

Job No.: Ensura Building Services-1**Address:** 340 MT Wesley Road, Dargaville, New Zealand**Date:** 09/05/2024**Latitude:** -35.966901**Longitude:** 173.835559**Elevation:** 41 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	3.5 m
Wind Region	NZ1	Terrain Category	2.0	Design Wind Speed	40.38 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 = Gable Enclosed

For roof $C_{p,i} = -0.6177$

For roof $C_{p,e}$ from 0 m To 4.25 m $C_{p,e} = -0.43$ $p_e = -0.37$ KPa $p_{net} = -0.82$ KPa

For roof $C_{p,e}$ from 4.25 m To 8.50 m $C_{p,e} = -0.58$ $p_e = -0.50$ KPa $p_{net} = -0.95$ KPa

For wall Windward $C_{p,i} = 0.4778$ side Wall $C_{p,i} = -0.6177$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 20 m $C_{p,e} = 0.7$ $p_e = 0.59$ KPa $p_{net} = 1.17$ KPa

For side wall $C_{p,e}$ from 0 m To 4.25 m $C_{p,e} =$ $p_e = -0.55$ KPa $p_{net} = 0.03$ KPa

Maximum Upward pressure used in roof member Design = 0.82 KPa

Maximum Downward pressure used in roof member Design = 0.75 KPa

Maximum Wall pressure used in Design = 1.17 KPa

Maximum Racking pressure used in Design = 0.96 KPa

Design Summary**Rafter Design Internal**

Internal Rafter Load Width = 5000 mm

Internal Rafter Span = 8350 mm

Try Rafter 2x360x63 LVL13

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 = 5.90 S1 Upward = 5.90

Shear Capacity of timber = 5.3 MPa Bending Capacity of timber = 48 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

$M_{1.35D}$	14.71 Kn-m	Capacity	60.82 Kn-m	Passing Percentage	413.46 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	45.76 Kn-m	Capacity	81.1 Kn-m	Passing Percentage	177.23 %
$M_{0.9D-W_nUp}$	-25.93 Kn-m	Capacity	-101.38 Kn-m	Passing Percentage	390.98 %
$V_{1.35D}$	7.05 Kn	Capacity	77.32 Kn	Passing Percentage	1096.74 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	21.92 Kn	Capacity	103.08 Kn	Passing Percentage	470.26 %
V _{0.9D-WnUp}	-12.42 Kn	Capacity	-128.86 Kn	Passing Percentage	1037.52 %

Deflections

Modulus of Elasticity = 11000 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 17.03 mm

Limit by Woolcock et al, 1999 Span/240 = 35.42 mm

Deflection under Dead and Service Wind = 27.59 mm

Limit by Woolcock et al, 1999 Span/100 = 85.00 mm

Reactions

Maximum downward = 21.92 kn Maximum upward = -12.42 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 = J2 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 = 12.6 f_{pj} = 22.7 Mpa for Rafter with effective thickness = 126 mm

For Parallel to grain loading

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

Capacity under short term loads = 43.67 Kn > -12.42 Kn

Rafter Design External

External Rafter Load Width = 2500 mm

External Rafter Span = 5103 mm

Try Rafter 240x45 LVL13

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 = 5.3 MPa Bending Capacity of timber = 48 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	2.75 Kn-m	Capacity	9.37 Kn-m	Passing Percentage	340.73 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	8.54 Kn-m	Capacity	12.49 Kn-m	Passing Percentage	146.25 %
M _{0.9D-WnUp}	-4.84 Kn-m	Capacity	-15.61 Kn-m	Passing Percentage	322.52 %
V _{1.35D}	2.15 Kn	Capacity	18.41 Kn	Passing Percentage	856.28 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	6.70 Kn	Capacity	24.54 Kn	Passing Percentage	366.27 %
V _{0.9D-WnUp}	-3.80 Kn	Capacity	-30.68 Kn	Passing Percentage	807.37 %

Deflections

Modulus of Elasticity = 11000 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 10.70 mm

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

Deflection under Dead and Service Wind = 15.61 mm

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

Reactions

Maximum downward = 6.70 kn Maximum upward = -3.80 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 = J2 Joint Group for Pole = J5

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 12.6 f_{pj} = 22.7 Mpa for Rafter with effective thickness = 45 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) = -30.05 kn > -3.80 Kn

Single Shear Capacity under short term loads = -21.83 Kn > -3.80 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2500 mm

Intermediate Span = 1849 mm

Try Intermediate 2x140x45 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 = 1.00

K₈ Upward = 1.00 S₁ Downward = 10.36 S₁ Upward = 0.47

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

Capacity Checks

M _{Wind+Snow}	1.25 Kn-m	Capacity	3.3 Kn-m	Passing Percentage	264.00 %
V _{0.9D-WnUp}	2.70 Kn	Capacity	-20.26 Kn	Passing Percentage	750.37 %

Deflections

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

Deflection under Snow and Service Wind = 4.005 mm

Limit by Woolcock et al, 1999 Span/100 = 18.49 mm

Reactions

Maximum = 2.70 kn

Girt Design Front and Back

Girt's Spacing = 1300 mm

Girt's Span = 2500 mm

Try Girt 140x45 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 =1.00

K8 Upward =0.80 S1 Downward =10.36 S1 Upward =17.27

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

Capacity Checks

$M_{Wind+Snow}$	1.19 Kn-m	Capacity	1.32 Kn-m	Passing Percentage	110.92 %
$V_{0.9D-WnUp}$	1.90 Kn	Capacity	10.13 Kn	Passing Percentage	533.16 %

Deflections

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

Deflection under Snow and Service Wind = 11.22 mm

Limit by Woolcock et al, 1999 Span/100 = 25.00 mm

Sag during installation = 2.92 mm

Reactions

Maximum = 1.90 kn

Girt Design Sides

Girt's Spacing = 1300 mm

Girt's Span = 2500 mm

Try Girt 140x45 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 =1.00

K8 Upward =0.98 S1 Downward =10.36 S1 Upward =12.21

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

Capacity Checks

$M_{Wind+Snow}$	1.19 Kn-m	Capacity	1.62 Kn-m	Passing Percentage	136.13 %
$V_{0.9D-WnUp}$	1.90 Kn	Capacity	10.13 Kn	Passing Percentage	533.16 %

Deflections

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

Deflection under Snow and Service Wind = 11.22 mm

Limit by Woolcock et al. 1999 Span/100 = 25.00 mm

Sag during installation =2.92 mm

Reactions

Maximum = 1.90 kn

Middle Pole Design

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3140 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	3140 mm c/c		

Loads

Total Area over Pole = 21.25 m²

Dead	5.31 Kn	Live	5.31 Kn
Wind Down	15.94 Kn	Snow	0.00 Kn
Moment wind	11.00 Kn-m		
Phi	0.8	K8	0.91
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	463.67 Kn	PhiMnx Wind	24.84 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	278.20 Kn	PhiMnx Dead	14.90 Kn-m	PhiVnx Dead	37.77 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.50 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.25 < 1$ OK

Deflection at top under service lateral loads = 18.34 mm < 31.40 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 =	1500 mm	Pile embedment length
f1 =	2625 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind = 11.00 Kn-m
Shear Wind = 4.19 Kn

Pile Properties

Safety Factor	0.55	
Hu =	7.29 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	11.57 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = $0.95 < 1$ 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 (1500) x Ks (1.5) x 0.5 x tan(30) x Pi x Dia of Pile (0.6) x Height of Pile (1500)

Skin Friction = 18.17 Kn

Weight of Pile + Pile Skin Friction = 22.07 Kn

Uplift on one Pile = 12.64 Kn

Uplift is ok