

Pole Shed App Ver 01 2022

Job No.: Steve Maley - 1

Address: 48 Morven Lane, Fairhall, New Zealand

Date: 3/10/2025

Latitude: -41.547677

Longitude: 173.886444

Elevation: 49.5 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	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	3	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	3.4 m
Wind Region	NZ2	Terrain Category	2.55	Design Wind Speed	39.07 m/s
Wind Pressure	0.92 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 3.10 m $C_{p,e} = -0.9$ $p_e = -0.74$ KPa $p_{net} = -0.74$ KPa

For roof $C_{p,e}$ from 3.10 m To 6.20 m $C_{p,e} = -0.5$ $p_e = -0.41$ KPa $p_{net} = -0.41$ 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 15 m $C_{p,e} = 0.7$ $p_e = 0.58$ KPa $p_{net} = 0.85$ KPa

For side wall $C_{p,e}$ from 0 m To 3.10 m $C_{p,e} =$ $p_e = -0.54$ KPa $p_{net} = -0.54$ KPa

Maximum Upward pressure used in roof member Design = 0.74 KPa

Maximum Downward pressure used in roof member Design = 0.43 KPa

Maximum Wall pressure used in Design = 0.85 KPa

Maximum Racking pressure used in Design = 0.99 KPa

Design Summary

Purlin Design

Purlin Spacing = 700 mm

Purlin Span = 4350 mm

Try Purlin 190x45 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 = 0.98

K8 Upward = 0.41 S1 Downward = 12.23 S1 Upward = 26.73

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	1.79 Kn-m	Passing Percentage	319.64 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.29 Kn-m	Capacity	2.38 Kn-m	Passing Percentage	103.93 %
M _{0.9D-W_nUp}	-0.85 Kn-m	Capacity	-1.23 Kn-m	Passing Percentage	144.71 %
V _{1.35D}	0.51 Kn	Capacity	8.25 Kn	Passing Percentage	1617.65 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.11 Kn	Capacity	11.00 Kn	Passing Percentage	990.99 %
V _{0.9D-W_nUp}	-0.78 Kn	Capacity	-13.75 Kn	Passing Percentage	1762.82 %

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 = 19.61 mm Limit by Woolcock et al, 1999 Span/240 = 17.92 mm

Deflection under Dead and Service Wind = 12.93 mm Limit by Woolcock et al, 1999 Span/100 = 43.00 mm

Reactions

Maximum downward = 1.11 kn Maximum upward = -0.78 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 = 3350 mm Try Rafter 2x240x45 SG8 Wet

Moisture Condition = Wet (Moisture in timber is less than 25%)

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 = 6.71 S1 Upward = 6.71

Shear Capacity of timber = 3 MPa Bending Capacity of timber = 11.7 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	2.13 Kn-m	Capacity	4.86 Kn-m	Passing Percentage	228.17 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	4.61 Kn-m	Capacity	6.46 Kn-m	Passing Percentage	140.13 %

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M _{0.9D-WnUp}	-3.25 Kn-m	Capacity	-8.08 Kn-m	Passing Percentage	248.62 %
V _{1.35D}	2.54 Kn	Capacity	20.84 Kn	Passing Percentage	820.47 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	5.50 Kn	Capacity	27.78 Kn	Passing Percentage	505.09 %
V _{0.9D-WnUp}	-3.88 Kn	Capacity	-34.74 Kn	Passing Percentage	895.36 %

Deflections

Modulus of Elasticity = 4400 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 3

Deflection under Dead and Live Load = 7.615 mm Limit by Woolcock et al, 1999 Span/240 = 14.58 mm

Deflection under Dead and Service Wind = 9.3 mm Limit by Woolcock et al, 1999 Span/100 = 35.00 mm

Reactions

Maximum downward = 5.50 kn Maximum upward = -3.88 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 fpj = 12.9 Mpa for Rafter with effective thickness = 90 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 = 13.65 Kn > -3.88 Kn

Rafter Design External

External Rafter Load Width = 2250 mm External Rafter Span = 3313 mm Try Rafter 240x45 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 K₁ Medium term = 0.8 K₁ Long term = 0.6 K₄ = 1 K₅ = 1 K₈ Downward = 0.94

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K8 Upward =0.94 S1 Downward =13.82 S1 Upward =13.82

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

Capacity Checks

M _{1.35D}	1.04 Kn-m	Capacity	2.73 Kn-m	Passing Percentage	262.50 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.25 Kn-m	Capacity	3.64 Kn-m	Passing Percentage	161.78 %
M _{0.9D-W_nUp}	-1.59 Kn-m	Capacity	-4.55 Kn-m	Passing Percentage	286.16 %
V _{1.35D}	1.26 Kn	Capacity	10.42 Kn	Passing Percentage	826.98 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.72 Kn	Capacity	13.89 Kn	Passing Percentage	510.66 %
V _{0.9D-W_nUp}	-1.92 Kn	Capacity	-17.37 Kn	Passing Percentage	904.69 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 4.71 mm Limit by Woolcock et al, 1999 Span/240= 14.58 mm

Deflection under Dead and Service Wind = 5.61 mm Limit by Woolcock et al, 1999 Span/100 = 35.00 mm

Reactions

Maximum downward =2.72 kn Maximum upward = -1.92 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 = 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) = -17.01 kn > -1.92 Kn

Single Shear Capacity under short term loads = -9.75 Kn > -1.92 Kn

Intermediate Design Sides

Intermediate Spacing = 1750 mm Intermediate Span = 3100 mm Try Intermediate 2x140x45 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 =1.00

K8 Upward =1.00 S1 Downward =10.36 S1 Upward =0.61

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	3.3 Kn-m	Passing Percentage	370.79 %
V _{0.9D-WnUp}	1.15 Kn	Capacity	20.26 Kn	Passing Percentage	1761.74 %

Deflections

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

Deflection under Snow and Service Wind = 16.095 mm Limit by Woolcock et al, 1999 Span/100 = 31.00 mm

Reactions

Maximum = 1.15 kn

Girt Design Front and Back

Girt's Spacing = 1100 mm Girt's Span = 2250 mm Try Girt 140x45 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 =1.00

K8 Upward =0.84 S1 Downward =10.36 S1 Upward =16.38

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

Capacity Checks

M _{Wind+Snow}	0.59 Kn-m	Capacity	1.39 Kn-m	Passing Percentage	235.59 %
V _{0.9D-WnUp}	1.05 Kn	Capacity	10.13 Kn	Passing Percentage	964.76 %

Deflections

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

Deflection under Snow and Service Wind = 4.53 mm Limit by Woolcock et al, 1999 Span/100 = 22.50 mm
Sag during installation = 1.92 mm

Reactions

Maximum = 1.05 kn

Girt Design Sides

Girt's Spacing = 0 mm Girt's Span = 1750 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 = 17.50 mm
Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

150 SED H5 (Minimum 175 dia. at Floor Level)	Dry Use	Height	3160 mm
Area	20729 mm ²	As	15546.6796875 mm ²
I _x	34210793 mm ⁴	Z _x	421056 mm ³

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Iy 34210793 mm⁴ Zx 421056 mm³
Lateral Restraint 3160 mm c/c

Loads

Total Area over Pole = 15.75 m²

Dead	3.94 Kn	Live	3.94 Kn
Wind Down	6.77 Kn	Snow	0.00 Kn
Moment wind	6.42 Kn-m		
Phi	0.8	K8	0.70
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	208.12 Kn	PhiMnx Wind	8.53 Kn-m	PhiVnx Wind	36.81 Kn
PhiNcx Dead	124.87 Kn	PhiMnx Dead	5.12 Kn-m	PhiVnx Dead	22.09 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.82 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.64 < 1$ OK

Deflection at top under service lateral loads = 30.61 mm < 31.60 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
K0 = $(1 - \sin(30)) / (1 + \sin(30))$
Kp = $(1 + \sin(30)) / (1 - \sin(30))$

Geometry For Middle Bay Pole

Ds = 0.6 mm Pile Diameter

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L =	1400 mm	Pile embedment length
f1 =	2550 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	6.42 Kn-m
Shear Wind =	2.52 Kn

Pile Properties

Safety Factory	0.55	
Hu =	6.19 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	9.49 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.68 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

150 SED H5 (Minimum 175 dia. at Floor Level)	Dry Use	Height	3200 mm
Area	20729 mm ²	As	15546.6796875 mm ²
Ix	34210793 mm ⁴	Zx	421056 mm ³
Iy	34210793 mm ⁴	Zx	421056 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 7.875 m²

Dead	1.97 Kn	Live	1.97 Kn
Wind Down	3.39 Kn	Snow	0.00 Kn
Moment Wind	3.21 Kn-m		
Phi	0.8	K8	0.69
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

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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

PhiNcx Wind	204.58 Kn	PhiMnx Wind	8.38 Kn-m	PhiVnx Wind	36.81 Kn
PhiNcx Dead	122.75 Kn	PhiMnx Dead	5.03 Kn-m	PhiVnx Dead	22.09 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.42 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.18 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 16.43 \text{ mm} < 33.91 \text{ mm}$$

$D_s =$	0.6 mm	Pile Diameter
$L =$	1400 mm	Pile embedment length
$f_1 =$	2550 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

$$\text{Total Area over Pole} = 7.875 \text{ m}^2$$

Moment Wind =	3.21 Kn-m
Shear Wind =	1.26 Kn

Pile Properties

Safety Factor	0.55	
$H_u =$	6.19 Kn	Ultimate Lateral Strength of the Pile, Short pile
$M_u =$	9.49 Kn-m	Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.34 < 1 \text{ OK}$$

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

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

Geometry For End Bay Pole

$$D_s = 0.6 \text{ mm} \quad \text{Pile Diameter}$$

$$L = 1400 \text{ mm} \quad \text{Pile embedment length}$$

$$f_1 = 2550 \text{ mm} \quad \text{Distance at which the shear force is applied}$$

$$f_2 = 0 \text{ mm} \quad \text{Distance of top soil at rest pressure}$$

Loads

$$\text{Moment Wind} = 3.21 \text{ Kn-m}$$

$$\text{Shear Wind} = 1.26 \text{ Kn}$$

Pile Properties

$$\text{Safety Factor} = 0.55$$

$$H_u = 6.19 \text{ Kn} \quad \text{Ultimate Lateral Strength of the Pile, Short pile}$$

$$M_u = 9.49 \text{ Kn-m} \quad \text{Ultimate Moment Capacity of Pile}$$

Checks

$$\text{Applied Forces/Capacities} = 0.34 < 1 \text{ OK}$$

Uplift Check

$$\text{Density of Concrete} = 24 \text{ Kn/m}^3$$

$$\text{Density of Timber Pole} = 5 \text{ Kn/m}^3$$

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

$$K_s \text{ (Lateral Earth Pressure Coefficient) for cast into place concrete piles} = 1.5$$

$$\text{Formula to calculate Skin Friction} = \text{Safety factor (0.55)} \times \text{Density of Soil (18)} \times \text{Height of Pile (1400)} \times K_s (1.5) \times 0.5 \times \tan(30) \times \pi \times \text{Dia of Pile (0.6)} \times \text{Height of Pile (1400)}$$

$$\text{Skin Friction} = 15.83 \text{ Kn}$$

$$\text{Weight of Pile} + \text{Pile Skin Friction} = 20.41 \text{ Kn}$$

$$\text{Uplift on one Pile} = 8.11 \text{ Kn}$$

Uplift is ok