

Pole Shed App Ver 01 2022

Job No.: GSH480
Latitude: -46.36407

Address: 13 Church Street, Riverton, New Zealand
Longitude: 168.017497

Date: 02/12/2024
Elevation: 4 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	1	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.8 m
Wind Region	NZ4	Terrain Category	2.5	Design Wind Speed	40.89 m/s
Wind Pressure	1 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 $C_{p,i} = -0.3$

For roof $C_{p,e}$ from 0 m To 4.40 m $C_{p,e} = -0.9$ $p_e = -0.81$ KPa $p_{net} = -0.81$ KPa

For roof $C_{p,e}$ from 4.40 m To 8.80 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 15 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 4.40 m $C_{p,e} =$ $p_e = -0.59$ KPa $p_{net} = -0.59$ 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 = 1.07 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm Purlin Span = 4650 mm Try Purlin 200x50 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 = 1.00

K8 Upward = 0.77 S1 Downward = 11.27 S1 Upward = 18.02

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

Capacity Checks

M _{1.35D}	0.82 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	271.95 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.26 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	131.42 %
M _{0.9D-WnUp}	-1.42 Kn-m	Capacity	-2.86 Kn-m	Passing Percentage	201.41 %
V _{1.35D}	0.71 Kn	Capacity	9.65 Kn	Passing Percentage	1359.15 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.95 Kn	Capacity	12.86 Kn	Passing Percentage	659.49 %
V _{0.9D-WnUp}	-1.22 Kn	Capacity	-16.08 Kn	Passing Percentage	1318.03 %

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 = 14.10 mm Limit by Woolcock et al, 1999 Span/240 = 19.17 mm

Deflection under Dead and Service Wind = 17.39 mm Limit by Woolcock et al, 1999 Span/100 = 46.00 mm

Reactions

Maximum downward = 1.95 kn Maximum upward = -1.22 kn

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

Rafter Design Internal

Internal Rafter Load Width = 4800 mm Internal Rafter Span = 4850 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}	4.76 Kn-m	Capacity	10.08 Kn-m	Passing Percentage	211.76 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	13.13 Kn-m	Capacity	13.44 Kn-m	Passing Percentage	102.36 %

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M _{0.9D-WnUp}	-8.26 Kn-m	Capacity	-16.8 Kn-m	Passing Percentage	203.39 %
V _{1.35D}	3.93 Kn	Capacity	28.94 Kn	Passing Percentage	736.39 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	10.83 Kn	Capacity	38.6 Kn	Passing Percentage	356.42 %
V _{0.9D-WnUp}	-6.81 Kn	Capacity	-48.24 Kn	Passing Percentage	708.37 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 8.68 mm Limit by Woolcock et al, 1999 Span/240 = 20.83 mm

Deflection under Dead and Service Wind = 11.895 mm Limit by Woolcock et al, 1999 Span/100 = 50.00 mm

Reactions

Maximum downward = 10.83 kn Maximum upward = -6.81 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

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 60 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 100 mm

For Parallel to grain loading

K₁₁ = 2.0 f_{cj} = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 21.67 Kn > -6.81 Kn

Girt Design Front and Back

Girt's Spacing = 800 mm

Girt's Span = 4800 mm

Try Girt 200x50 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

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K8 Upward =0.75 S1 Downward =11.27 S1 Upward =18.41

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

Capacity Checks

M _{Wind+Snow}	2.14 Kn-m	Capacity	2.79 Kn-m	Passing Percentage	130.37 %
V _{0.9D-WnUp}	1.79 Kn	Capacity	16.08 Kn	Passing Percentage	898.32 %

Deflections

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

Deflection under Snow and Service Wind = 38.62 mm Limit by Woolcock et al, 1999 Span/100 = 48.00 mm
Sag during installation = 32.19 mm

Reactions

Maximum = 1.79 kn

Girt Design Sides

Girt's Spacing = 800 mm Girt's Span = 5000 mm Try Girt 200x50 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 =0.73 S1 Downward =11.27 S1 Upward =18.79

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

Capacity Checks

M _{Wind+Snow}	2.33 Kn-m	Capacity	2.72 Kn-m	Passing Percentage	116.74 %
V _{0.9D-WnUp}	1.86 Kn	Capacity	16.08 Kn	Passing Percentage	864.52 %

Deflections

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

Deflection under Snow and Service Wind = 45.48 mm Limit by Woolcock et al. 1999 Span/100 = 50.00 mm
Sag during installation =37.90 mm

Reactions

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Maximum = 1.86 kn

Middle Pole Design

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	4500 mm
Area	35448 mm ²	As	26585.7421875 mm ²
I _x	100042702 mm ⁴	Z _x	941578 mm ³
I _y	100042702 mm ⁴	Z _y	941578 mm ³
Lateral Restraint	4500 mm c/c		

Loads

Total Area over Pole = 24 m²

Dead	6.00 Kn	Live	6.00 Kn
Wind Down	11.52 Kn	Snow	15.12 Kn
Moment wind	11.07 Kn-m	Moment snow	2.59 Kn-m
Phi	0.8	K ₈	0.61
K ₁ snow	0.8	K ₁ Dead	0.6
K ₁ wind	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

PhiN _{cx} Wind	313.02 Kn	PhiM _{nx} Wind	16.77 Kn-m	PhiV _{nx} Wind	62.96 Kn
PhiN _{cx} Dead	187.81 Kn	PhiM _{nx} Dead	10.06 Kn-m	PhiV _{nx} Dead	37.77 Kn
PhiN _{cx} Snow	250.42 Kn	PhiM _{nx} Snow	13.41 Kn-m	PhiV _{nx} Snow	50.36 Kn

Checks

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

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.53 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 36.27 \text{ mm} < 45.00 \text{ mm}$$

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

Geometry For Middle Bay Pole

D_s = 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 = 11.07 Kn-m Moment Snow = Kn-m
Shear Wind = 3.07 Kn Shear Snow = 2.59 Kn

Pile Properties

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

Checks

Applied Forces/Capacities = 0.89 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	4500 mm
Area	27598 mm ²	As	20698.2421875 mm ²
I _x	60639381 mm ⁴	Z _x	646820 mm ³
I _y	60639381 mm ⁴	Z _y	646820 mm ³
Lateral Restraint	mm c/c		

Loads

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Total Area over Pole = 12 m²

Dead	3.00 Kn	Live	3.00 Kn
Wind Down	5.76 Kn	Snow	7.56 Kn
Moment Wind	5.53 Kn-m	Moment snow	1.29 Kn-m
Phi	0.8	K8	0.49
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	196.09 Kn	PhiMnx Wind	9.27 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	117.66 Kn	PhiMnx Dead	5.56 Kn-m	PhiVnx Dead	29.41 Kn
PhiNcx Snow	156.87 Kn	PhiMnx Snow	7.41 Kn-m	PhiVnx Snow	39.21 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.68 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.44 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 31.83 mm < 47.88 mm

Ds =	0.6 mm	Pile Diameter
L =	1300 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 = 12 m²

Moment Wind =	5.53 Kn-m	Moment Snow =	1.29 Kn-m
Shear Wind =	1.54 Kn	Shear Snow =	1.29 Kn

Pile Properties

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Safety Factory	0.55	
Hu =	3.99 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.33 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 =	1300 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 =	5.53 Kn-m	Moment Snow =	1.29 Kn-m
Shear Wind =	1.54 Kn	Shear Snow =	1.29 Kn

Pile Properties

Safety Factory	0.55	
Hu =	3.99 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.33 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

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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(1500) x Ks(1.5) x $0.5 \times \tan(30)$ x π 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 = 14.04 Kn

Uplift is ok