

Pole Shed App Ver 01 2022

Job No.: Southern Pastures
Mamaku-Training

Address: 142 Mamaku South Road Kineith New
Zealand, Tokoroa, New Zealand

Date: 16/06/2025

Latitude: -38.251015

Longitude: 176.054543

Elevation: 608 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	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	3.75 m
Wind Region	NZ2	Terrain Category	2.27	Design Wind Speed	45.85 m/s
Wind Pressure	1.26 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 = Mono Open

For roof $C_{p,i} = 0.656$

For roof $C_{p,e}$ from 0 m To 3.75 m $C_{p,e} = -0.9$ $p_e = -1.00$ KPa $p_{net} = -1.88$ KPa

For roof $C_{p,e}$ from 3.75 m To 7.50 m $C_{p,e} = -0.5$ $p_e = -0.56$ KPa $p_{net} = -1.44$ KPa

For wall Windward $C_{p,i} = 0.656$ side Wall $C_{p,i} = -0.5682$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 13.5 m $C_{p,e} = 0.7$ $p_e = 0.79$ KPa $p_{net} = 1.57$ KPa

For side wall $C_{p,e}$ from 0.0 m To 3.75 m $C_{p,e} =$ $p_e = -0.74$ KPa $p_{net} = 0.04$ KPa

Maximum Upward pressure used in roof member Design = 1.88 KPa

Maximum Downward pressure used in roof member Design = 1.01 KPa

Maximum Wall pressure used in Design = 1.57 KPa

Maximum Racking pressure used in Design = 1.34 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 4350 mm

Try Purlin 250x50 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 = 0.97

K8 Upward = 0.38 S1 Downward = 12.68 S1 Upward = 27.71

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

Capacity Checks

M _{1.35D}	0.72 Kn-m	Capacity	3.40 Kn-m	Passing Percentage	472.22 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_{nDn}}	2.79 Kn-m	Capacity	4.53 Kn-m	Passing Percentage	162.37 %
M _{0.9D-W_{nUp}}	-3.52 Kn-m	Capacity	-2.21 Kn-m	Passing Percentage	62.78 %
V _{1.35D}	0.66 Kn	Capacity	12.06 Kn	Passing Percentage	1827.27 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_{nDn}}	2.56 Kn	Capacity	16.08 Kn	Passing Percentage	628.12 %
V _{0.9D-W_{nUp}}	-3.24 Kn	Capacity	-20.10 Kn	Passing Percentage	620.37 %

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 = 8.77 mm Limit by Woolcock et al, 1999 Span/240 = 17.92 mm

Deflection under Dead and Service Wind = 9.23 mm Limit by Woolcock et al, 1999 Span/100 = 43.00 mm

Reactions

Maximum downward = 2.56 kn Maximum upward = -3.24 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 = 4500 mm Internal Rafter Span = 3850 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}	2.81 Kn-m	Capacity	10.08 Kn-m	Passing Percentage	358.72 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_{nDn}}	10.92 Kn-m	Capacity	13.44 Kn-m	Passing Percentage	123.08 %

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M _{0.9D-WnUp}	-13.80 Kn-m	Capacity	-16.8 Kn-m	Passing Percentage	121.74 %
V _{1.35D}	2.92 Kn	Capacity	28.94 Kn	Passing Percentage	991.10 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	11.35 Kn	Capacity	38.6 Kn	Passing Percentage	340.09 %
V _{0.9D-WnUp}	-14.34 Kn	Capacity	-48.24 Kn	Passing Percentage	336.40 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 3.335 mm Limit by Woolcock et al, 1999 Span/240 = 16.67 mm

Deflection under Dead and Service Wind = 6.205 mm Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Reactions

Maximum downward = 11.35 kn Maximum upward = -14.34 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 > -14.34 Kn

Rafter Design External

External Rafter Load Width = 2250 mm External Rafter Span = 3808 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}	1.38 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	342.03 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.34 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	117.98 %
M _{0.9D-W_nUp}	-6.75 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	116.59 %
V _{1.35D}	1.45 Kn	Capacity	14.47 Kn	Passing Percentage	997.93 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.61 Kn	Capacity	19.30 Kn	Passing Percentage	344.03 %
V _{0.9D-W_nUp}	-7.09 Kn	Capacity	-24.12 Kn	Passing Percentage	340.20 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 3.70 mm Limit by Woolcock et al, 1999 Span/240= 16.67 mm

Deflection under Dead and Service Wind = 6.20 mm Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Reactions

Maximum downward =5.61 kn Maximum upward = -7.09 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

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) = -25.20 kn > -7.09 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -7.09 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2250 mm Intermediate Span = 3099 mm Try Intermediate 2x200x50 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 =1.00 S1 Downward =11.27 S1 Upward =0.66

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

Capacity Checks

M _{Wind+Snow}	4.24 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	175.94 %
V _{0.9D-WnUp}	5.47 Kn	Capacity	-32.16 Kn	Passing Percentage	587.93 %

Deflections

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

Deflection under Snow and Service Wind = 11.79 mm Limit by Woolcock et al, 1999 Span/100 = 30.99 mm

Reactions

Maximum = 5.47 kn

Intermediate Design Sides

Intermediate Spacing = 2000 mm Intermediate Span = 3475 mm Try Intermediate 2x200x50 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 =1.00 S1 Downward =11.27 S1 Upward =0.70

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

Capacity Checks

M _{Wind+Snow}	2.37 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	314.77 %
V _{0.9D-WnUp}	2.73 Kn	Capacity	32.16 Kn	Passing Percentage	1178.02 %

Deflections

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

Deflection under Snow and Service Wind = 16.56 mm Limit by Woolcock et al, 1999 Span/100 = 34.75 mm

Reactions

Maximum = 2.73 kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 2250 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 = 0.78 S1 Downward = 11.27 S1 Upward = 17.82

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

Capacity Checks

M _{Wind+Snow}	0.89 Kn-m	Capacity	2.90 Kn-m	Passing Percentage	325.84 %
V _{0.9D-WnUp}	1.59 Kn	Capacity	16.08 Kn	Passing Percentage	1011.32 %

Deflections

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

Deflection under Snow and Service Wind = 2.11 mm Limit by Woolcock et al, 1999 Span/100 = 22.50 mm

Sag during installation = 1.55 mm

Reactions

Maximum = 1.59 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 2000 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 = 0.82 S1 Downward = 11.27 S1 Upward = 16.80

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

Capacity Checks

$M_{Wind+Snow}$	0.71 Kn-m	Capacity	3.08 Kn-m	Passing Percentage	433.80 %
$V_{0.9D-WnUp}$	1.41 Kn	Capacity	16.08 Kn	Passing Percentage	1140.43 %

Deflections

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

Deflection under Snow and Service Wind = 1.32 mm Limit by Woolcock et al. 1999 Span/100 = 20.00 mm
Sag during installation = 0.97 mm

Reactions

Maximum = 1.41 kn

Middle Pole Design

Geometry

250 SED H5 (Minimum 275 dia. at Floor Level)	Dry Use	Height	3750 mm
Area	13125 mm ²	As	9843.75 mm ²
I_x	75366211 mm ⁴	Z_x	574219 mm ³
I_y	75366211 mm ⁴	Z_y	574219 mm ³
Lateral Restraint	3750 mm c/c		

Loads

Total Area over Pole = 18 m²

Dead	4.50 Kn	Live	4.50 Kn
Wind Down	18.18 Kn	Snow	0.00 Kn
Moment wind	10.57 Kn-m		
Phi	0.8	K8	0.93
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
$f_c =$	18 MPa	$f_p =$	7.2 MPa

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ft = 22 MPa E = 9257 MPa

Capacities

PhiNcx Wind	174.97 Kn	PhiMnx Wind	15.44 Kn-m	PhiVnx Wind	23.31 Kn
PhiNcx Dead	104.98 Kn	PhiMnx Dead	9.26 Kn-m	PhiVnx Dead	13.99 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.84 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.62 < 1$ OK

Deflection at top under service lateral loads = 29.94 mm < 37.50 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

Ds = 0.6 mm Pile Diameter
L = 1500 mm Pile embedment length
f1 = 2813 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 10.57 Kn-m
Shear Wind = 3.76 Kn

Pile Properties

Safety Factory 0.55
Hu = 6.97 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 11.76 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.90 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3450 mm
Area	10625 mm ²	As	7968.75 mm ²
Ix	39982096 mm ⁴	Zx	376302 mm ³
Iy	39982096 mm ⁴	Zy	376302 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 4.5 m²

Dead	1.13 Kn	Live	1.13 Kn
Wind Down	4.54 Kn	Snow	0.00 Kn
Moment Wind	5.29 Kn-m		
Phi	0.8	K8	0.85
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	130.00 Kn	PhiMnx Wind	9.28 Kn-m	PhiVnx Wind	18.87 Kn
PhiNcx Dead	78.00 Kn	PhiMnx Dead	5.57 Kn-m	PhiVnx Dead	11.32 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.62 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.38 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 28.15 \text{ mm} < 37.41 \text{ mm}$$

Ds =	0.6 mm	Pile Diameter
L =	1500 mm	Pile embedment length

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f1 = 2813 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Total Area over Pole = 4.5 m²

Moment Wind = 5.29 Kn-m
Shear Wind = 1.88 Kn

Pile Properties

Safety Factory 0.55
Hu = 6.97 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 11.76 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.45 < 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 = 1500 mm Pile embedment length
f1 = 2813 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 5.29 Kn-m
Shear Wind = 1.88 Kn

Pile Properties

Safety Factory 0.55
Hu = 6.97 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 11.76 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = $0.45 < 1$ 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(1500) x Ks(1.5) x $0.5 \times \tan(30)$ x Pi x Dia of Pile(0.6) x Height of Pile(1500)

Skin Friction = 18.17 Kn

Weight of Pile + Pile Skin Friction = 21.19 Kn

Uplift on one Pile = 29.79 Kn

Uplift is ok