

Pole Shed App Ver 01 2022

Job No.: 2501049 - 1

Address: 886 Abel Tasman Drive, Pohara, New Zealand

Date: 3/10/2025

Latitude: -40.830371

Longitude: 172.893032

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	N0	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	D
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	6.05 m
Wind Region	NZ2	Terrain Category	1.0	Design Wind Speed	44.82 m/s
Wind Pressure	1.21 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 Open

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

For roof $C_{p,e}$ from 0 m To 3.03 m $C_{p,e} = -1.105$ $p_e = -1.20$ KPa $p_{net} = -1.44$ KPa

For roof $C_{p,e}$ from 3.03 m To 6.05 m $C_{p,e} = -0.7975$ $p_e = -0.87$ KPa $p_{net} = -1.11$ 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 10.8 m $C_{p,e} = 0.7$ $p_e = 0.76$ KPa $p_{net} = 1.12$ KPa

For side wall $C_{p,e}$ from 0 m To 6.05 m $C_{p,e} =$ $p_e = -0.71$ KPa $p_{net} = -0.71$ KPa

Maximum Upward pressure used in roof member Design = 1.44 KPa

Maximum Downward pressure used in roof member Design = 0.19 KPa

Maximum Wall pressure used in Design = 1.12 KPa

Maximum Racking pressure used in Design = 1.23 KPa

Design Summary

Rafter Design Internal

Internal Rafter Load Width = 4000 mm Internal Rafter Span = 10650 mm Try Rafter 2x360x63 LVL13

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 = 5.90 S1 Upward = 5.90

Shear Capacity of timber = 5.3 MPa Bending Capacity of timber = 48 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	19.14 Kn-m	Capacity	60.82 Kn-m	Passing Percentage	317.76 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	38.28 Kn-m	Capacity	81.1 Kn-m	Passing Percentage	211.86 %
M _{0.9D-W_nUp}	-68.90 Kn-m	Capacity	-101.38 Kn-m	Passing Percentage	147.14 %
V _{1.35D}	7.19 Kn	Capacity	77.32 Kn	Passing Percentage	1075.38 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	14.38 Kn	Capacity	103.08 Kn	Passing Percentage	716.83 %
V _{0.9D-W_nUp}	-25.88 Kn	Capacity	-128.86 Kn	Passing Percentage	497.91 %

Deflections

Modulus of Elasticity = 11000 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 35.505 mm Limit by Woolcock et al, 1999 Span/240 = 45.00 mm

Deflection under Dead and Service Wind = 39.12 mm Limit by Woolcock et al, 1999 Span/100 = 108.00 mm

Reactions

Maximum downward = 14.38 kn Maximum upward = -25.88 kn

Rafter to Pole Connection check

Bolt Size = M16 Number of Bolts = 2

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Joint Group for Rafters = J2 Joint Group for Pole = J5

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 80 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 12.6 f_{pj} = 22.7 Mpa for Rafter with effective thickness = 126 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 = 51.75 Kn > -25.88 Kn

Rafter Design External

External Rafter Load Width = 2000 mm External Rafter Span = 3647 mm Try Rafter 300x50 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 = 0.94

K8 Upward = 0.94 S1 Downward = 13.93 S1 Upward = 13.93

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

Capacity Checks

M _{1.35D}	1.12 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	421.43 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.24 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	281.25 %
M _{0.9D-W_nUp}	-4.04 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	194.80 %
V _{1.35D}	1.23 Kn	Capacity	14.47 Kn	Passing Percentage	1176.42 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.46 Kn	Capacity	19.30 Kn	Passing Percentage	784.55 %
V _{0.9D-W_nUp}	-4.43 Kn	Capacity	-24.12 Kn	Passing Percentage	544.47 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 2.54 mm Limit by Woolcock et al, 1999 Span/240 = 15.63 mm

Deflection under Dead and Service Wind = 2.52 mm Limit by Woolcock et al, 1999 Span/100 = 37.50 mm

Reactions

Maximum downward = 2.46 kn Maximum upward = -4.43 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

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 50 mm

For Parallel to grain loading

$K_{11} = 2.0$ fcj = 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) = -25.20 kn > -4.43 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -4.43 Kn

Girt Design Front and Back

Girt's Spacing = 800 mm

Girt's Span = 4000 mm

Try Girt 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and does not remain in continuous wet condition after installation)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 1.00

K_8 Upward = 0.92 S_1 Downward = 9.63 S_1 Upward = 14.36

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

Capacity Checks

$M_{Wind+Snow}$	1.79 Kn-m	Capacity	1.94 Kn-m	Passing Percentage	108.38 %
$V_{0.9D-WnUp}$	1.79 Kn	Capacity	12.06 Kn	Passing Percentage	673.74 %

Deflections

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

Deflection under Snow and Service Wind = 31.70 mm Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Sag during installation = 15.52 mm

Reactions

Maximum = 1.79 kn

Girt Design Sides

Girt's Spacing = 800 mm

Girt's Span = 3750 mm

Try Girt 150x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and does not remain in continuous wet condition after installation)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 1.00

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K8 Upward =0.94 S1 Downward =9.63 S1 Upward =13.90

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

Capacity Checks

M _{Wind+Snow}	1.58 Kn-m	Capacity	1.97 Kn-m	Passing Percentage	124.68 %
V _{0.9D-WnUp}	1.68 Kn	Capacity	12.06 Kn	Passing Percentage	717.86 %

Deflections

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

Deflection under Snow and Service Wind = 24.49 mm Limit by Woolcock et al. 1999 Span/100 = 37.50 mm
Sag during installation =11.99 mm

Reactions

Maximum = 1.68 kn

Middle Pole Design

Geometry

275 SED H5 (Minimum 300 dia. at Floor Level)	Dry Use	Height	5750 mm
Area	64885 mm ²	As	48663.8671875 mm ²
I _x	335197731 mm ⁴	Z _x	2331810 mm ³
I _y	335197731 mm ⁴	Z _y	2331810 mm ³
Lateral Restraint	5750 mm c/c		

Loads

Total Area over Pole = 21.6 m²

Dead	5.40 Kn	Live	5.40 Kn
Wind Down	4.10 Kn	Snow	0.00 Kn
Moment wind	33.68 Kn-m		
Phi	0.8	K8	0.67
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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$f_c = 18 \text{ MPa}$ $f_p = 7.2 \text{ MPa}$
 $f_t = 22 \text{ MPa}$ $E = 9257 \text{ MPa}$

Capacities

PhiNcx Wind	626.01 Kn	PhiMnx Wind	45.37 Kn-m	PhiVnx Wind	115.24 Kn
PhiNcx Dead	375.61 Kn	PhiMnx Dead	27.22 Kn-m	PhiVnx Dead	69.14 Kn

Checks

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

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.57 < 1 \text{ OK}$

Deflection at top under service lateral loads = 53.06 mm < 57.50 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

$D_s = 0.6 \text{ mm}$ Pile Diameter
 $L = 2200 \text{ mm}$ Pile embedment length
 $f_1 = 4538 \text{ mm}$ Distance at which the shear force is applied
 $f_2 = 0 \text{ mm}$ Distance of top soil at rest pressure

Loads

Moment Wind = 33.68 Kn-m
Shear Wind = 7.42 Kn

Pile Properties

Safety Factory 0.55
 $H_u = 14.08 \text{ Kn}$ Ultimate Lateral Strength of the Pile, Short pile
 $M_u = 37.94 \text{ Kn-m}$ Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.89 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	5750 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	mm c/c		

Loads

Total Area over Pole = 7.5 m²

Dead	1.88 Kn	Live	1.88 Kn
Wind Down	1.43 Kn	Snow	0.00 Kn
Moment Wind	8.68 Kn-m		
Phi	0.8	K ₈	0.40
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	202.20 Kn	PhiM _{nx} Wind	10.83 Kn-m	PhiV _{nx} Wind	62.96 Kn
PhiN _{cx} Dead	121.32 Kn	PhiM _{nx} Dead	6.50 Kn-m	PhiV _{nx} Dead	37.77 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.83 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.67 < 1$ OK

Deflection at top under service lateral loads = 48.09 mm < 60.35 mm

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Ds =	0.6 mm	Pile Diameter
L =	1400 mm	Pile embedment length
f1 =	4538 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 7.5 m²

Moment Wind =	8.68 Kn-m
Shear Wind =	1.91 Kn

Pile Properties

Safety Factory	0.55	
Hu =	4.12 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	10.72 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.81 < 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 =	4538 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	8.68 Kn-m
Shear Wind =	1.91 Kn

Pile Properties

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Safety Factor	0.55	
Hu =	4.12 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	10.72 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.81 < 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(2200) x Ks(1.5) x $0.5 \times \tan(30) \times \pi \times \text{Dia of Pile}(0.6) \times \text{Height of Pile}(2200)$

Skin Friction = 39.09 Kn

Weight of Pile + Pile Skin Friction = 42.94 Kn

Uplift on one Pile = 26.24 Kn

Uplift is ok