

Pole Shed App Ver 01 2022

Job No.: Helen Costley - 1 **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	1.03 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

Rafter Design Internal

Internal Rafter Load Width = 4000 mm Internal Rafter Span = 3850 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)

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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 = 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}	2.50 Kn-m	Capacity	8.48 Kn-m	Passing Percentage	339.20 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	9.86 Kn-m	Capacity	11.3 Kn-m	Passing Percentage	114.60 %
M _{0.9D-W_nUp}	-5.74 Kn-m	Capacity	-14.12 Kn-m	Passing Percentage	245.99 %
V _{1.35D}	2.60 Kn	Capacity	25.18 Kn	Passing Percentage	968.46 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	10.24 Kn	Capacity	33.58 Kn	Passing Percentage	327.93 %
V _{0.9D-W_nUp}	-5.97 Kn	Capacity	-41.96 Kn	Passing Percentage	702.85 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 3.645 mm Limit by Woolcock et al, 1999 Span/240 = 16.67 mm

Deflection under Dead and Service Wind = 4.995 mm Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Reactions

Maximum downward = 10.24 kn Maximum upward = -5.97 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 > -5.97 Kn

Rafter Design External

External Rafter Load Width = 2000 mm External Rafter Span = 4108 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

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}	1.42 Kn-m	Capacity	3.78 Kn-m	Passing Percentage	266.20 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.61 Kn-m	Capacity	5.04 Kn-m	Passing Percentage	89.84 %
M _{0.9D-W_nUp}	-3.27 Kn-m	Capacity	-6.29 Kn-m	Passing Percentage	192.35 %
V _{1.35D}	1.39 Kn	Capacity	12.59 Kn	Passing Percentage	905.76 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.46 Kn	Capacity	16.79 Kn	Passing Percentage	307.51 %
V _{0.9D-W_nUp}	-3.18 Kn	Capacity	-20.98 Kn	Passing Percentage	659.75 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 4.05 mm Limit by Woolcock et al, 1999 Span/240 = 16.67 mm
Deflection under Dead and Service Wind = 4.99 mm Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Reactions

Maximum downward = 5.46 kn Maximum upward = -3.18 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

$K_{11} = 2.0$ $f_{c,j} = 36.1$ Mpa for Pole with effective thickness = 100 mm

Eccentric Load check

$V = \phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots$ (Eq 4.12) = -21.73 kn > -3.18 Kn

Single Shear Capacity under short term loads = -14.63 Kn > -3.18 Kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 4000 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)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.98

K_8 Upward = 0.76 S_1 Downward = 12.23 S_1 Upward = 18.23

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

Capacity Checks

$M_{Wind+Snow}$	2.07 Kn-m	Capacity	2.30 Kn-m	Passing Percentage	111.11 %
$V_{0.9D-WnUp}$	2.07 Kn	Capacity	13.75 Kn	Passing Percentage	664.25 %

Deflections

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

Deflection under Snow and Service Wind = 37.95 mm Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Sag during installation = 19.16 mm

Reactions

Maximum = 2.07 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 4000 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)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.98

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K8 Upward =0.76 S1 Downward =12.23 S1 Upward =18.23

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

Capacity Checks

M _{Wind+Snow}	2.07 Kn-m	Capacity	2.30 Kn-m	Passing Percentage	111.11 %
V _{0.9D-WnUp}	2.07 Kn	Capacity	13.75 Kn	Passing Percentage	664.25 %

Deflections

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

Deflection under Snow and Service Wind = 37.95 mm Limit by Woolcock et al. 1999 Span/100 = 40.00 mm
Sag during installation =19.16 mm

Reactions

Maximum = 2.07 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 = 16 m²

Dead	4.00 Kn	Live	4.00 Kn
Wind Down	7.68 Kn	Snow	16.48 Kn
Moment wind	8.20 Kn-m	Moment snow	3.79 Kn-m
Phi	0.8	K8	0.75
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Peeling	Steaming	Normal	Dry Use
f _b =	36.3 MPa	f _s =	2.96 MPa

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$f_c =$	18 MPa	$f_p =$	7.2 MPa
$f_t =$	22 MPa	$E =$	9257 MPa

Capacities

PhiNcx Wind	382.12 Kn	PhiMnx Wind	20.47 Kn-m	PhiVnx Wind	62.96 Kn
PhiNcx Dead	229.27 Kn	PhiMnx Dead	12.28 Kn-m	PhiVnx Dead	37.77 Kn
PhiNcx Snow	305.70 Kn	PhiMnx Snow	16.38 Kn-m	PhiVnx Snow	50.36 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.48 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.24 < 1$ OK

Deflection at top under service lateral loads = 20.42 mm < 39.10 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
$K_0 =$	$(1 - \sin(30)) / (1 + \sin(30))$				
$K_p =$	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For Middle Bay Pole

$D_s =$	0.6 mm	Pile Diameter
$L =$	1400 mm	Pile embedment length
$f_1 =$	3150 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	8.20 Kn-m	Moment Snow =	Kn-m
Shear Wind =	2.60 Kn	Shear Snow =	3.79 Kn

Pile Properties

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

Checks

Applied Forces/Capacities = 0.82 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

150 SED H5 (Minimum 175 dia. at Floor Level)	Dry Use	Height	4000 mm
Area	20729 mm ²	As	15546.6796875 mm ²
I _x	34210793 mm ⁴	Z _x	421056 mm ³
I _y	34210793 mm ⁴	Z _y	421056 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 4 m²

Dead	1.00 Kn	Live	1.00 Kn
Wind Down	1.92 Kn	Snow	4.12 Kn
Moment Wind	4.10 Kn-m	Moment snow	1.89 Kn-m
Phi	0.8	K ₈	0.47
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	140.96 Kn	PhiM _{nx} Wind	5.77 Kn-m	PhiV _{nx} Wind	36.81 Kn
PhiN _{cx} Dead	84.58 Kn	PhiM _{nx} Dead	3.46 Kn-m	PhiV _{nx} Dead	22.09 Kn
PhiN _{cx} Snow	112.77 Kn	PhiM _{nx} Snow	4.62 Kn-m	PhiV _{nx} Snow	29.45 Kn

Checks

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

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

Deflection at top under service lateral loads = 32.00 mm < 41.90 mm

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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

Total Area over Pole = 4 m²

Moment Wind =	4.10 Kn-m	Moment Snow =	1.89 Kn-m
Shear Wind =	1.30 Kn	Shear Snow =	1.89 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 = 0.41 < 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 =	4.10 Kn-m	Moment Snow =	1.89 Kn-m
Shear Wind =	1.30 Kn	Shear Snow =	1.89 Kn

Pile Properties

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Safety Factor	0.55	
$H_u =$	5.37 Kn	Ultimate Lateral Strength of the Pile, Short pile
$M_u =$	9.97 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.41 < 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(1400) x K_s (1.5) x $0.5 \times \tan(30) \times \pi \times \text{Dia of Pile}(0.6) \times \text{Height of Pile}(1400)$

Skin Friction = 15.83 Kn

Weight of Pile + Pile Skin Friction = 19.47 Kn

Uplift on one Pile = 12.40 Kn

Uplift is ok