

Pole Shed App Ver 01 2022

Job No.: Wither Hills Farm
Park Woolshed-Training Bay
6000

Address: Lot 1 DP 8914, Redwood Street, Witherlea, New Zealand
Date: 25/06/2025

Latitude: -41.544902

Longitude: 173.963463

Elevation: 48.5 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	6.8 m
Wind Region	NZ2	Terrain Category	1.91	Design Wind Speed	40.36 m/s
Wind Pressure	0.98 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 = Gable Enclosed

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

For roof $C_{p,e}$ from 0 m To 4.5 m $C_{p,e} = -1.0689$ $p_e = -0.94$ KPa $p_{net} = -0.94$ KPa

For roof $C_{p,e}$ from 4.5 m To 9 m $C_{p,e} = -0.5844$ $p_e = -0.51$ KPa $p_{net} = -0.51$ 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 25.13 m $C_{p,e} = 0.7$ $p_e = 0.62$ KPa $p_{net} = 0.91$ KPa

For side wall $C_{p,e}$ from 0 m To 6.40 m $C_{p,e} =$ $p_e = -0.57$ KPa $p_{net} = -0.57$ KPa

Maximum Upward pressure used in roof member Design = 0.94 KPa

Maximum Downward pressure used in roof member Design = 0.47 KPa

Maximum Wall pressure used in Design = 0.91 KPa

Maximum Racking pressure used in Design = 0.88 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 5850 mm

Try Purlin 300x50 SG8 Dry

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

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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 = 0.46 S1 Downward = 13.93 S1 Upward = 25.01

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

Capacity Checks

M _{1.35D}	1.3 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	363.08 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	3.57 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	176.47 %
M _{0.9D-W_nUp}	-2.75 Kn-m	Capacity	-3.87 Kn-m	Passing Percentage	140.73 %
V _{1.35D}	0.89 Kn	Capacity	14.47 Kn	Passing Percentage	1625.84 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	2.03 Kn	Capacity	19.30 Kn	Passing Percentage	950.74 %
V _{0.9D-W_nUp}	-1.88 Kn	Capacity	-24.12 Kn	Passing Percentage	1282.98 %

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 = 14.73 mm Limit by Woolcock et al, 1999 Span/240 = 24.17 mm

Deflection under Dead and Service Wind = 12.93 mm Limit by Woolcock et al, 1999 Span/100 = 58.00 mm

Reactions

Maximum downward = 2.03 kn Maximum upward = -1.88 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 = 5935 mm Internal Rafter Span = 8850 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)

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

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M _{1.35D}	19.61 Kn-m	Capacity	60.82 Kn-m	Passing Percentage	310.15 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	44.74 Kn-m	Capacity	81.1 Kn-m	Passing Percentage	181.27 %
M _{0.9D-WnUp}	-41.55 Kn-m	Capacity	-101.38 Kn-m	Passing Percentage	244.00 %
V _{1.35D}	8.86 Kn	Capacity	77.32 Kn	Passing Percentage	872.69 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	20.22 Kn	Capacity	103.08 Kn	Passing Percentage	509.79 %
V _{0.9D-WnUp}	-18.78 Kn	Capacity	-128.86 Kn	Passing Percentage	686.16 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 25.405 mm Limit by Woolcock et al, 1999 Span/240 = 37.50 mm

Deflection under Dead and Service Wind = 34.58 mm Limit by Woolcock et al, 1999 Span/100 = 90.00 mm

Reactions

Maximum downward = 20.22 kn Maximum upward = -18.78 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 3

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 = 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 = 43.67 Kn > -18.78 Kn

Rafter Design External

External Rafter Load Width = 3000 mm External Rafter Span = 4371 mm Try Rafter 360x45 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 = 0.81

K8 Upward = 0.81 S1 Downward = 17.01 S1 Upward = 17.01

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

Capacity Checks

M _{1.35D}	2.42 Kn-m	Capacity	17.70 Kn-m	Passing Percentage	731.40 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_{nDn}}	5.52 Kn-m	Capacity	23.60 Kn-m	Passing Percentage	427.54 %
M _{0.9D-W_{nUp}}	-5.12 Kn-m	Capacity	-29.50 Kn-m	Passing Percentage	576.17 %
V _{1.35D}	2.21 Kn	Capacity	27.61 Kn	Passing Percentage	1249.32 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_{nDn}}	5.05 Kn	Capacity	36.82 Kn	Passing Percentage	729.11 %
V _{0.9D-W_{nUp}}	-4.69 Kn	Capacity	-46.02 Kn	Passing Percentage	981.24 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 2.50 mm Limit by Woolcock et al, 1999 Span/240 = 18.75 mm
Deflection under Dead and Service Wind = 3.06 mm Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Reactions

Maximum downward = 5.05 kn Maximum upward = -4.69 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 3

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 = 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 = $\phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s$ (Eq 4.12) = -50.09 kn > -4.69 Kn

Single Shear Capacity under short term loads = -21.83 Kn > -4.69 Kn

Intermediate Design Front and Back

Intermediate Spacing = 3000 mm Intermediate Span = 5849 mm Try Intermediate 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 K4 = 1 K5 = 1 K8 Downward = 0.94

K8 Upward = 1.00 S1 Downward = 13.93 S1 Upward = 1.12

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

Capacity Checks

M _{Wind+Snow}	11.68 Kn-m	Capacity	16.8 Kn-m	Passing Percentage	143.84 %
V _{0.9D-WnUp}	7.98 Kn	Capacity	-48.24 Kn	Passing Percentage	604.51 %

Deflections

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

Deflection under Snow and Service Wind = 34.245 mm Limit by Woolcock et al, 1999 Span/100 = 58.49 mm

Reactions

Maximum = 7.98 kn

Intermediate Design Sides

Intermediate Spacing = 2250 mm Intermediate Span = 6250 mm Try Intermediate 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 K4 = 1 K5 = 1 K8 Downward = 0.94

K8 Upward = 1.00 S1 Downward = 13.93 S1 Upward = 1.16

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

Capacity Checks

M _{Wind+Snow}	5.00 Kn-m	Capacity	16.8 Kn-m	Passing Percentage	336.00 %
V _{0.9D-WnUp}	3.20 Kn	Capacity	48.24 Kn	Passing Percentage	1507.50 %

Deflections

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

Deflection under Snow and Service Wind = 33.475 mm Limit by Woolcock et al, 1999 Span/100 = 62.50 mm

Reactions

Maximum = 3.20 kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 3000 mm

Try Girt 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 K4 = 1 K5 = 1 K8 Downward = 0.94

K8 Upward = 0.45 S1 Downward = 13.93 S1 Upward = 25.43

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

Capacity Checks

M _{Wind+Snow}	0.92 Kn-m	Capacity	3.75 Kn-m	Passing Percentage	407.61 %
V _{0.9D-WnUp}	1.23 Kn	Capacity	24.12 Kn	Passing Percentage	1960.98 %

Deflections

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

Deflection under Snow and Service Wind = 1.15 mm Limit by Woolcock et al, 1999 Span/100 = 30.00 mm

Sag during installation = 4.91 mm

Reactions

Maximum = 1.23 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 2250 mm

Try Girt 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 K4 = 1 K5 = 1 K8 Downward = 0.94

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K8 Upward =0.57 S1 Downward =13.93 S1 Upward =22.03

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

Capacity Checks

M _{Wind+Snow}	0.52 Kn-m	Capacity	4.82 Kn-m	Passing Percentage	926.92 %
V _{0.9D-WnUp}	0.92 Kn	Capacity	24.12 Kn	Passing Percentage	2621.74 %

Deflections

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

Deflection under Snow and Service Wind = 0.36 mm Limit by Woolcock et al. 1999 Span/100 = 22.50 mm
Sag during installation =1.55 mm

Reactions

Maximum = 0.92 kn

Middle Pole Design

Geometry

300 SED H5 (Minimum 325 dia. at Floor Level)	Dry Use	Height	6440 mm
Area	76660 mm ²	As	57495.1171875 mm ²
I _x	467896461 mm ⁴	Z _x	2994537 mm ³
I _y	467896461 mm ⁴	Z _y	2994537 mm ³
Lateral Restraint	6440 mm c/c		

Loads

Total Area over Pole = 26.7075 m²

Dead	6.68 Kn	Live	6.68 Kn
Wind Down	12.55 Kn	Snow	0.00 Kn
Moment wind	45.17 Kn-m		
Phi	0.8	K8	0.64
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	706.94 Kn	PhiMnx Wind	55.69 Kn-m	PhiVnx Wind	136.15 Kn
PhiNcx Dead	424.17 Kn	PhiMnx Dead	33.41 Kn-m	PhiVnx Dead	81.69 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.85 < 1 \text{ OK}$

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.69 < 1 \text{ OK}$

Deflection at top under service lateral loads = 64.17 mm < 64.40 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

$D_s = 0.6 \text{ m}$ Pile Diameter
 $L = 2400 \text{ mm}$ Pile embedment length
 $f_1 = 5100 \text{ mm}$ Distance at which the shear force is applied
 $f_2 = 0 \text{ mm}$ Distance of top soil at rest pressure

Loads

Moment Wind = 45.17 Kn-m
Shear Wind = 8.86 Kn

Pile Properties

Safety Factor 0.55
 $H_u = 16.42 \text{ Kn}$ Ultimate Lateral Strength of the Pile, Short pile
 $M_u = 49.58 \text{ Kn-m}$ Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.91 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

275 SED H5 (Minimum 300 dia. at Floor Level)	Dry Use	Height	6440 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	mm c/c		

Loads

Total Area over Pole = 6.75 m²

Dead	1.69 Kn	Live	1.69 Kn
Wind Down	3.17 Kn	Snow	0.00 Kn
Moment Wind	15.22 Kn-m		
Phi	0.8	K ₈	0.56
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	521.11 Kn	PhiM _{nx} Wind	37.77 Kn-m	PhiV _{nx} Wind	115.24 Kn
PhiN _{cx} Dead	312.67 Kn	PhiM _{nx} Dead	22.66 Kn-m	PhiV _{nx} Dead	69.14 Kn

Checks

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

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.17 < 1$ OK

Deflection at top under service lateral loads = 31.79 mm < 67.83 mm

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Ds =	0.6 mm	Pile Diameter
L =	1700 mm	Pile embedment length
f1 =	5100 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 6.75 m²

Moment Wind =	15.22 Kn-m
Shear Wind =	2.98 Kn

Pile Properties

Safety Factory	0.55	
Hu =	6.44 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	18.92 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.80 < 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 =	1700 mm	Pile embedment length
f1 =	5100 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	15.22 Kn-m
Shear Wind =	2.98 Kn

Pile Properties

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Safety Factor	0.55	
Hu =	6.44 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	18.92 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.80 < 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(2400) x Ks(1.5) x $0.5 \times \tan(30) \times \pi \times \text{Dia of Pile}(0.6) \times \text{Height of Pile}(2400)$

Skin Friction = 46.52 Kn

Weight of Pile + Pile Skin Friction = 50.15 Kn

Uplift on one Pile = 19.10 Kn

Uplift is ok