Job No.: 618411 - 2   **Address:** 1263A Bulls Rd, Kerikeri, New Zealand   **Date:** 11/22/2023

Latitude: -35.268603   **Longitude:** 173.938025   **Elevation:** 172.5 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	4.4 m
Wind Region	NZ1	Terrain Category	2.96	Design Wind Speed	43.23 m/s
Wind Pressure	1.12 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 $C_{p,i}$ = -0.3

For roof $C_{P,e}$ from 0 m To 4.0 m C_{pe} = -0.9 p_e = -0.91 KPa p_{net} = -0.91 KPa

For roof $C_{P,e}$ from 4.0 m To 8.0 m C_{pe} = -0.5 p_e = -0.50 KPa p_{net} = -0.50 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 11.0 m C_{pe} = 0.7 p_e = 0.71 KPa p_{net} = 1.05 KPa

For side wall $C_{P,e}$ from 0 m To 4.0 m C_{pe} = p_e = -0.66 KPa p_{net} = -0.66 KPa

Maximum Upward pressure used in roof member Design = 0.91 KPa

Maximum Downward pressure used in roof member Design = 0.44 KPa

Maximum Wall pressure used in Design = 1.05 KPa

Maximum Racking pressure used in Design = 1.14 KPa

Design Summary

Rafter Design Internal

Internal Rafter Load Width = 4080 mm   Internal Rafter Span = 10850 mm   Try Rafter 2x450x45 LVL13

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet

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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 =9.45   S1 Upward =9.45

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

Capacity Checks

$M_{1.35D}$	20.26 Kn-m	Capacity	65.4 Kn-m	Passing Percentage	**322.80 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	44.43 Kn-m	Capacity	87.2 Kn-m	Passing Percentage	**196.26 %**
$M_{0.9D-WnUp}$	-41.13 Kn-m	Capacity	-109 Kn-m	Passing Percentage	**265.01 %**
$V_{1.35D}$	7.47 Kn	Capacity	69.04 Kn	Passing Percentage	**924.23 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	16.38 Kn	Capacity	92.04 Kn	Passing Percentage	**561.90 %**
$V_{0.9D-WnUp}$	-15.16 Kn	Capacity	-115.06 Kn	Passing Percentage	**758.97 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 27.935 mm   Limit by Woolcock et al, 1999 Span/240 = 45.83 mm

Deflection under Dead and Service Wind = 37.245 mm   Limit by Woolcock et al, 1999 Span/100 = 110.00 mm

Reactions

Maximum downward =16.38 kn   Maximum upward = -15.16 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 fpj = 22.7 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

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Capacity under short term loads = 43.67 Kn > -15.16 Kn

Rafter Design External

External Rafter Load Width = 2040 mm   External Rafter Span = 10829 mm   Try Rafter 450x45 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 =0.72

K8 Upward =0.72   S1 Downward =19.04   S1 Upward =19.04

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

Capacity Checks

$M_{1.35D}$	10.09 Kn-m	Capacity	23.45 Kn-m	Passing Percentage	**232.41 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	22.13 Kn-m	Capacity	31.26 Kn-m	Passing Percentage	**141.26 %**
$M_{0.9D-WnUp}$	-20.48 Kn-m	Capacity	-39.08 Kn-m	Passing Percentage	**190.82 %**
$V_{1.35D}$	3.73 Kn	Capacity	34.52 Kn	Passing Percentage	**925.47 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	8.17 Kn	Capacity	46.02 Kn	Passing Percentage	**563.28 %**
$V_{0.9D-WnUp}$	-7.57 Kn	Capacity	-57.53 Kn	Passing Percentage	**759.97 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 31.04 mm   Limit by Woolcock et al, 1999 Span/240= 45.83 mm
Deflection under Dead and Service Wind = 37.25 mm   Limit by Woolcock et al, 1999 Span/100 = 110.00 mm

Reactions

Maximum downward =8.17 kn   Maximum upward = -7.57 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 = 45 mm

For Parallel to grain loading

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

Eccentric Load check

$V = phi \times k1 \times k4 \times k5 \times fs \times b \times ds$ .... (Eq 4.12) = -65.11 kn > -7.57 Kn

Single Shear Capacity under short term loads = -21.83 Kn > -7.57 Kn

Intermediate Design Sides

Intermediate Spacing = 5500 mm   Intermediate Span = 3850 mm   Try Intermediate 2x250x50 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   K4 =1   K5 =1   K8 Downward =0.97

K8 Upward =1.00   S1 Downward =12.68   S1 Upward =0.83

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

Capacity Checks

$M_{Wind+Snow}$	5.35 Kn-m	Capacity	11.66 Kn-m	Passing Percentage	**217.94 %**
$V_{0.9D-WnUp}$	5.56 Kn-m	Capacity	40.2 Kn-m	Passing Percentage	**723.02 %**

Deflections

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

Deflection under Snow and Service Wind = 23.495 mm   Limit by Woolcock et al, 1999 Span/100 = 38.50 mm

Reactions

Maximum = 5.56 kn

Girt Design Front and Back

Girt's Spacing = 600 mm   Girt's Span = 4080 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 =0.43   S1 Downward =12.23   S1 Upward =26.04

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

Capacity Checks

$M_{Wind+Snow}$	1.31 Kn-m	Capacity	1.29 Kn-m	Passing Percentage	**98.47 %**
$V_{0.9D-WnUp}$	1.29 Kn-m	Capacity	13.75 Kn-m	Passing Percentage	**1065.89 %**

Deflections

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

Deflection under Snow and Service Wind = 13.19 mm   Limit by Woolcock et al, 1999 Span/100 = 40.80 mm
Sag during installation = 20.74 mm

Reactions

Maximum = 1.29 kn

Girt Design Sides

Girt's Spacing = 600 mm   Girt's Span = 5500 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 =0.60   S1 Downward =12.23   S1 Upward =21.37

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

Capacity Checks

$M_{Wind+Snow}$	2.38 Kn-m	Capacity	1.83 Kn-m	Passing Percentage	**76.89 %**
$V_{0.9D-WnUp}$	1.73 Kn-m	Capacity	13.75 Kn-m	Passing Percentage	**794.80 %**

Deflections

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

Deflection under Snow and Service Wind = 43.56 mm   Limit by Woolcock et al. 1999 Span/100 = 55.00 mm
Sag during installation =68.50 mm

Reactions

Maximum = 1.73 kn

Middle Pole Design

Geometry

225 SED H5 (Minimum 250 dia. at Floor Level)	Dry Use	Height	3950 mm
Area	44279 mm2	As	33209.1796875 mm2
Ix	156100441 mm4	Zx	1314530 mm3
Iy	156100441 mm4	Zx	1314530 mm3
Lateral Restraint	3400 mm c/c		

Loads

Total Area over Pole = 22.44 m2

Dead	5.61 Kn	Live	5.61 Kn
Wind Down	9.87 Kn	Snow	0.00 Kn
Moment wind	16.84 Kn-m		
Phi	0.8	K8	0.92
K1 snow	0.8	K1 Dead	0.6
K1wind	1		

Material

Peeling	Steaming	Normal	Dry Use
$f_b =$	36.3 MPa	$f_s =$	2.96 MPa
$f_c =$	18 MPa	$f_p =$	7.2 MPa
$f_t =$	22 MPa	$E =$	9257 MPa

Capacities

PhiNcx Wind	589.62 Kn	PhiMnx Wind	35.30 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	353.77 Kn	PhiMnx Dead	21.18 Kn-m	PhiVnx Dead	47.18 Kn

Checks

$(Mx/PhiMnx)+(N/phiNcx) = 0.51 < 1$ OK

$(Mx/PhiMnx)^2+(N/phiNcx) = 0.26 < 1$ OK

Deflection at top under service lateral loads = 28.46 mm < 39.50 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 = $	1700 mm	Pile embedment length
$f1 = $	3300 mm	Distance at which the shear force is applied
$f2 = $	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =   16.84 Kn-m

Shear Wind =   5.10 Kn

Pile Properties

Safety Factory	0.55	
$Hu = $	8.75 Kn	Ultimate Lateral Strength of the Pile, Short pile
$Mu = $	17.26 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.98 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

225 SED H5 (Minimum 250 dia. at Floor Level)	Dry Use		Height	3950 mm
Area	44279 mm2	As	33209.1796875 mm2	
Ix	156100441 mm4	Zx	1314530 mm3	
Iy	156100441 mm4	Zx	1314530 mm3	
Lateral Restraint	mm c/c			

Loads

Total Area over Pole = 22.44 m2

Dead	5.61 Kn	Live	5.61 Kn
Wind Down	9.87 Kn	Snow	0.00 Kn
Moment Wind	8.42 Kn-m		

Phi	0.8	K8	0.83
K1 snow	0.8	K1 Dead	0.6
K1 wind	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	530.60 Kn	PhiMnx Wind	31.77 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	318.36 Kn	PhiMnx Dead	19.06 Kn-m	PhiVnx Dead	47.18 Kn

Checks

$(Mx/PhiMnx)+(N/phiNcx) = 0.30 < 1$ OK

$(Mx/PhiMnx)^2+(N/phiNcx) = 0.11 < 1$ OK

Deflection at top under service lateral loads = 15.81 mm < 43.89 mm

Ds =	0.6 mm	Pile Diameter
L =	1700 mm	Pile embedment length
f1 =	3300 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 22.44 m2

Moment Wind =	8.42 Kn-m
Shear Wind =	2.55 Kn

Pile Properties

Safety Factory	0.55	
Hu =	8.75 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	17.26 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.49 < 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

$K_0 =$ $(1-\sin(30)) / (1+\sin(30))$

$K_p =$ $(1+\sin(30)) / (1-\sin(30))$

Geometry For End Bay Pole

$Ds =$ 0.6 mm   Pile Diameter

$L =$ 1700 mm   Pile embedment length

$f1 =$ 3300 mm   Distance at which the shear force is applied

$f2 =$ 0 mm   Distance of top soil at rest pressure

Loads

Moment Wind =   8.42 Kn-m

Shear Wind =   2.55 Kn

Pile Properties

Safety Factory   0.55

$Hu =$ 8.75 Kn   Ultimate Lateral Strength of the Pile, Short pile

$Mu =$ 17.26 Kn-m   Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.49 < 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(1700) x Ks(1.5) x

0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1700)

Skin Friction = 23.34 Kn

Weight of Pile + Pile Skin Friction = 27.24 Kn

Uplift on one Pile = 15.37 Kn

Uplift is ok

0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1700)

Skin Friction = 23.34 Kn

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