<u>Pole Shed App Ver 01 2022</u>

Job No.:	EHB 268 - 1	**Address:**	28 Hereford Street, Wright Bush, New Zealand	**Date:**	16/10/2024
Latitude:	-46.299316	**Longitude:**	168.198098	**Elevation:**	19.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N5	Ground Snow Load	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.9 m
Wind Region	NZ4	Terrain Category	2.0	Design Wind Speed	44.78 m/s
Wind Pressure	1.2 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	Very 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 = Gable   Enclosed

For roof Cp,i = -0.3

For roof   CP,e   from 0 m   To 5.3 m   Cpe = -0.9   pe = -0.88 KPa   pnet = -0.88 KPa

For roof   CP,e   from 5.3 m   To 10.6 m   Cpe = -0.5   pe = -0.49 KPa   pnet = -0.49 KPa

For wall Windward Cp,i = -0.3   side Wall Cp,i = -0.3

For wall Windward and Leeward   CP,e   from 0 m   To 8 m   Cpe = 0.7   pe = 0.76 KPa   pnet = 1.12 KPa

For side wall   CP,e   from 0 m   To 5.3 m   Cpe =   pe = -0.70 KPa   pnet = -0.70 KPa

Maximum Upward pressure used in roof member Design = 0.88 KPa

Maximum Downward pressure used in roof member Design = 0.43 KPa

Maximum Wall pressure used in Design = 1.12 KPa

Maximum Racking pressure used in Design = 1.12 KPa

Design Summary

Rafter Design External

External Rafter Load Width = 2350 mm   External Rafter Span = 2584 mm   Try Rafter 300x50 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 =0.94

K8 Upward =0.94   S1 Downward =13.93   S1 Upward =13.93

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

Capacity Checks

$M_{1.35D}$	0.66 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	**715.15 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	1.82 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	**346.15 %**
$M_{0.9D-WnUp}$	-1.28 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	**614.84 %**
$V_{1.35D}$	1.02 Kn	Capacity	14.47 Kn	Passing Percentage	**1418.63 %**

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$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.82 Kn	Capacity	19.30 Kn	Passing Percentage	**684.40 %**
$V_{0.9D\text{-}WnUp}$	-1.99 Kn	Capacity	-24.12 Kn	Passing Percentage	**1212.06 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 0.76 mm	Limit by Woolcock et al, 1999 Span/240= 11.11 mm
Deflection under Dead and Service Wind = 0.91 mm	Limit by Woolcock et al, 1999 Span/100 = 26.67 mm

Reactions

Maximum downward =2.82 kn   Maximum upward = -1.99 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 2

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

K11 = 14.9 fpj = 12.9 Mpa for Rafter with effective thickness = 50 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) = -25.20 kn > -1.99 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -1.99 Kn

Intermediate Design Sides

Intermediate Spacing = 1333.3333333333333 mm	Intermediate Span = 5450 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 =0.99

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

Capacity Checks

$M_{Wind+Snow}$	2.77 Kn-m	Capacity	11.66 Kn-m	Passing Percentage	**420.94 %**
$V_{0.9D\text{-}WnUp}$	2.03 Kn	Capacity	40.2 Kn	Passing Percentage	**1980.30 %**

Deflections

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

Deflection under Snow and Service Wind = 44.005 mm Limit by Woolcock et al, 1999 Span/100 = 54.50 mm

Reactions

Maximum = 2.03 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	Capacity	0.00 Kn	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 = 900 mm Girt's Span = 1333 mm Try Girt 250x50 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 =0.88 S1 Downward =12.68 S1 Upward =15.43

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

Capacity Checks

$M_{Wind+Snow}$	0.22 Kn-m	Capacity	5.15 Kn-m	Passing Percentage	**2340.91 %**
$V_{0.9D-WnUp}$	0.67 Kn	Capacity	20.10 Kn	Passing Percentage	**3000.00 %**

Deflections

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

Deflection under Snow and Service Wind = 0.15 mm Limit by Woolcock et al. 1999 Span/100 = 13.33 mm
Sag during installation =0.19 mm

Reactions

Maximum = 0.67 kn

End Pole Design

Geometry For End Bay Pole

Geometry

225 SED H5 (Minimum 250 dia. at Floor Level)	Dry Use	Height	5600 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 = 6.266666666666666 m2

Dead	1.57 Kn	Live	1.57 Kn
Wind Down	2.69 Kn	Snow	3.95 Kn
Moment Wind	8.57 Kn-m	Moment snow	1.56 Kn-m
Phi	0.8	K8	0.51
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	324.65 Kn	PhiMnx Wind	19.44 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	194.79 Kn	PhiMnx Dead	11.66 Kn-m	PhiVnx Dead	47.18 Kn
PhiNcx Snow	259.72 Kn	PhiMnx Snow	15.55 Kn-m	PhiVnx Snow	62.91 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.47 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.22 < 1 OK

Deflection at top under service lateral loads = 28.93 mm < 58.85 mm

Ds =	0.6 mm	Pile Diameter
L =	1500 mm	Pile embedment length
f1 =	4425 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 6.266666666666666 m2

Moment Wind =	8.57 Kn-m	Moment Snow =	1.56 Kn-m

Shear Wind =	1.94 Kn	Shear Snow =	1.56 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.08 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	12.96 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.66 < 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 =	1500 mm	Pile embedment length
f1 =	4425 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	8.57 Kn-m	Moment Snow =	1.56 Kn-m
Shear Wind =	1.94 Kn	Shear Snow =	1.56 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.08 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	12.96 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.66 < 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(1800) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1800)

Skin Friction = 26.17 Kn

Weight of Pile + Pile Skin Friction = 29.78 Kn

Uplift on one Pile = 12.31 Kn

Uplift is ok