

Pole Shed App Ver 01 2022

Job No.: Horse Arena
Latitude: -40.218059

Address: 131 Sandon Rd, Feilding, New Zealand
Longitude: 175.542694

Date: 19/08/2024
Elevation: 99.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N1	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	3	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.3 m
Wind Region	NZ2	Terrain Category	2.2	Design Wind Speed	40.43 m/s
Wind Pressure	0.98 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 = Gable Free

For roof $C_{p,i} = -0.3$

For roof $C_{p,e}$ from 0 m To 5.78 m $C_{p,e} = -0.9$ $p_e = -0.81$ KPa $p_{net} = -0.81$ KPa

For roof $C_{p,e}$ from 5.78 m To 11.56 m $C_{p,e} = -0.5$ $p_e = -0.45$ KPa $p_{net} = -0.45$ 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 22 m $C_{p,e} = 0.7$ $p_e = 0.63$ KPa $p_{net} = 0.93$ KPa

For side wall $C_{p,e}$ from 0 m To 5.78 m $C_{p,e} =$ $p_e = -0.58$ KPa $p_{net} = -0.58$ KPa

Maximum Upward pressure used in roof member Design = 0.81 KPa

Maximum Downward pressure used in roof member Design = 0.48 KPa

Maximum Wall pressure used in Design = 0.93 KPa

Maximum Racking pressure used in Design = 0.53 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 5850 mm

Try Purlin 250x50 SG8 Dry

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 = 0.97

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}	1.3 Kn-m	Capacity	3.40 Kn-m	Passing Percentage	261.54 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	3 Kn-m	Capacity	4.53 Kn-m	Passing Percentage	151.00 %
M _{0.9D-W_nUp}	-2.25 Kn-m	Capacity	-3.16 Kn-m	Passing Percentage	140.44 %
V _{1.35D}	0.89 Kn	Capacity	12.06 Kn	Passing Percentage	1355.06 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.05 Kn	Capacity	16.08 Kn	Passing Percentage	784.39 %
V _{0.9D-W_nUp}	-1.54 Kn	Capacity	-20.10 Kn	Passing Percentage	1305.19 %

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 = 18.24 mm Limit by Woolcock et al, 1999 Span/240 = 24.17 mm

Deflection under Dead and Service Wind = 22.50 mm Limit by Woolcock et al, 1999 Span/100 = 58.00 mm

Reactions

Maximum downward = 2.05 kn Maximum upward = -1.54 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 = 0 mm

Girt's Span = 3000 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-W_nUp}	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 = 30.00 mm

Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Girt Design Sides

Girt's Spacing = 0 mm

Girt's Span = 11000 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 = 110.00 mm

Sag during installation =NaN mm

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

350 SED H5 (Minimum 375 dia. at Floor Level)	Dry Use	Height	5100 mm
Area	103154 mm ²	As	77365.4296875 mm ²

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Ix	847191750 mm ⁴	Zx	4674161 mm ³
Iy	847191750 mm ⁴	Zx	4674161 mm ³
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 66 m²

Dead	16.50 Kn	Live	16.50 Kn
Wind Down	31.68 Kn	Snow	0.00 Kn
Moment wind	16.71 Kn-m		
Phi	0.8	K8	1.00
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	1485.42 Kn	PhiMnx Wind	135.74 Kn-m	PhiVnx Wind	183.20 Kn
PhiNcx Dead	891.25 Kn	PhiMnx Dead	81.44 Kn-m	PhiVnx Dead	109.92 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.17 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.06 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 8.09 \text{ mm} < 51.00 \text{ mm}$$

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

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Geometry For Middle Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	2150 mm	Pile embedment length
f1 =	3975 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	16.71 Kn-m
Shear Wind =	4.20 Kn

Pile Properties

Safety Factory	0.55	
Hu =	14.46 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	34.51 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.48 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

350 SED H5 (Minimum 375 dia. at Floor Level)	Dry Use	Height	5150 mm
Area	103154 mm ²	As	77365.4296875 mm ²
Ix	847191750 mm ⁴	Zx	4674161 mm ³
Iy	847191750 mm ⁴	Zx	4674161 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 66 m²

Dead	16.50 Kn	Live	16.50 Kn
Wind Down	31.68 Kn	Snow	0.00 Kn
Moment Wind	8.35 Kn-m		
Phi	0.8	K8	0.93
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

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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	1379.25 Kn	PhiMnx Wind	126.04 Kn-m	PhiVnx Wind	183.20 Kn
PhiNcx Dead	827.55 Kn	PhiMnx Dead	75.62 Kn-m	PhiVnx Dead	109.92 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.11 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.05 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 4.19 \text{ mm} < 52.87 \text{ mm}$$

$D_s =$	0.6 mm	Pile Diameter
$L =$	1350 mm	Pile embedment length
$f_1 =$	3975 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

$$\text{Total Area over Pole} = 66 \text{ m}^2$$

Moment Wind =	8.35 Kn-m
Shear Wind =	2.10 Kn

Pile Properties

Safety Factor	0.55	
$H_u =$	4.12 Kn	Ultimate Lateral Strength of the Pile, Short pile
$M_u =$	9.44 Kn-m	Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.88 < 1 \text{ OK}$$

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

Assumed Soil Properties

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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 = 1350 mm Pile embedment length
f1 = 3975 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 8.35 Kn-m
Shear Wind = 2.10 Kn

Pile Properties

Safety Factory 0.55
Hu = 4.12 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 9.44 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.88 < 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 = Safety factor (0.55) x Density of Soil(18) x Height of Pile(2150) x Ks(1.5) x $0.5 \times \tan(30)$ x Pi x Dia of Pile(0.6) x Height of Pile(2150)

Skin Friction = 37.33 Kn

Weight of Pile + Pile Skin Friction = 39.71 Kn

Uplift on one Pile = 38.61 Kn

Uplift is ok

