

Pole Shed App Ver 01 2022

Job No.: Helen Costley

Address: 8969 Wairau Valley Highway, St Arnaud,
New Zealand

Date: 19/06/2025

Latitude: -41.800439

Longitude: 172.880806

Elevation: 790.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N3	Ground Snow Load	1.92 KPa	Roof Snow Load	1.11 KPa
Earthquake Zone	3	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.2 m
Wind Region	NZ2	Terrain Category	2.5	Design Wind Speed	45.45 m/s
Wind Pressure	1.24 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 Pressures

Shed Type = Gable Enclosed

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

For roof $C_{p,e}$ from 0 m To 4.20 m $C_{p,e} = -0.9$ $p_e = -1.00$ KPa $p_{net} = -1.00$ KPa

For roof $C_{p,e}$ from 4.20 m To 8.40 m $C_{p,e} = -0.5$ $p_e = -0.56$ KPa $p_{net} = -0.56$ 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 12 m $C_{p,e} = 0.7$ $p_e = 0.78$ KPa $p_{net} = 1.15$ KPa

For side wall $C_{p,e}$ from 0 m To 4.20 m $C_{p,e} =$ $p_e = -0.73$ KPa $p_{net} = -0.73$ KPa

Maximum Upward pressure used in roof member Design = 1.00 KPa

Maximum Downward pressure used in roof member Design = 0.48 KPa

Maximum Wall pressure used in Design = 1.15 KPa

Maximum Racking pressure used in Design = 1.32 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 3850 mm

Try Purlin 240x45 SG8

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 = 0.94

K8 Upward = 0.36 S1 Downward = 13.82 S1 Upward = 28.39

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

Capacity Checks

M _{1.35D}	0.56 Kn-m	Capacity	2.73 Kn-m	Passing Percentage	487.50 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.35 Kn-m	Capacity	3.64 Kn-m	Passing Percentage	154.89 %
M _{0.9D-WnUp}	-1.29 Kn-m	Capacity	-1.74 Kn-m	Passing Percentage	134.88 %
V _{1.35D}	0.58 Kn	Capacity	10.42 Kn	Passing Percentage	1796.55 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.44 Kn	Capacity	13.89 Kn	Passing Percentage	569.26 %
V _{0.9D-WnUp}	-1.34 Kn	Capacity	-17.37 Kn	Passing Percentage	1296.27 %

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 = 7.14 mm Limit by Woolcock et al, 1999 Span/240 = 15.83 mm

Deflection under Dead and Service Wind = 5.21 mm Limit by Woolcock et al, 1999 Span/100 = 38.00 mm

Reactions

Maximum downward = 2.44 kn Maximum upward = -1.34 kn

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

Rafter Design Internal

Internal Rafter Load Width = 4000 mm Internal Rafter Span = 4850 mm Try Rafter 2x290x45 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 = 7.47 S1 Upward = 7.47

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

Capacity Checks

M _{1.35D}	3.97 Kn-m	Capacity	8.48 Kn-m	Passing Percentage	213.60 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	16.58 Kn-m	Capacity	11.3 Kn-m	Passing Percentage	68.15 %

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M _{0.9D-WnUp}	-9.11 Kn-m	Capacity	-14.12 Kn-m	Passing Percentage	154.99 %
V _{1.35D}	3.27 Kn	Capacity	25.18 Kn	Passing Percentage	770.03 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	13.68 Kn	Capacity	33.58 Kn	Passing Percentage	245.47 %
V _{0.9D-WnUp}	-7.52 Kn	Capacity	-41.96 Kn	Passing Percentage	557.98 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 8.9 mm Limit by Woolcock et al, 1999 Span/240 = 20.83 mm

Deflection under Dead and Service Wind = 12.195 mm Limit by Woolcock et al, 1999 Span/100 = 50.00 mm

Reactions

Maximum downward = 13.68 kn Maximum upward = -7.52 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 3

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 = 90 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 = 29.26 Kn > -7.52 Kn

Rafter Design External

External Rafter Load Width = 2000 mm External Rafter Span = 5086 mm Try Rafter 290x45 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 = 0.89

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K8 Upward =0.89 S1 Downward =15.23 S1 Upward =15.23

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

Capacity Checks

M _{1.35D}	2.18 Kn-m	Capacity	3.78 Kn-m	Passing Percentage	173.39 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	9.12 Kn-m	Capacity	5.04 Kn-m	Passing Percentage	55.26 %
M _{0.9D-W_nUp}	-5.01 Kn-m	Capacity	-6.29 Kn-m	Passing Percentage	125.55 %
V _{1.35D}	1.72 Kn	Capacity	12.59 Kn	Passing Percentage	731.98 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	7.17 Kn	Capacity	16.79 Kn	Passing Percentage	234.17 %
V _{0.9D-W_nUp}	-3.94 Kn	Capacity	-20.98 Kn	Passing Percentage	532.49 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 9.89 mm Limit by Woolcock et al, 1999 Span/240= 20.83 mm

Deflection under Dead and Service Wind = 12.19 mm Limit by Woolcock et al, 1999 Span/100 = 50.00 mm

Reactions

Maximum downward =7.17 kn Maximum upward = -3.94 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 3

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 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 45 mm

For Parallel to grain loading

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

Eccentric Load check

V = phi x k₁ x k₄ x k₅ x f_s x b x d_s (Eq 4.12) = -21.73 kn > -3.94 Kn

Single Shear Capacity under short term loads = -14.63 Kn > -3.94 Kn

Girt Design Front and Back

Girt's Spacing = 0 mm

Girt's Span = 4000 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 = 40.00 mm

Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 2500 mm

Try Girt 190x45 SG8

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 =0.98

K8 Upward =0.65 S1 Downward =12.23 S1 Upward =20.38

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

Capacity Checks

M _{Wind+Snow}	0.81 Kn-m	Capacity	1.98 Kn-m	Passing Percentage	244.44 %
V _{0.9D-WnUp}	1.29 Kn	Capacity	13.75 Kn	Passing Percentage	1065.89 %

Deflections

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

Deflection under Snow and Service Wind = 6.00 mm Limit by Woolcock et al. 1999 Span/100 = 25.00 mm
Sag during installation = 2.92 mm

Reactions

Maximum = 1.29 kn

Middle Pole Design

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3910 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	3910 mm c/c		

Loads

Total Area over Pole = 20 m²

Dead	5.00 Kn	Live	5.00 Kn
Wind Down	9.60 Kn	Snow	22.20 Kn
Moment wind	9.68 Kn-m	Moment snow	4.47 Kn-m
Phi	0.8	K ₈	0.75
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	382.12 Kn	PhiM _{nx} Wind	20.47 Kn-m	PhiV _{nx} Wind	62.96 Kn
PhiN _{cx} Dead	229.27 Kn	PhiM _{nx} Dead	12.28 Kn-m	PhiV _{nx} Dead	37.77 Kn
PhiN _{cx} Snow	305.70 Kn	PhiM _{nx} Snow	16.38 Kn-m	PhiV _{nx} Snow	50.36 Kn

Checks

$$(M_x/\phi M_{nx}) + (N/\phi N_{cx}) = 0.57 < 1 \text{ OK}$$

$$(M_x/\phi M_{nx})^2 + (N/\phi N_{cx}) = 0.32 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 24.11 \text{ mm} < 39.10 \text{ mm}$$

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

$$K_0 = (1 - \sin(30)) / (1 + \sin(30))$$

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

Geometry For Middle Bay Pole

Ds = 0.6 mm Pile Diameter
L = 1400 mm Pile embedment length
f1 = 3150 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 9.68 Kn-m Moment Snow = Kn-m
Shear Wind = 3.07 Kn Shear Snow = 4.47 Kn

Pile Properties

Safety Factory 0.55
Hu = 5.37 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 9.97 Kn-m Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.97 < 1 \text{ OK}$$

End Pole Design

Geometry For End Bay Pole

Geometry

150 SED H5 (Minimum 175 dia. at Floor Level) Dry Use Height 4000 mm

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Area	20729 mm ²	As	15546.6796875 mm ²
Ix	34210793 mm ⁴	Zx	421056 mm ³
Iy	34210793 mm ⁴	Zy	421056 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 5 m²

Dead	1.25 Kn	Live	1.25 Kn
Wind Down	2.40 Kn	Snow	5.55 Kn
Moment Wind	4.84 Kn-m	Moment snow	2.23 Kn-m
Phi	0.8	K8	0.47
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	140.96 Kn	PhiMnx Wind	5.77 Kn-m	PhiVnx Wind	36.81 Kn
PhiNcx Dead	84.58 Kn	PhiMnx Dead	3.46 Kn-m	PhiVnx Dead	22.09 Kn
PhiNcx Snow	112.77 Kn	PhiMnx Snow	4.62 Kn-m	PhiVnx Snow	29.45 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.90 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.77 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 37.78 mm < 41.90 mm

Ds =	0.6 mm	Pile Diameter
L =	1400 mm	Pile embedment length
f1 =	3150 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

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Total Area over Pole = 5 m²

Moment Wind =	4.84 Kn-m	Moment Snow =	2.23 Kn-m
Shear Wind =	1.54 Kn	Shear Snow =	2.23 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.37 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	9.97 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.49 < 1 OK

Drained Lateral Strength of End 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 =	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For End Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1400 mm	Pile embedment length
f1 =	3150 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	4.84 Kn-m	Moment Snow =	2.23 Kn-m
Shear Wind =	1.54 Kn	Shear Snow =	2.23 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.37 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	9.97 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.49 < 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(1400) x Ks(1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1400)

Skin Friction = 15.83 Kn

Weight of Pile + Pile Skin Friction = 19.47 Kn

Uplift on one Pile = 15.50 Kn

Uplift is ok