

Pole Shed App Ver 01 2022

Job No.: Rob Rosa Station **Address:** 1653 Cardrona Valley Road, Cardrona, New Zealand **Date:** 10/31/2023
Latitude: -44.83666 **Longitude:** 169.057148 **Elevation:** 455 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	1.21 KPa	Roof Snow Load	0.85 KPa
Earthquake Zone	3	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4 m
Wind Region	NZ2	Terrain Category	2.27	Design Wind Speed	37.31 m/s
Wind Pressure	0.84 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 Pressures

Shed Type = Mono Open

For roof $C_{p,i} = 0.6745$

For roof $C_{p,e}$ from 0 m To 1.88 m $C_{p,e} = -1.0$ $p_e = -0.64$ KPa $p_{net} = -1.16$ KPa

For roof $C_{p,e}$ from 1.88 m To 3.75 m $C_{p,e} = -0.85$ $p_e = -0.54$ KPa $p_{net} = -1.06$ KPa

For wall Windward $C_{p,i} = 0.6745$ side Wall $C_{p,i} = -0.5$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 6.00 m $C_{p,e} = 0.7$ $p_e = 0.53$ KPa $p_{net} = 0.98$ KPa

For side wall $C_{p,e}$ from 0 m To 3.75 m $C_{p,e} =$ $p_e = -0.49$ KPa $p_{net} = -0.04$ KPa

Maximum Upward pressure used in roof member Design = 1.16 KPa

Maximum Downward pressure used in roof member Design = 0.57 KPa

Maximum Wall pressure used in Design = 0.98 KPa

Maximum Racking pressure used in Design = 0.91 KPa

Design Summary

Purlin Design

Purlin Spacing = 700 mm Purlin Span = 5850 mm Try Purlin 250x50 SG8 Dry

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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 = 0.97

K8 Upward = 0.54 S1 Downward = 12.68 S1 Upward = 22.76

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

Capacity Checks

M _{1.35D}	1.01 Kn-m	Capacity	3.40 Kn-m	Passing Percentage	336.63 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	3.44 Kn-m	Capacity	4.53 Kn-m	Passing Percentage	131.69 %
M _{0.9D-W_nUp}	-2.8 Kn-m	Capacity	-3.16 Kn-m	Passing Percentage	112.86 %
V _{1.35D}	0.69 Kn	Capacity	12.06 Kn	Passing Percentage	1747.83 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.35 Kn	Capacity	16.08 Kn	Passing Percentage	684.26 %
V _{0.9D-W_nUp}	-1.91 Kn	Capacity	-20.10 Kn	Passing Percentage	1052.36 %

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 = 14.19 mm Limit by Woolcock et al, 1999 Span/240 = 24.17 mm

Deflection under Dead and Service Wind = 18.56 mm Limit by Woolcock et al, 1999 Span/100 = 58.00 mm

Reactions

Maximum downward = 2.35 kn Maximum upward = -1.91 kn

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

Girt Design Front and Back

Girt's Spacing = 800 mm

Girt's Span = 6000 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 = 0.72 S1 Downward = 12.68 S1 Upward = 18.90

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

Capacity Checks

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$M_{Wind+Snow}$	3.53 Kn-m	Capacity	4.22 Kn-m	Passing Percentage	119.55 %
$V_{0.9D-WnUp}$	2.35 Kn-m	Capacity	20.10 Kn-m	Passing Percentage	855.32 %

Deflections

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

Deflection under Snow and Service Wind = 56.64 mm Limit by Woolcock et al, 1999 Span/100 = 60.00 mm
Sag during installation = 78.58 mm

Reactions

Maximum = 2.35 kn

Girt Design Sides

Girt's Spacing = 0 mm Girt's Span = 6000 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 =0.00 S1 Downward =12.68 S1 Upward =Infinity

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	0.00 Kn-m	Passing Percentage	NaN %
$V_{0.9D-WnUp}$	0.00 Kn-m	Capacity	20.10 Kn-m	Passing Percentage	Infinity %

Deflections

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

Deflection under Snow and Service Wind = 0.00 mm Limit by Woolcock et al. 1999 Span/100 = 60.00 mm
Sag during installation =78.58 mm

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

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200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3700 mm
Area	35448 mm ²	As	26585.7421875 mm ²
Ix	100042702 mm ⁴	Zx	941578 mm ³
Iy	100042702 mm ⁴	Zx	941578 mm ³
Lateral Restraint	3400 mm c/c		

Loads

Total Area over Pole = 18 m²

Dead	4.50 Kn	Live	4.50 Kn
Wind Down	10.26 Kn	Snow	15.30 Kn
Moment wind	16.34 Kn-m	Moment snow	7.24 Kn-m
Phi	0.8	K8	0.86
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	438.78 Kn	PhiMnx Wind	23.50 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	263.27 Kn	PhiMnx Dead	14.10 Kn-m	PhiVnx Dead	37.77 Kn
PhiNcx Snow	351.02 Kn	PhiMnx Snow	18.80 Kn-m	PhiVnx Snow	50.36 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.76 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.55 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 36.69 \text{ mm} < 37.00 \text{ mm}$$

Drained Lateral Strength of Middle pile in cohesionless soils Free Head short pile

Assumed Soil Properties

Gamma	18 Kn/m ³	Friction angle	30 deg	Cohesion	0 Kn/m ³
K0 =	$(1 - \sin(30)) / (1 + \sin(30))$				

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

Geometry For Middle Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1700 mm	Pile embedment length
f1 =	3000 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	16.34 Kn-m	Moment Snow =	Kn-m
Shear Wind =	5.45 Kn	Shear Snow =	7.24 Kn

Pile Properties

Safety Factory	0.55	
Hu =	9.31 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	16.87 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.97 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3850 mm
Area	35448 mm ²	As	26585.7421875 mm ²
Ix	100042702 mm ⁴	Zx	941578 mm ³
Iy	100042702 mm ⁴	Zx	941578 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 18 m²

Dead	4.50 Kn	Live	4.50 Kn
Wind Down	10.26 Kn	Snow	15.30 Kn
Moment Wind	8.17 Kn-m	Moment snow	3.62 Kn-m
Phi	0.8	K8	0.76

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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	389.24 Kn	PhiMnx Wind	20.85 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	233.54 Kn	PhiMnx Dead	12.51 Kn-m	PhiVnx Dead	37.77 Kn
PhiNcx Snow	311.39 Kn	PhiMnx Snow	16.68 Kn-m	PhiVnx Snow	50.36 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\phi N_{cx}) = 0.46 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\phi N_{cx}) = 0.23 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 19.78 \text{ mm} < 39.90 \text{ mm}$$

Ds =	0.6 mm	Pile Diameter
L =	1400 mm	Pile embedment length
f1 =	3000 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

$$\text{Total Area over Pole} = 18 \text{ m}^2$$

Moment Wind =	8.17 Kn-m	Moment Snow =	3.62 Kn-m
Shear Wind =	2.72 Kn	Shear Snow =	3.62 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.56 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	9.86 Kn-m	Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.83 < 1 \text{ OK}$$

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

Geometry For End Bay Pole

D_s = 0.6 mm Pile Diameter
L = 1400 mm Pile embedment length
f₁ = 3000 mm Distance at which the shear force is applied
f₂ = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 8.17 Kn-m Moment Snow = 3.62 Kn-m
Shear Wind = 2.72 Kn Shear Snow = 3.62 Kn

Pile Properties

Safety Factory 0.55
H_u = 5.56 Kn Ultimate Lateral Strength of the Pile, Short pile
M_u = 9.86 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.83 < 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

K_s (Lateral Earth Pressure Coefficient) for cast into place concrete piles = 1.5

Formula to calculate Skin Friction = Safety factor (0.55) x Density of Soil(18) x Height of Pile(1700) x K_s(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 = 27.76 Kn

Uplift on one Pile = 16.83 Kn

Uplift is ok