

Pole Shed App Ver 01 2022

Job No.: J Vanek - 2
Latitude: -41.076688

Address: 38 Wilkie St, Greytown, New Zealand
Longitude: 175.440854

Date: 3/6/2025
Elevation: 65.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N1	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	3.5 m
Wind Region	NZ2	Terrain Category	2.61	Design Wind Speed	37.66 m/s
Wind Pressure	0.85 KPa	Lee Zone	YES	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 = Gable Enclosed

For roof $C_{p,i} = 0.6714$

For roof $C_{p,e}$ from 0 m To 3.0 m $C_{p,e} = -0.9103$ $p_e = -0.26$ KPa $p_{net} = -0.78$ KPa

For roof $C_{p,e}$ from 3.0 m To 6.0 m $C_{p,e} = -0.529$ $p_e = -0.34$ KPa $p_{net} = -0.86$ KPa

For wall Windward $C_{p,i} = 0.6714$ side Wall $C_{p,i} = -0.5969$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 13.50 m $C_{p,e} = 0.7$ $p_e = 0.54$ KPa $p_{net} = 1.09$ KPa

For side wall $C_{p,e}$ from 0 m To 3.50 m $C_{p,e} =$ $p_e = -0.50$ KPa $p_{net} = 0.05$ KPa

Maximum Upward pressure used in roof member Design = 1.10 KPa

Maximum Downward pressure used in roof member Design = 0.70 KPa

Maximum Wall pressure used in Design = 1.09 KPa

Maximum Racking pressure used in Design = 0.77 KPa

Design Summary

Purlin Design

Purlin Spacing = 800 mm Purlin Span = 3450 mm Try Purlin 200x50 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 = 0.58 S1 Downward = 11.27 S1 Upward = 21.91

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

Capacity Checks

M _{1.35D}	0.4 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	557.50 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.78 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	166.85 %
M _{0.9D-WnUp}	-1.04 Kn-m	Capacity	-2.16 Kn-m	Passing Percentage	207.69 %
V _{1.35D}	0.47 Kn	Capacity	9.65 Kn	Passing Percentage	2053.19 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.38 Kn	Capacity	12.86 Kn	Passing Percentage	931.88 %
V _{0.9D-WnUp}	-1.21 Kn	Capacity	-16.08 Kn	Passing Percentage	1328.93 %

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 = 7.15 mm Limit by Woolcock et al, 1999 Span/240 = 14.17 mm

Deflection under Dead and Service Wind = 5.30 mm Limit by Woolcock et al, 1999 Span/100 = 34.00 mm

Reactions

Maximum downward = 1.38 kn Maximum upward = -1.21 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 = 3600 mm Internal Rafter Span = 5850 mm Try Rafter 2x240x45 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 = 6.71 S1 Upward = 6.71

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

Capacity Checks

M _{1.35D}	5.20 Kn-m	Capacity	19.9 Kn-m	Passing Percentage	382.69 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	15.40 Kn-m	Capacity	26.54 Kn-m	Passing Percentage	172.34 %

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M _{0.9D-WnUp}	-13.48 Kn-m	Capacity	-33.18 Kn-m	Passing Percentage	246.14 %
V _{1.35D}	3.55 Kn	Capacity	36.82 Kn	Passing Percentage	1037.18 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	10.53 Kn	Capacity	49.08 Kn	Passing Percentage	466.10 %
V _{0.9D-WnUp}	-9.21 Kn	Capacity	-61.36 Kn	Passing Percentage	666.23 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 14.38 mm Limit by Woolcock et al, 1999 Span/240 = 25.00 mm

Deflection under Dead and Service Wind = 22.64 mm Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward = 10.53 kn Maximum upward = -9.21 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 f_{pj} = 22.7 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 = 29.11 Kn > -9.21 Kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 3600 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)

K₁ Short term = 1 K₄ = 1 K₅ = 1 K₈ Downward = 1.00

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K8 Upward =0.95 S1 Downward =9.63 S1 Upward =13.62

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

Capacity Checks

M _{Wind+Snow}	1.59 Kn-m	Capacity	1.99 Kn-m	Passing Percentage	125.16 %
V _{0.9D-WnUp}	1.77 Kn	Capacity	12.06 Kn	Passing Percentage	681.36 %

Deflections

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

Deflection under Snow and Service Wind = 22.77 mm Limit by Woolcock et al, 1999 Span/100 = 36.00 mm
Sag during installation = 10.18 mm

Reactions

Maximum = 1.77 kn

Girt Design Sides

Girt's Spacing = 900 mm Girt's Span = 3000 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)

K1 Short term = 1 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.98 S1 Downward =9.63 S1 Upward =12.44

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

Capacity Checks

M _{Wind+Snow}	1.10 Kn-m	Capacity	2.05 Kn-m	Passing Percentage	186.36 %
V _{0.9D-WnUp}	1.47 Kn	Capacity	12.06 Kn	Passing Percentage	820.41 %

Deflections

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

Deflection under Snow and Service Wind = 10.98 mm Limit by Woolcock et al. 1999 Span/100 = 30.00 mm
Sag during installation =4.91 mm

Reactions

Maximum = 1.47 kn

Middle Pole Design

Geometry

175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	3500 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	1300 mm c/c		

Loads

Total Area over Pole = 10.8 m²

Dead	2.70 Kn	Live	2.70 Kn
Wind Down	7.56 Kn	Snow	0.00 Kn
Moment wind	6.35 Kn-m		
Phi	0.8	K8	1.00
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	397.41 Kn	PhiMnx Wind	18.78 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	238.44 Kn	PhiMnx Dead	11.27 Kn-m	PhiVnx Dead	29.41 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.37 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.15 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 19.47 \text{ mm} < 35.00 \text{ mm}$$

Drained Lateral Strength of Middle pile in cohesionless soils Free Head short pile

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Assumed Soil Properties

Gamma 18 Kn/m³ Friction angle 30 deg Cohesion 0 Kn/m³
K₀ = $(1 - \sin(30)) / (1 + \sin(30))$
K_p = $(1 + \sin(30)) / (1 - \sin(30))$

Geometry For Middle Bay Pole

D_s = 0.6 mm Pile Diameter
L = 1500 mm Pile embedment length
f₁ = 2625 mm Distance at which the shear force is applied
f₂ = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 6.35 Kn-m
Shear Wind = 2.42 Kn

Pile Properties

Safety Factory 0.55
H_u = 7.29 Kn Ultimate Lateral Strength of the Pile, Short pile
M_u = 11.57 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.55 < 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(1500) x K_s(1.5) x 0.5 x 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 = 22.56 Kn

Uplift on one Pile = 9.45 Kn

Uplift is ok