



Pole Shed App Ver 01 2022

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

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

**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 <sub>1.35D</sub>	1.3 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	<b>363.08 %</b>
M <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	3.57 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	<b>176.47 %</b>
M <sub>0.9D-W<sub>n</sub>Up</sub>	-2.75 Kn-m	Capacity	-3.87 Kn-m	Passing Percentage	<b>140.73 %</b>
V <sub>1.35D</sub>	0.89 Kn	Capacity	14.47 Kn	Passing Percentage	<b>1625.84 %</b>
V <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	2.03 Kn	Capacity	19.30 Kn	Passing Percentage	<b>950.74 %</b>
V <sub>0.9D-W<sub>n</sub>Up</sub>	-1.88 Kn	Capacity	-24.12 Kn	Passing Percentage	<b>1282.98 %</b>

#### Deflections

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3 considering at least 4 members acting together

k<sub>2</sub> 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 <sub>1.35D</sub>	19.61 Kn-m	Capacity	60.82 Kn-m	Passing Percentage	<b>310.15 %</b>
M <sub>1.2D+1.5L 1.2D+Sn 1.2D+WnDn</sub>	44.74 Kn-m	Capacity	81.1 Kn-m	Passing Percentage	<b>181.27 %</b>
M <sub>0.9D-WnUp</sub>	-41.55 Kn-m	Capacity	-101.38 Kn-m	Passing Percentage	<b>244.00 %</b>
V <sub>1.35D</sub>	8.86 Kn	Capacity	77.32 Kn	Passing Percentage	<b>872.69 %</b>
V <sub>1.2D+1.5L 1.2D+Sn 1.2D+WnDn</sub>	20.22 Kn	Capacity	103.08 Kn	Passing Percentage	<b>509.79 %</b>
V <sub>0.9D-WnUp</sub>	-18.78 Kn	Capacity	-128.86 Kn	Passing Percentage	<b>686.16 %</b>

**Deflections**

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

k<sub>2</sub> 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

K<sub>11</sub> = 12.6 f<sub>pj</sub> = 22.7 Mpa for Rafter with effective thickness = 126 mm

For Parallel to grain loading

K<sub>11</sub> = 2.0 f<sub>cj</sub> = 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 300x50 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 = 0.94

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 <sub>1.35D</sub>	2.42 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	<b>195.04 %</b>
M <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	5.52 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	<b>114.13 %</b>
M <sub>0.9D-W<sub>n</sub>Up</sub>	-5.12 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	<b>153.71 %</b>
V <sub>1.35D</sub>	2.21 Kn	Capacity	14.47 Kn	Passing Percentage	<b>654.75 %</b>
V <sub>1.2D+1.5L 1.2D+S<sub>n</sub> 1.2D+W<sub>n</sub>D<sub>n</sub></sub>	5.05 Kn	Capacity	19.30 Kn	Passing Percentage	<b>382.18 %</b>
V <sub>0.9D-W<sub>n</sub>Up</sub>	-4.69 Kn	Capacity	-24.12 Kn	Passing Percentage	<b>514.29 %</b>

**Deflections**

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

k<sub>2</sub> for Long Term Loads = 2

Deflection under Dead and Live Load = 7.91 mm      Limit by Woolcock et al, 1999 Span/240 = 18.75 mm

Deflection under Dead and Service Wind = 9.69 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 = 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

K<sub>11</sub> = 14.9 f<sub>pj</sub> = 12.9 Mpa for Rafter with effective thickness = 50 mm

For Parallel to grain loading

K<sub>11</sub> = 2.0 f<sub>cj</sub> = 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) = -25.20 kn > -4.69 Kn

Single Shear Capacity under short term loads = -10.84 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 <sub>Wind+Snow</sub>	11.68 Kn-m	Capacity	16.8 Kn-m	Passing Percentage	<b>143.84 %</b>
V <sub>0.9D-WnUp</sub>	7.98 Kn	Capacity	-48.24 Kn	Passing Percentage	<b>604.51 %</b>

#### 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 <sub>Wind+Snow</sub>	5.00 Kn-m	Capacity	16.8 Kn-m	Passing Percentage	<b>336.00 %</b>
V <sub>0.9D-WnUp</sub>	3.20 Kn	Capacity	48.24 Kn	Passing Percentage	<b>1507.50 %</b>

**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 <sub>Wind+Snow</sub>	0.92 Kn-m	Capacity	3.75 Kn-m	Passing Percentage	<b>407.61 %</b>
V <sub>0.9D-WnUp</sub>	1.23 Kn	Capacity	24.12 Kn	Passing Percentage	<b>1960.98 %</b>

**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 <sub>Wind+Snow</sub>	0.52 Kn-m	Capacity	4.82 Kn-m	Passing Percentage	<b>926.92 %</b>
V <sub>0.9D-WnUp</sub>	0.92 Kn	Capacity	24.12 Kn	Passing Percentage	<b>2621.74 %</b>

**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 <sup>2</sup>	As	57495.1171875 mm <sup>2</sup>
I <sub>x</sub>	467896461 mm <sup>4</sup>	Z <sub>x</sub>	2994537 mm <sup>3</sup>
I <sub>y</sub>	467896461 mm <sup>4</sup>	Z <sub>y</sub>	2994537 mm <sup>3</sup>
Lateral Restraint	6440 mm c/c		

**Loads**

Total Area over Pole = 26.7075 m<sup>2</sup>

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 <sub>b</sub> =	36.3 MPa	f <sub>s</sub> =	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/m<sup>3</sup>      Friction angle 30 deg      Cohesion 0 Kn/m<sup>3</sup>

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

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

**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	6500 mm
Area	64885 mm <sup>2</sup>	As	48663.8671875 mm <sup>2</sup>
I <sub>x</sub>	335197731 mm <sup>4</sup>	Z <sub>x</sub>	2331810 mm <sup>3</sup>
I <sub>y</sub>	335197731 mm <sup>4</sup>	Z <sub>y</sub>	2331810 mm <sup>3</sup>
Lateral Restraint	mm c/c		

#### Loads

Total Area over Pole = 6.75 m<sup>2</sup>

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 <sub>8</sub>	0.55
K <sub>1</sub> snow	0.8	K <sub>1</sub> Dead	0.6
K <sub>1</sub> wind	1		

#### Material

Peeling	Steaming	Normal	Dry Use
f <sub>b</sub> =	36.3 MPa	f <sub>s</sub> =	2.96 MPa
f <sub>c</sub> =	18 MPa	f <sub>p</sub> =	7.2 MPa
f <sub>t</sub> =	22 MPa	E =	9257 MPa

#### Capacities

PhiN <sub>cx</sub> Wind	512.68 Kn	PhiM <sub>nx</sub> Wind	37.16 Kn-m	PhiV <sub>nx</sub> Wind	115.24 Kn
PhiN <sub>cx</sub> Dead	307.61 Kn	PhiM <sub>nx</sub> Dead	22.29 Kn-m	PhiV <sub>nx</sub> Dead	69.14 Kn

#### Checks

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

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

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 <sup>3</sup>	Friction angle	30 deg	Cohesion	0 Kn/m <sup>3</sup>
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/m<sup>3</sup>

Density of Timber Pole = 5 Kn/m<sup>3</sup>

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