<u>Pole Shed App Ver 01 2022</u>

Job No.: Wither Hills Farm Park Woolshed-Training Bay 4420	**Address:** Lot 1 DP 8914, Redwood Street, Witherlea, New Zealand	**Date:** 24/06/2025
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 Pressues

Shed Type = Gable Enclosed

For roof Cp,i = -0.3

For roof CP,e from 0 m To 4.5 m Cpe = -1.0689 pe = -0.94 KPa pnet = -0.94 KPa

For roof CP,e from 4.5 m To 9 m Cpe = -0.5844 pe = -0.51 KPa pnet = -0.51 KPa

For wall Windward Cp,i = -0.3 side Wall Cp,i = -0.3

For wall Windward and Leeward CP,e from 0 m To 25.13 m Cpe = 0.7 pe = 0.62 KPa pnet = 0.91 KPa

For side wall CP,e from 0 m To 6.40 m Cpe = pe = -0.57 KPa pnet = -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 = 4270 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 =0.32   S1 Downward =13.93   S1 Upward =30.17

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

Capacity Checks

$M_{1.35D}$	0.69 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	**684.06 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.38 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	**264.71 %**
$M_{0.9D-WnUp}$	-1.47 Kn-m	Capacity	-2.69 Kn-m	Passing Percentage	**182.99 %**
$V_{1.35D}$	0.65 Kn	Capacity	14.47 Kn	Passing Percentage	**2226.15 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	1.48 Kn	Capacity	19.30 Kn	Passing Percentage	**1304.05 %**
$V_{0.9D-WnUp}$	-1.37 Kn	Capacity	-24.12 Kn	Passing Percentage	**1760.58 %**

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 = 4.75 mm	Limit by Woolcock et al, 1999 Span/240 = 17.58 mm
Deflection under Dead and Service Wind = 3.62 mm	Limit by Woolcock et al, 1999 Span/100 = 42.20 mm

Reactions

Maximum downward =1.48 kn   Maximum upward = -1.37 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 = 4420 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

$M_{1.35D}$	14.60 Kn-m	Capacity	60.82 Kn-m	Passing Percentage	**416.58 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	33.32 Kn-m	Capacity	81.1 Kn-m	Passing Percentage	**243.40 %**
$M_{0.9D-WnUp}$	-30.94 Kn-m	Capacity	-101.38 Kn-m	Passing Percentage	**327.67 %**
$V_{1.35D}$	6.60 Kn	Capacity	77.32 Kn	Passing Percentage	**1171.52 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	15.06 Kn	Capacity	103.08 Kn	Passing Percentage	**684.46 %**
$V_{0.9D-WnUp}$	-13.98 Kn	Capacity	-128.86 Kn	Passing Percentage	**921.75 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 18.92 mm   Limit by Woolcock et al, 1999 Span/240 = 37.50 mm

Deflection under Dead and Service Wind = 25.75 mm   Limit by Woolcock et al, 1999 Span/100 = 90.00 mm

Reactions

Maximum downward =15.06 kn   Maximum upward = -13.98 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 > -13.98 Kn

Rafter Design External

External Rafter Load Width = 2210 mm   External Rafter Span = 4371 mm   Try Rafter 360x63 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 =0.98

K8 Upward =0.98 S1 Downward =12.10 S1 Upward =12.10

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

Capacity Checks

$M_{1.35D}$	1.78 Kn-m	Capacity	29.91 Kn-m	Passing Percentage	**1680.34 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	4.06 Kn-m	Capacity	39.88 Kn-m	Passing Percentage	**982.27 %**
$M_{0.9D-WnUp}$	-3.77 Kn-m	Capacity	-49.85 Kn-m	Passing Percentage	**1322.28 %**
$V_{1.35D}$	1.63 Kn	Capacity	38.66 Kn	Passing Percentage	**2371.78 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	3.72 Kn	Capacity	51.54 Kn	Passing Percentage	**1385.48 %**
$V_{0.9D-WnUp}$	-3.45 Kn	Capacity	-64.43 Kn	Passing Percentage	**1867.54 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 1.31 mm	Limit by Woolcock et al, 1999 Span/240= 18.75 mm
Deflection under Dead and Service Wind = 1.61 mm	Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Reactions

Maximum downward =3.72 kn Maximum upward = -3.45 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 fpj = 22.7 Mpa for Rafter with effective thickness = 63 mm

For Parallel to grain loading

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

Eccentric Load check

V = phi x k1 x k4 x k5 x fs x b x ds .... (Eq 4.12) = -70.12 kn > -3.45 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -3.45 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2210 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

$M_{Wind+Snow}$	8.60 Kn-m	Capacity	16.8 Kn-m	Passing Percentage	**195.35 %**
$V_{0.9D-WnUp}$	5.88 Kn	Capacity	-48.24 Kn	Passing Percentage	**820.41 %**

Deflections

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

Deflection under Snow and Service Wind = 25.23 mm   Limit byWoolcock et al, 1999 Span/100 = 58.49 mm

Reactions

Maximum = 5.88 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 = 2210 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 =0.58 S1 Downward =13.93 S1 Upward =21.83

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

Capacity Checks

$M_{Wind+Snow}$	0.50 Kn-m	Capacity	4.90 Kn-m	Passing Percentage	**980.00 %**
$V_{0.9D-WnUp}$	0.90 Kn	Capacity	24.12 Kn	Passing Percentage	**2680.00 %**

Deflections

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

Deflection under Snow and Service Wind = 0.34 mm Limit by Woolcock et al, 1999 Span/100 = 22.10 mm
Sag during installation = 1.45 mm

Reactions

Maximum = 0.90 kn

Girt Design Sides

Girt's Spacing = 0 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

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

$M_{Wind+Snow}$	0.00 Kn-m	Capacity	4.82 Kn-m	Passing Percentage	**Infinity %**
$V_{0.9D-WnUp}$	0.00 Kn	Capacity	24.12 Kn	Passing Percentage	**Infinity %**

Deflections

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

Deflection under Snow and Service Wind = 0.00 mm Limit by Woolcock et al. 1999 Span/100 = 22.50 mm
Sag during installation =1.55 mm

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

300 SED H5 (Minimum 325 dia. at Floor Level)	Dry Use	Height	6440 mm
Area	76660 mm2	As	57495.1171875 mm2
Ix	467896461 mm4	Zx	2994537 mm3
Iy	467896461 mm4	Zx	2994537 mm3
Lateral Restraint	6440 mm c/c		

Loads

Total Area over Pole = 19.89 m2

Dead	4.97 Kn	Live	4.97 Kn
Wind Down	9.35 Kn	Snow	0.00 Kn
Moment wind	33.64 Kn-m		
Phi	0.8	K8	0.64
K1 snow	0.8	K1 Dead	0.6
K1wind	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	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

(Mx/PhiMnx)+(N/phiNcx) = 0.63 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.39 < 1 OK

Deflection at top under service lateral loads = 47.79 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
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
L =	2200 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 =	33.64 Kn-m
Shear Wind =	6.60 Kn

Pile Properties

Safety Factory	0.55	
Hu =	13.00 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	38.93 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.86 < 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 mm2	As	48663.8671875 mm2
Ix	335197731 mm4	Zx	2331810 mm3
Iy	335197731 mm4	Zx	2331810 mm3
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 4.9725 m2

Dead	1.24 Kn	Live	1.24 Kn
Wind Down	2.34 Kn	Snow	0.00 Kn
Moment Wind	11.21 Kn-m		
Phi	0.8	K8	0.56
K1 snow	0.8	K1 Dead	0.6
K1wind	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	521.11 Kn	PhiMnx Wind	37.77 Kn-m	PhiVnx Wind	115.24 Kn
PhiNcx Dead	312.67 Kn	PhiMnx Dead	22.66 Kn-m	PhiVnx Dead	69.14 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.31 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.10 < 1 OK

Deflection at top under service lateral loads = 23.42 mm < 67.83 mm

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 = 4.9725 m2

Moment Wind =	11.21 Kn-m
Shear Wind =	2.20 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 = 0.59 < 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 =	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 =	11.21 Kn-m
Shear Wind =	2.20 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 = 0.59 < 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 = Safecty factor (0.55) x Density of Soil(18) x Height of Pile(2200) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(2200)

Skin Friction = 39.09 Kn

Weight of Pile + Pile Skin Friction = 42.41 Kn

Uplift on one Pile = 14.22 Kn

Uplift is ok