

Pole Shed App Ver 01 2022

Job No.: Orlando

Address: 748 Rangitikei Line, Palmerston North, New Zealand **Date:** 3/6/2025

Latitude: -40.326109

Longitude: 175.583104

Elevation: 27 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	1	Subsoil Category	D	Exposure Zone	D
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.4 m
Wind Region	NZ2	Terrain Category	2.3	Design Wind Speed	37.3 m/s
Wind Pressure	0.83 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 Enclosed

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

For roof $C_{p,e}$ from 0 m To 5.15 m $C_{p,e} = -0.9$ $p_e = -0.68$ KPa $p_{net} = -0.68$ KPa

For roof $C_{p,e}$ from 5.15 m To 10.30 m $C_{p,e} = -0.5$ $p_e = -0.38$ KPa $p_{net} = -0.38$ 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 20 m $C_{p,e} = 0.7$ $p_e = 0.53$ KPa $p_{net} = 0.78$ KPa

For side wall $C_{p,e}$ from 0 m To 5.15 m $C_{p,e} =$ $p_e = -0.49$ KPa $p_{net} = -0.49$ KPa

Maximum Upward pressure used in roof member Design = 0.68 KPa

Maximum Downward pressure used in roof member Design = 0.40 KPa

Maximum Wall pressure used in Design = 0.78 KPa

Maximum Racking pressure used in Design = 0.9 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 4650 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 = 0.57 S1 Downward = 13.82 S1 Upward = 22.09

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	2.73 Kn-m	Passing Percentage	332.93 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.65 Kn-m	Capacity	3.64 Kn-m	Passing Percentage	137.36 %
M _{0.9D-W_nUp}	-1.11 Kn-m	Capacity	-2.76 Kn-m	Passing Percentage	248.65 %
V _{1.35D}	0.71 Kn	Capacity	10.42 Kn	Passing Percentage	1467.61 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.46 Kn	Capacity	13.89 Kn	Passing Percentage	951.37 %
V _{0.9D-W_nUp}	-0.95 Kn	Capacity	-17.37 Kn	Passing Percentage	1828.42 %

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 = 13.98 mm Limit by Woolcock et al, 1999 Span/240 = 19.17 mm

Deflection under Dead and Service Wind = 10.57 mm Limit by Woolcock et al, 1999 Span/100 = 46.00 mm

Reactions

Maximum downward = 1.46 kn Maximum upward = -0.95 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 = 6850.350017500875 mm Try Rafter 2x300x63 LVL13

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 = 5.30 S1 Upward = 5.30

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

Capacity Checks

M _{1.35D}	9.50 Kn-m	Capacity	43.54 Kn-m	Passing Percentage	458.32 %
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M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	19.71 Kn-m	Capacity	58.06 Kn-m	Passing Percentage	294.57 %
M _{0.9D-WnUp}	-12.81 Kn-m	Capacity	-72.58 Kn-m	Passing Percentage	566.59 %
V _{1.35D}	5.55 Kn	Capacity	64.42 Kn	Passing Percentage	1160.72 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	11.51 Kn	Capacity	85.9 Kn	Passing Percentage	746.31 %
V _{0.9D-WnUp}	-7.48 Kn	Capacity	-107.38 Kn	Passing Percentage	1435.56 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 12.995 mm Limit by Woolcock et al, 1999 Span/240 = 29.17 mm

Deflection under Dead and Service Wind = 16.845 mm Limit by Woolcock et al, 1999 Span/100 = 70.00 mm

Reactions

Maximum downward = 11.51 kn Maximum upward = -7.48 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 = J2 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 = 12.6 fpj = 22.7 Mpa for Rafter with effective thickness = 126 mm

For Parallel to grain loading

K₁₁ = 2.0 fcj = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 29.11 Kn > -7.48 Kn

Rafter Design External

External Rafter Load Width = 2400 mm External Rafter Span = 6823 mm Try Rafter 300x63 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 = 11.01 S1 Upward = 11.01

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

Capacity Checks

M _{1.35D}	4.71 Kn-m	Capacity	21.72 Kn-m	Passing Percentage	461.15 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	9.78 Kn-m	Capacity	28.96 Kn-m	Passing Percentage	296.11 %
M _{0.9D-W_nUp}	-6.35 Kn-m	Capacity	-36.20 Kn-m	Passing Percentage	570.08 %
V _{1.35D}	2.76 Kn	Capacity	32.21 Kn	Passing Percentage	1167.03 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.73 Kn	Capacity	42.95 Kn	Passing Percentage	749.56 %
V _{0.9D-W_nUp}	-3.73 Kn	Capacity	-53.69 Kn	Passing Percentage	1439.41 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 14.44 mm Limit by Woolcock et al, 1999 Span/240 = 29.17 mm

Deflection under Dead and Service Wind = 16.85 mm Limit by Woolcock et al, 1999 Span/100 = 70.00 mm

Reactions

Maximum downward = 5.73 kn Maximum upward = -3.73 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 = J2 Joint Group for Pole = J5

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 12.6 f_{pj} = 22.7 Mpa for Rafter with effective thickness = 63 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 = $\phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s$ (Eq 4.12) = -56.10 kn > -3.73 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -3.73 Kn

Girt Design Front and Back

Girt's Spacing = 1300 mm

Girt's Span = 2400 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 =0.67 S1 Downward =12.23 S1 Upward =19.97

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

Capacity Checks

M _{Wind+Snow}	0.73 Kn-m	Capacity	2.04 Kn-m	Passing Percentage	279.45 %
V _{0.9D-WnUp}	1.22 Kn	Capacity	13.75 Kn	Passing Percentage	1127.05 %

Deflections

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

Deflection under Snow and Service Wind = 2.54 mm Limit by Woolcock et al, 1999 Span/100 = 24.00 mm

Sag during installation = 2.48 mm

Reactions

Maximum = 1.22 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 3500 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 =0.49 S1 Downward =12.23 S1 Upward =24.11

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

Capacity Checks

M _{Wind+Snow}	1.08 Kn-m	Capacity	1.48 Kn-m	Passing Percentage	137.04 %
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V _{0.9D-WnUp}	1.23 Kn	Capacity	13.75 Kn	Passing Percentage	1117.89 %
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Deflections

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

Deflection under Snow and Service Wind = 7.96 mm Limit by Woolcock et al. 1999 Span/100 = 35.00 mm
Sag during installation = 11.24 mm

Reactions

Maximum = 1.23 kn

Middle Pole Design

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	4440 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	4440 mm c/c		

Loads

Total Area over Pole = 33.6016800840042 m²

Dead	8.40 Kn	Live	8.40 Kn
Wind Down	13.44 Kn	Snow	0.00 Kn
Moment wind	8.11 Kn-m		
Phi	0.8	K ₈	0.63
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	319.87 Kn	PhiM _{Nx} Wind	17.13 Kn-m	PhiV _{Nx} Wind	62.96 Kn
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PhiNcx Dead 191.92 Kn PhiMnx Dead 10.28 Kn-m PhiVnx Dead 37.77 Kn

Checks

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

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

Deflection at top under service lateral loads = 24.04 mm < 44.40 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 = 1600 mm Pile embedment length
f1 = 3300 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 8.11 Kn-m
Shear Wind = 2.46 Kn

Pile Properties

Safety Factory 0.55
Hu = 7.45 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 14.59 Kn-m Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.56 < 1 \text{ OK}$$

End Pole Design

Geometry For End Bay Pole

Geometry

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175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	4100 mm
Area	27598 mm ²	As	20698.2421875 mm ²
Ix	60639381 mm ⁴	Zx	646820 mm ³
Iy	60639381 mm ⁴	Zx	646820 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 16.8008400420021 m²

Dead	4.20 Kn	Live	4.20 Kn
Wind Down	6.72 Kn	Snow	0.00 Kn
Moment Wind	4.06 Kn-m		
Phi	0.8	K8	0.58
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	231.09 Kn	PhiMnx Wind	10.92 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	138.65 Kn	PhiMnx Dead	6.55 Kn-m	PhiVnx Dead	29.41 Kn

Checks

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

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.20 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 19.60 mm < 43.89 mm

Ds =	0.6 mm	Pile Diameter
L =	1300 mm	Pile embedment length
f1 =	3300 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 = 16.8008400420021 m²

Moment Wind = 4.06 Kn-m

Shear Wind = 1.23 Kn

Pile Properties

Safety Factory 0.55

Hu = 4.26 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 8.19 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.50 < 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 = 3300 mm Distance at which the shear force is applied

f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 4.06 Kn-m

Shear Wind = 1.23 Kn

Pile Properties

Safety Factory 0.55

Hu = 4.26 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 8.19 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.50 < 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(1600) x Ks(1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1600)

Skin Friction = 20.68 Kn

Weight of Pile + Pile Skin Friction = 24.83 Kn

Uplift on one Pile = 15.29 Kn

Uplift is ok