Job No.: Q2256 - 2   **Address:** 1130 Thongcaster Rd, Burnt Hill, New Zealand   **Date:** 04/03/2024

Latitude: -43.385953   **Longitude:** 172.12497   **Elevation:** 248.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N4	Ground Snow Load	1.25 KPa	Roof Snow Load	0.88 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	3.6 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	41.45 m/s
Wind Pressure	1.03 KPa	Lee Zone	YES	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   Open

For roof $C_{p,i}$ = 0.6731

For roof $C_{P,e}$ from 0 m To 1.65 m C_{pe} = -0.94 p_e = -0.60 KPa p_{net} = -1.12 KPa

For roof $C_{P,e}$ from 1.65 m To 3.30 m C_{pe} = -0.88 p_e = -0.56 KPa p_{net} = -1.08 KPa

For wall Windward $C_{p,i}$ = 0.6731   side Wall $C_{p,i}$ = -0.6

For wall Windward and Leeward $C_{P,e}$ from 0 m To 11.70 m C_{pe} = 0.7 p_e = 0.65 KPa p_{net} = 1.32 KPa

For side wall $C_{P,e}$ from 0 m To 3.30 m C_{pe} = p_e = -0.60 KPa p_{net} = 0.07 KPa

Maximum Upward pressure used in roof member Design = 1.12 KPa

Maximum Downward pressure used in roof member Design = 0.63 KPa

Maximum Wall pressure used in Design = 1.32 KPa

Maximum Racking pressure used in Design = 1.11 KPa

Design Summary

Purlin Design

Purlin Spacing = 800 mm   Purlin Span = 3450 mm   Try Purlin 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and 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 =0.73   S1 Downward =9.63   S1 Upward =18.72

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

Capacity Checks

$M_{1.35D}$	0.4 Kn-m	Capacity	1.26 Kn-m	Passing Percentage	**315.00 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	1.4 Kn-m	Capacity	1.68 Kn-m	Passing Percentage	**120.00 %**
$M_{0.9D-WnUp}$	-1.07 Kn-m	Capacity	-1.54 Kn-m	Passing Percentage	**143.93 %**

First Page

$V_{1.35D}$	0.47 Kn	Capacity	7.24 Kn	Passing Percentage	**1540.43 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	1.63 Kn	Capacity	9.65 Kn	Passing Percentage	**592.02 %**
$V_{0.9D-WnUp}$	-1.24 Kn	Capacity	-12.06 Kn	Passing Percentage	**972.58 %**

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 = 8.86 mm		Limit by Woolcock et al, 1999 Span/240 = 14.17 mm
Deflection under Dead and Service Wind = 12.04 mm		Limit by Woolcock et al, 1999 Span/100 = 34.00 mm

Reactions

Maximum downward =1.63 kn   Maximum upward = -1.24 kn

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

Rafter Design Internal

Internal Rafter Load Width = 3600 mm   Internal Rafter Span = 5850 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

$M_{1.35D}$	5.20 Kn-m	Capacity	10.08 Kn-m	Passing Percentage	**193.85 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	18.17 Kn-m	Capacity	13.44 Kn-m	Passing Percentage	**73.97 %**
$M_{0.9D-WnUp}$	-13.78 Kn-m	Capacity	-16.8 Kn-m	Passing Percentage	**121.92 %**
$V_{1.35D}$	3.55 Kn	Capacity	28.94 Kn	Passing Percentage	**815.21 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	12.43 Kn	Capacity	38.6 Kn	Passing Percentage	**310.54 %**
$V_{0.9D-WnUp}$	-9.42 Kn	Capacity	-48.24 Kn	Passing Percentage	**512.10 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 13.5 mm		Limit by Woolcock et al, 1999 Span/240 = 25.00 mm
Deflection under Dead and Service Wind = 20.375 mm		Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward =12.43 kn   Maximum upward = -9.42 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 fpj = 12.9 Mpa for Rafter with effective thickness = 100 mm

For Parallel to grain loading

K_{11} = 2.0 fcj = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 21.67 Kn > -9.42 Kn

Intermediate Design Sides

Intermediate Spacing = 3000 mm   Intermediate Span = 3150 mm   Try Intermediate 2x200x50 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 =1.00 S_1 Downward =11.27 S_1 Upward =0.67

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

Capacity Checks

$M_{Wind+Snow}$	2.46 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	**303.25 %**
$V_{0.9D-WnUp}$	3.12 Kn-m	Capacity	32.16 Kn-m	Passing Percentage	**1030.77 %**

Deflections

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

Deflection under Snow and Service Wind = 27.44 mm   Limit by Woolcock et al, 1999 Span/100 = 31.50 mm

Reactions

Maximum = 3.12 kn

Girt Design Front and Back

Girt's Spacing = 700 mm   Girt's Span = 3600 mm   Try Girt 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and 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 =0.95 S_1 Downward =9.63 S_1 Upward =13.62

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

Capacity Checks

$M_{Wind+Snow}$	1.50 Kn-m	Capacity	1.99 Kn-m	Passing Percentage	**132.67 %**
$V_{0.9D-WnUp}$	1.66 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	**726.51 %**

Deflections

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

Deflection under Snow and Service Wind = 35.75 mm   Limit by Woolcock et al, 1999 Span/100 = 36.00 mm

Sag during installation = 10.18 mm

Reactions

Maximum = 1.66 kn

Girt Design Sides

Girt's Spacing = 700 mm   Girt's Span = 3000 mm   Try Girt 150x50 SG8 Dry

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

K1 Short term = 1   K4 =1   K5 =1   K8 Downward =1.00

K8 Upward =0.79   S1 Downward =9.63   S1 Upward =17.59

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

Capacity Checks

$M_{Wind+Snow}$	1.04 Kn-m	Capacity	1.65 Kn-m	Passing Percentage	**158.65 %**
$V_{0.9D-WnUp}$	1.39 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	**867.63 %**

Deflections

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

Deflection under Snow and Service Wind = 17.24 mm   Limit by Woolcock et al. 1999 Span/100 = 30.00 mm

Sag during installation =4.91 mm

Reactions

Maximum = 1.39 kn

Middle Pole Design

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3300 mm
Area	35448 mm2	As	26585.7421875 mm2
Ix	100042702 mm4	Zx	941578 mm3
Iy	100042702 mm4	Zx	941578 mm3
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 10.8 m2

Dead	2.70 Kn	Live	2.70 Kn
Wind Down	6.80 Kn	Snow	9.50 Kn
Moment wind	9.69 Kn-m	Moment snow	4.04 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	510.45 Kn	PhiMnx Wind	27.34 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	306.27 Kn	PhiMnx Dead	16.41 Kn-m	PhiVnx Dead	37.77 Kn
PhiNcx Snow	408.36 Kn	PhiMnx Snow	21.87 Kn-m	PhiVnx Snow	50.36 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.39 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.16 < 1 OK

Deflection at top under service lateral loads = 17.46 mm < 33.00 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 =	900 mm	Pile embedment length
f1 =	2700 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	9.69 Kn-m	Moment Snow =	Kn-m
Shear Wind =	3.59 Kn	Shear Snow =	4.04 Kn

Pile Properties

Safety Factory	0.55	
Hu =	1.80 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	2.81 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 3.45 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

175 SED H5 (Minimum 200 dia. at Floor Level)		Dry Use	Height	3450 mm
Area		27598 mm2	As	20698.2421875 mm2
Ix		60639381 mm4	Zx	646820 mm3
Iy		60639381 mm4	Zx	646820 mm3
Lateral Restraint		mm c/c		

Loads

Total Area over Pole = 10.8 m2

Dead	2.70 Kn	Live	2.70 Kn
Wind Down	6.80 Kn	Snow	9.50 Kn
Moment Wind	4.84 Kn-m	Moment snow	2.02 Kn-m
Phi	0.8	K8	0.75
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	297.59 Kn	PhiMnx Wind	14.07 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	178.56 Kn	PhiMnx Dead	8.44 Kn-m	PhiVnx Dead	29.41 Kn
PhiNcx Snow	238.07 Kn	PhiMnx Snow	11.25 Kn-m	PhiVnx Snow	39.21 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.40 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.18 < 1 OK

Deflection at top under service lateral loads = 15.67 mm < 35.91 mm

Ds =	0.6 mm	Pile Diameter
L =	900 mm	Pile embedment length
f1 =	2700 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 =	4.84 Kn-m	Moment Snow =	2.02 Kn-m
Shear Wind =	1.79 Kn	Shear Snow =	2.02 Kn

Pile Properties

Safety Factory	0.55	
Hu =	1.80 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	2.81 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 1.73 < 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

$L =$ 900 mm   Pile embedment length

$f1 =$ 2700 mm   Distance at which the shear force is applied

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

Loads

Moment Wind =   4.84 Kn-m   Moment Snow =   2.02 Kn-m

Shear Wind =   1.79 Kn   Shear Snow =   2.02 Kn

Pile Properties

Safety Factory   0.55

$Hu =$ 1.80 Kn   Ultimate Lateral Strength of the Pile, Short pile

$Mu =$ 2.81 Kn-m   Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 1.73 < 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(900) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(900)

Skin Friction = 6.54 Kn

Weight of Pile + Pile Skin Friction = 8.88 Kn

Uplift on one Pile = 9.67 Kn

Uplift is ok

Last Page