Job No.: EHB 128 A | **Address:** 57 BlacKmore Road, Garston, New Zealand | **Date:** 24/01/2024
Latitude: -45.474105 | **Longitude:** 168.686346 | **Elevation:** 319 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	0.93 KPa	Roof Snow Load	0.65 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	8.4 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	41.41 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 Pressues

Shed Type = Mono Enclosed

For roof Cp,i = 0.6883

For roof CP,e from 0 m To 8.40 m Cpe = -0.9 pe = -0.81 KPa pnet = -1.56 KPa

For roof CP,e from 8.40 m To 16.8 m Cpe = -0.5 pe = -0.45 KPa pnet = -1.20 KPa

For wall Windward Cp,i = 0.6883 side Wall Cp,i = -0.6284

For wall Windward and Leeward CP,e from 0 m To 12 m Cpe = 0.7 pe = 0.65 KPa pnet = 1.35 KPa

For side wall CP,e from 0 m To 8.40 m Cpe = pe = -0.60 KPa pnet = 0.10 KPa

Maximum Upward pressure used in roof member Design = 1.56 KPa

Maximum Downward pressure used in roof member Design = 0.59 KPa

Maximum Wall pressure used in Design = 1.35 KPa

Maximum Racking pressure used in Design = 1.11 KPa

Design Summary

Rafter Design Internal

Internal Rafter Load Width = 4700 mm   Internal Rafter Span = 11850 mm   Try Rafter 2x450x63 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 =6.68 S1 Upward =6.68

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

Capacity Checks

$M_{1.35D}$	27.84 Kn-m	Capacity	91.56 Kn-m	Passing Percentage	**328.88 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	78.37 Kn-m	Capacity	122.08 Kn-m	Passing Percentage	**155.77 %**
$M_{0.9D-WnUp}$	-110.14 Kn-m	Capacity	-152.6 Kn-m	Passing Percentage	**138.55 %**

$V_{1.35D}$	9.40 Kn	Capacity	96.64 Kn	Passing Percentage	**1028.09 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	26.46 Kn	Capacity	128.86 Kn	Passing Percentage	**487.00 %**
$V_{0.9D-WnUp}$	-37.18 Kn	Capacity	-161.08 Kn	Passing Percentage	**433.24 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 32.555 mm Limit by Woolcock et al, 1999 Span/240 = 50.00 mm

Deflection under Dead and Service Wind = 47.925 mm Limit by Woolcock et al, 1999 Span/100 = 120.00 mm

Reactions

Maximum downward =26.46 kn Maximum upward = -37.18 kn

Rafter to Pole Connection check

Bolt Size = M16 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 = 80 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K11 = 12.6 fpj = 22.7 Mpa for Rafter with effective thickness = 126 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 = 77.63 Kn > -37.18 Kn

Rafter Design External

External Rafter Load Width = 2350 mm External Rafter Span = 11854 mm Try Rafter 450x63 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 =0.95

K8 Upward =0.95 S1 Downward =13.57 S1 Upward =13.57

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

Capacity Checks

$M_{1.35D}$	13.93 Kn-m	Capacity	43.42 Kn-m	Passing Percentage	**311.70 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	39.21 Kn-m	Capacity	57.89 Kn-m	Passing Percentage	**147.64 %**
$M_{0.9D-WnUp}$	-55.10 Kn-m	Capacity	-72.37 Kn-m	Passing Percentage	**131.34 %**
$V_{1.35D}$	4.70 Kn	Capacity	48.32 Kn	Passing Percentage	**1028.09 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	13.23 Kn	Capacity	64.43 Kn	Passing Percentage	**487.00 %**
$V_{0.9D-WnUp}$	-18.59 Kn	Capacity	-80.54 Kn	Passing Percentage	**433.24 %**

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Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 36.17 mm	Limit by Woolcock et al, 1999 Span/240= 50.00 mm
Deflection under Dead and Service Wind = 47.93 mm	Limit by Woolcock et al, 1999 Span/100 = 120.00 mm

Reactions

Maximum downward =13.23 kn   Maximum upward = -18.59 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 fpj = 22.7 Mpa for Rafter with effective thickness = 63 mm

For Parallel to grain loading

K11 = 2.0 fcj = 36.1 Mpa for Pole with effective thickness = 100 mm

Eccentric Load check

V = phi x k1 x k4 x k5 x fs x b x ds .... (Eq 4.12) = -91.15 kn > -18.59 Kn

Single Shear Capacity under short term loads = -21.83 Kn > -18.59 Kn

Girt Design Front and Back

Girt's Spacing = 0 mm	Girt's Span = 2350 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

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

Deflections

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

Deflection under Snow and Service Wind = NaN mm	Limit by Woolcock et al, 1999 Span/100 = 23.50 mm
Sag during installation = NaN mm	

Reactions

Maximum = 0.00 kn

Girt Design Sides

Girt's Spacing = 0 mm	Girt's Span = 6000 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

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

Deflections

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

Deflection under Snow and Service Wind = NaN mm	Limit by Woolcock et al. 1999 Span/100 = 60.00 mm
Sag during installation =NaN mm	

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

350 SED H5 (Minimum 375 dia. at Floor Level)	Dry Use	Height	8450 mm
Area	103154 mm2	As	77365.4296875 mm2
Ix	847191750 mm4	Zx	4674161 mm3
Iy	847191750 mm4	Zx	4674161 mm3
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 28.2 m2

Dead	7.05 Kn	Live	7.05 Kn
Wind Down	16.64 Kn	Snow	18.33 Kn
Moment wind	68.85 Kn-m	Moment snow	9.16 Kn-m
Phi	0.8	K8	1.00
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	1485.42 Kn	PhiMnx Wind	135.74 Kn-m	PhiVnx Wind	183.20 Kn
PhiNcx Dead	891.25 Kn	PhiMnx Dead	81.44 Kn-m	PhiVnx Dead	109.92 Kn
PhiNcx Snow	1188.33 Kn	PhiMnx Snow	108.59 Kn-m	PhiVnx Snow	146.56 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.53 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.28 < 1 OK

Deflection at top under service lateral loads = 87.55 mm < 84.50 mm

Drained Lateral Strength of Middle 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 Middle Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	2700 mm	Pile embedment length
f1 =	6300 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	68.85 Kn-m	Moment Snow =	Kn-m
Shear Wind =	10.93 Kn	Shear Snow =	9.16 Kn

Pile Properties

Safety Factory	0.55	
Hu =	19.49 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	72.07 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.96 < 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 = Safecty factor (0.55) x Density of Soil(18) x Height of Pile(2700) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of

Pile(0.6) x Height of Pile(2700)

Skin Friction = 58.88 Kn

Weight of Pile + Pile Skin Friction = 61.86 Kn

Uplift on one Pile = 37.65 Kn

Uplift is ok