Pole Shed App Ver 01 2022

Job No.:	Justin Mills	**Address:**	2 Robinson Street, Cambridge 3434, New Zealand	**Date:**	08/11/2024
Latitude:	-37.884276	**Longitude:**	175.476739	**Elevation:**	70.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N0	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	1	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	5.25 m
Wind Region	NZ1	Terrain Category	3.0	Design Wind Speed	40.08 m/s
Wind Pressure	0.96 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 4.38 m Cpe = -0.9 pe = -0.78 KPa pnet = -0.78 KPa

For roof CP,e from 4.38 m To 8.75 m Cpe = -0.5 pe = -0.43 KPa pnet = -0.43 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 11 m Cpe = 0.7 pe = 0.61 KPa pnet = 0.90 KPa

For side wall CP,e from 0 m To 4.38 m Cpe = pe = -0.56 KPa pnet = -0.56 KPa

Maximum Upward pressure used in roof member Design = 0.78 KPa

Maximum Downward pressure used in roof member Design = 0.38 KPa

Maximum Wall pressure used in Design = 0.78 KPa

Maximum Racking pressure used in Design = 1.04 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm Purlin Span = 5350 mm Try Purlin 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

K8 Upward =0.50 S1 Downward =13.82 S1 Upward =23.71

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

Capacity Checks

$M_{1.35D}$	1.09 Kn-m	Capacity	2.73 Kn-m	Passing Percentage	**250.46 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.44 Kn-m	Capacity	3.64 Kn-m	Passing Percentage	**149.18 %**
$M_{0.9D-WnUp}$	-1.79 Kn-m	Capacity	-2.44 Kn-m	Passing Percentage	**64.55 %**
$V_{1.35D}$	0.81 Kn	Capacity	10.42 Kn	Passing Percentage	**1286.42 %**

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$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	1.64 Kn	Capacity	13.89 Kn	Passing Percentage	**846.95 %**
$V_{0.9D-WnUp}$	-1.34 Kn	Capacity	-17.37 Kn	Passing Percentage	**1296.27 %**

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 = 15.97 mm	Limit by Woolcock et al, 1999 Span/240 = 22.08 mm
Deflection under Dead and Service Wind = 18.37 mm	Limit by Woolcock et al, 1999 Span/100 = 53.00 mm

Reactions

Maximum downward =1.64 kn   Maximum upward = -1.34 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 = 5500 mm   Internal Rafter Span = 5850 mm   Try Rafter 2x240x63 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 =4.59   S1 Upward =4.59

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

Capacity Checks

$M_{1.35D}$	7.94 Kn-m	Capacity	27.86 Kn-m	Passing Percentage	**350.88 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	16.00 Kn-m	Capacity	37.16 Kn-m	Passing Percentage	**232.25 %**
$M_{0.9D-WnUp}$	-13.06 Kn-m	Capacity	-46.44 Kn-m	Passing Percentage	**355.59 %**
$V_{1.35D}$	5.43 Kn	Capacity	51.54 Kn	Passing Percentage	**949.17 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	10.94 Kn	Capacity	68.72 Kn	Passing Percentage	**628.15 %**
$V_{0.9D-WnUp}$	-8.93 Kn	Capacity	-85.9 Kn	Passing Percentage	**961.93 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 15.695 mm	Limit by Woolcock et al, 1999 Span/240 = 25.00 mm
Deflection under Dead and Service Wind = 20.055 mm	Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward =10.94 kn   Maximum upward = -8.93 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 > -8.93 Kn

Rafter Design External

External Rafter Load Width = 2750 mm External Rafter Span = 4663 mm Try Rafter 240x63 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 =9.78 S1 Upward =9.78

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

Capacity Checks

$M_{1.35D}$	2.52 Kn-m	Capacity	13.93 Kn-m	Passing Percentage	**552.78 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	5.08 Kn-m	Capacity	18.58 Kn-m	Passing Percentage	**365.75 %**
$M_{0.9D\text{-}WnUp}$	-4.15 Kn-m	Capacity	-23.22 Kn-m	Passing Percentage	**559.52 %**
$V_{1.35D}$	2.16 Kn	Capacity	25.77 Kn	Passing Percentage	**1193.06 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	4.36 Kn	Capacity	34.36 Kn	Passing Percentage	**788.07 %**
$V_{0.9D\text{-}WnUp}$	-3.56 Kn	Capacity	-42.95 Kn	Passing Percentage	**1206.46 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 4.19 mm Limit by Woolcock et al, 1999 Span/240= 17.50 mm

Deflection under Dead and Service Wind = 4.82 mm Limit by Woolcock et al, 1999 Span/100 = 42.00 mm

Reactions

Maximum downward =4.36 kn Maximum upward = -3.56 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) = -42.07 kn > -3.56 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -3.56 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2750 mm Intermediate Span = 3350 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 =0.63

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

Capacity Checks

$M_{Wind+Snow}$	3.01 Kn-m	Capacity	3.3 Kn-m	Passing Percentage	**109.63 %**
$V_{0.9D-WnUp}$	3.59 Kn	Capacity	-20.26 Kn	Passing Percentage	**564.35 %**

Deflections

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

Deflection under Snow and Service Wind = 31.645 mm Limit byWoolcock et al, 1999 Span/100 = 33.50 mm

Reactions

Maximum = 3.59 kn

Intermediate Design Sides

Intermediate Spacing = 2100.1050052502624 mm Intermediate Span = 4662 mm Try Intermediate 2x190x45 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 =0.98

K8 Upward =1.00 S1 Downward =12.23 S1 Upward =0.88

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

Capacity Checks

$M_{Wind+Snow}$	2.23 Kn-m	Capacity	6.06 Kn-m	Passing Percentage	**271.75 %**
$V_{0.9D-WnUp}$	1.91 Kn	Capacity	27.5 Kn	Passing Percentage	**1439.79 %**

Deflections

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

Deflection under Snow and Service Wind = 36.285 mm Limit by Woolcock et al, 1999 Span/100 = 46.62 mm

Reactions

Maximum = 1.91 kn

Girt Design Front and Back

Girt's Spacing = 1300 mm   Girt's Span = 2750 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 =0.76   S1 Downward =10.36   S1 Upward =18.11

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

Capacity Checks

$M_{Wind+Snow}$	0.96 Kn-m	Capacity	1.26 Kn-m	Passing Percentage	**131.25 %**
$V_{0.9D-WnUp}$	1.39 Kn	Capacity	10.13 Kn	Passing Percentage	**728.78 %**

Deflections

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

Deflection under Snow and Service Wind = 10.95 mm   Limit by Woolcock et al, 1999 Span/100 = 27.50 mm
Sag during installation = 4.28 mm

Reactions

Maximum = 1.39 kn

Girt Design Sides

Girt's Spacing = 1300 mm   Girt's Span = 2100 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 =0.87   S1 Downward =10.36   S1 Upward =15.83

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

Capacity Checks

$M_{Wind+Snow}$	0.56 Kn-m	Capacity	1.43 Kn-m	Passing Percentage	**255.36 %**
$V_{0.9D-WnUp}$	1.06 Kn	Capacity	10.13 Kn	Passing Percentage	**955.66 %**

Deflections

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

Deflection under Snow and Service Wind = 3.73 mm   Limit by Woolcock et al. 1999 Span/100 = 21.00 mm
Sag during installation =1.46 mm

Reactions

Maximum = 1.06 kn

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(900) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(900)

Skin Friction = 6.54 Kn

Weight of Pile + Pile Skin Friction = 8.88 Kn

Uplift on one Pile = 9.16 Kn

Uplift is ok