Pole Shed App Ver 01 2022

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Job No.: James Hood   **Address:** 9 Barron Cresent, Fenton Park, New Zealand   **Date:** 15/04/2025

Latitude: -38.15672   **Longitude:** 176.257854   **Elevation:** 292 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	2	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.8 m
Wind Region	NZ2	Terrain Category	3.0	Design Wind Speed	34.86 m/s
Wind Pressure	0.73 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	Medium	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 2.25 m   Cpe = -0.95   pe = -0.62 KPa   pnet = -0.62 KPa

For roof $C_{P,e}$ from 2.25 m   To 4.50 m   Cpe = -0.875   pe = -0.57 KPa   pnet = -0.57 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 8 m   Cpe = 0.7   pe = 0.46 KPa   pnet = 0.68 KPa

For side wall $C_{P,e}$ from 0 m   To 4.50 m   Cpe =   pe = -0.43 KPa   pnet = -0.43 KPa

Maximum Upward pressure used in roof member Design = 0.62 KPa

Maximum Downward pressure used in roof member Design = 0.23 KPa

Maximum Wall pressure used in Design = 0.68 KPa

Maximum Racking pressure used in Design = 0.79 KPa

Design Summary

Rafter Design External

External Rafter Load Width = 1750 mm   External Rafter Span = 7822 mm   Try Rafter 300x45 LVL13

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

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K1 Short term = 1   K1 Medium term = 0.8   K1 Long term = 0.6   K4 =1   K5 =1   K8 Downward =0.88

K8 Upward =0.88   S1 Downward =15.50   S1 Upward =15.50

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

Capacity Checks

$M_{1.35D}$	4.52 Kn-m	Capacity	13.69 Kn-m	Passing Percentage	**302.88 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	9.03 Kn-m	Capacity	18.26 Kn-m	Passing Percentage	**202.21 %**
$M_{0.9D-WnUp}$	-5.29 Kn-m	Capacity	-22.82 Kn-m	Passing Percentage	**431.38 %**
$V_{1.35D}$	2.31 Kn	Capacity	23.01 Kn	Passing Percentage	**996.10 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	4.62 Kn	Capacity	30.68 Kn	Passing Percentage	**664.07 %**
$V_{0.9D-WnUp}$	-2.70 Kn	Capacity	-38.35 Kn	Passing Percentage	**1420.37 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 25.14 mm   Limit by Woolcock et al, 1999 Span/240= 33.33 mm
Deflection under Dead and Service Wind = 25.77 mm   Limit by Woolcock et al, 1999 Span/100 = 80.00 mm

Reactions

Maximum downward =4.62 kn   Maximum upward = -2.70 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 =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) = -40.07 kn > -2.70 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -2.70 Kn

Intermediate Design Sides

Intermediate Spacing = 4000 mm   Intermediate Span = 4350 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)

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

K8 Upward =1.00   S1 Downward =11.27   S1 Upward =0.78

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

Capacity Checks

$M_{Wind+Snow}$	3.22 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	**231.68 %**
$V_{0.9D-WnUp}$	2.96 Kn	Capacity	32.16 Kn	Passing Percentage	**1086.49 %**

Deflections

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

Deflection under Snow and Service Wind = 35.225 mm   Limit by Woolcock et al, 1999 Span/100 = 43.50 mm

Reactions

Maximum = 2.96 kn

Girt Design Front and Back

Girt's Spacing = 900 mm   Girt's Span = 3500 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 =0.72   S1 Downward =9.63   S1 Upward =19.00

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

Capacity Checks

$M_{Wind+Snow}$	0.94 Kn-m	Capacity	1.51 Kn-m	Passing Percentage	**160.64 %**
$V_{0.9D-WnUp}$	1.07 Kn	Capacity	12.06 Kn	Passing Percentage	**1127.10 %**

Deflections

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

Deflection under Snow and Service Wind = 12.69 mm   Limit by Woolcock et al, 1999 Span/100 = 35.00 mm
Sag during installation = 9.10 mm

Reactions

Maximum = 1.07 kn

Girt Design Sides

Girt's Spacing = 900 mm   Girt's Span = 4000 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 =0.92   S1 Downward =9.63   S1 Upward =14.36

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

Capacity Checks

$M_{Wind+Snow}$	1.22 Kn-m	Capacity	1.94 Kn-m	Passing Percentage	**159.02 %**
$V_{0.9D-WnUp}$	1.22 Kn	Capacity	12.06 Kn	Passing Percentage	**988.52 %**

Deflections

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

Deflection under Snow and Service Wind = 21.65 mm   Limit by Woolcock et al. 1999 Span/100 = 40.00 mm
Sag during installation =15.52 mm

Reactions

Maximum = 1.22 kn

End Pole Design

Geometry For End Bay Pole

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)   Dry Use   Height   4500 mm

Area	35448 mm2	As	26585.7421875 mm2
Ix	100042702 mm4	Zx	941578 mm3
Iy	100042702 mm4	Zx	941578 mm3
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 14 m2

Dead	3.50 Kn	Live	3.50 Kn
Wind Down	3.22 Kn	Snow	0.00 Kn
Moment Wind	5.96 Kn-m		
Phi	0.8	K8	0.61
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	313.16 Kn	PhiMnx Wind	16.78 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	187.89 Kn	PhiMnx Dead	10.07 Kn-m	PhiVnx Dead	37.77 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 = 20.77 mm < 47.88 mm

Ds =	0.6 mm	Pile Diameter
L =	1500 mm	Pile embedment length
f1 =	3600 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 14 m2

Moment Wind =   5.96 Kn-m
Shear Wind =   1.65 Kn

Pile Properties

Safety Factory   0.55
Hu =   5.90 Kn   Ultimate Lateral Strength of the Pile, Short pile
Mu =   12.43 Kn-m   Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.48 < 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 =   3600 mm   Distance at which the shear force is applied
f2 =   0 mm   Distance of top soil at rest pressure

Loads

Moment Wind =   5.96 Kn-m
Shear Wind =   1.65 Kn

Pile Properties

Safety Factory   0.55
Hu =   5.90 Kn   Ultimate Lateral Strength of the Pile, Short pile
Mu =   12.43 Kn-m   Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.48 < 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(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 = 5.53 Kn

Uplift is ok

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