Maximum Downward pressure used in roof member Design = 0.50 KPa

Maximum Wall pressure used in Design = 1.27 KPa

Maximum Racking pressure used in Design = 0.90 KPa

Design Summary**Purlin Design**

Purlin Spacing = 900 mm

Purlin Span = 4650 mm

Try Purlin 240x45 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 = 0.94

K8 Upward = 0.77 S1 Downward = 13.82 S1 Upward = 18.04

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

Capacity Checks

$M_{1.35D}$	0.82 Kn-m	Capacity	2.73 Kn-m	Passing Percentage	332.93 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	2.01 Kn-m	Capacity	3.64 Kn-m	Passing Percentage	181.09 %
$M_{0.9D-W_nUp}$	-3 Kn-m	Capacity	-3.71 Kn-m	Passing Percentage	123.67 %
$V_{1.35D}$	0.71 Kn	Capacity	10.42 Kn	Passing Percentage	1467.61 %

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V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.67 Kn	Capacity	13.89 Kn	Passing Percentage	831.74 %
V _{0.9D-W_nUp}	-2.58 Kn	Capacity	-17.37 Kn	Passing Percentage	673.26 %

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 = 9.06 mm Limit by Woolcock et al, 1999 Span/240 = 19.17 mm

Deflection under Dead and Service Wind = 11.33 mm Limit by Woolcock et al, 1999 Span/100 = 46.00 mm

Reactions

Maximum downward = 1.67 kn Maximum upward = -2.58 kn

Number of Blocking = 2 if 0 then no blocking required, if 1 then one midspan blocking required

Rafter Design External

External Rafter Load Width = 2400 mm External Rafter Span = 4310 mm Try Rafter 240x45 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 = 0.94

K₈ Upward = 0.94 S₁ Downward = 13.82 S₁ Upward = 13.82

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

Capacity Checks

M _{1.35D}	1.88 Kn-m	Capacity	2.73 Kn-m	Passing Percentage	145.21 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	4.46 Kn-m	Capacity	3.64 Kn-m	Passing Percentage	81.61 %
M _{0.9D-W_nUp}	-6.88 Kn-m	Capacity	-4.55 Kn-m	Passing Percentage	66.13 %
V _{1.35D}	1.75 Kn	Capacity	10.42 Kn	Passing Percentage	595.43 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	4.14 Kn	Capacity	13.89 Kn	Passing Percentage	335.51 %
V _{0.9D-W_nUp}	-6.39 Kn	Capacity	-17.37 Kn	Passing Percentage	271.83 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 13.73 mm Limit by Woolcock et al, 1999 Span/240 = 18.75 mm

Deflection under Dead and Service Wind = 17.17 mm Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Reactions

Maximum downward = 4.14 kn Maximum upward = -6.39 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts =

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 = 45 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

$V = \phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots (\text{Eq 4.12}) = -17.01 \text{ kn} > -6.39 \text{ Kn}$

Single Shear Capacity under short term loads = -0.00 Kn > -6.39 Kn

Girt Design Front and Back

Girt's Spacing = 600 mm

Girt's Span = 4800 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)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.98

K_8 Upward = 0.85 S_1 Downward = 12.23 S_1 Upward = 16.30

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

Capacity Checks

$M_{\text{Wind+Snow}}$	2.19 Kn-m	Capacity	2.57 Kn-m	Passing Percentage	117.35 %
$V_{0.9D-WnUp}$	1.83 Kn	Capacity	13.75 Kn	Passing Percentage	751.37 %

Deflections

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

Deflection under Snow and Service Wind = 30.56 mm

Limit by Woolcock et al, 1999 Span/100 = 48.00 mm

Sag during installation = 39.74 mm

Reactions

Maximum = 1.83 kn

Girt Design Sides

Girt's Spacing = 600 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)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.98

K_8 Upward = 0.70 S_1 Downward = 12.23 S_1 Upward = 19.33

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

Capacity Checks

$M_{\text{Wind+Snow}}$	1.93 Kn-m	Capacity	2.13 Kn-m	Passing Percentage	110.36 %
$V_{0.9D-WnUp}$	1.71 Kn	Capacity	13.75 Kn	Passing Percentage	804.09 %

Deflections

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

Deflection under Snow and Service Wind = 23.61 mm

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

Sag during installation = 30.70 mm

Reactions

Maximum = 1.71 kn

End Pole Design

Geometry For End Bay Pole

Geometry

175 SED H5 HIGH DENSITY (Minimum 200 dia. at Floor Level)	Dry Use	Height	3700 mm
Area	27598 mm ²	As	20698.2421875 mm ²
Ix	60639381 mm ⁴	Zx	646820 mm ³
Iy	60639381 mm ⁴	Zy	646820 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 10.8 m²

Dead	2.70 Kn	Live	2.70 Kn
Wind Down	5.40 Kn	Snow	0.00 Kn
Moment Wind	4.10 Kn-m		
Phi	0.8	K8	0.68
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	424.32 Kn	PhiMnx Wind	17.58 Kn-m	PhiVnx Wind	47.03 Kn
PhiNcx Dead	254.59 Kn	PhiMnx Dead	10.55 Kn-m	PhiVnx Dead	28.22 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.26 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.08 < 1$ OK

Deflection at top under service lateral loads = 11.19 mm < 38.90 mm

Ds =	0.6 mm	Pile Diameter
L =	1600 mm	Pile embedment length

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f1 = 2925 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Total Area over Pole = 10.8 m²

Moment Wind = 4.10 Kn-m
Shear Wind = 1.40 Kn

Pile Properties

Safety Factory 0.55
Hu = 8.07 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 14.19 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/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 = 1600 mm Pile embedment length
f1 = 2925 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 4.10 Kn-m
Shear Wind = 1.40 Kn

Pile Properties

Safety Factory 0.55
Hu = 8.07 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 14.19 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

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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 = 25.36 Kn

Uplift on one Pile = 26.68 Kn

Uplift is ok