Pole Shed App Ver 01 2022 by RnH Consulting Engineers

Job No.: Landpower **Address:** 69 School Road, Yaldhurst, New Zealand **Date:** 9/8/2022
Latitude: -43.51049 **Longitude:** 172.499567 **Elevation:** 42.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N4	Ground Snow Load	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	7 m
Wind Region	NZ2	Terrain Category	2.22	Design Wind Speed	38.41 m/s
Wind Pressure	0.89 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	High				

Note: Wind lateral loads are governing over Earthquake loads, So only wind loads are considered in calculations

Pressure Coefficients and Pressues

Shed Type = Mono Open

For roof Cp,i = -0.55

For roof CP,e from 0 m To 3.25 m Cpe = -0.933 pe = -0.52 KPa pnet = -0.95 KPa

For roof CP,e from 3.25 m To 6.50 m Cpe = -0.88 pe = -0.49 KPa pnet = -0.92 KPa

For wall Windward Cp,i = 0.645 side Wall Cp,i = -0.55

For wall Windward and Leeward CP,e from 0 m To 12 m Cpe = 0.7 pe = 0.56 KPa pnet = 1.03 KPa

For side wall CP,e from 0 m To 6.50 m Cpe = pe = -0.52 KPa pnet = 0.05 KPa

Maximum Upward pressure used in roof member Design = 0.95 KPa

Maximum Downward pressure used in roof member Design = 0.47 KPa

Maximum Wall pressure used in Design = 1.03 KPa

Maximum Racking pressure used in Design = 0.96 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm Purlin Span = 11800 mm Try Purlin 450x45 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 =0.72

K8 Upward =0.19 S1 Downward =19.04 S1 Upward =39.81

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

Capacity Checks

$M_{1.35D}$	5.29 Kn-m	Capacity	23.45 Kn-m	Passing Percentage	**443.29 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	14.57 Kn-m	Capacity	31.26 Kn-m	Passing Percentage	**214.55 %**
$M_{0.9D-WnUp}$	-11.36 Kn-m	Capacity	-10.21 Kn-m	Passing Percentage	**89.88 %**
$V_{1.35D}$	1.79 Kn	Capacity	34.52 Kn	Passing Percentage	**1928.49 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	4.94 Kn	Capacity	46.02 Kn	Passing Percentage	**931.58 %**
$V_{0.9D-WnUp}$	-3.85 Kn	Capacity	-57.53 Kn	Passing Percentage	**1494.29 %**

Deflections

Modulus of Elasticity = 13200 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 = 30.22 mm	Limit by AS1170.0 Table C1 Span/250 = 47.20 mm
Deflection under Dead and Service Wind = 37.02 mm	Limit by AS1170.0 Table C1 Span/120 = 98.33 mm

Reactions

Maximum downward =4.94 kn Maximum upward = -3.85 kn

Number of Blocking = 2 if 0 then no blocking required, if 1 then one midspan blocking required

Rafter Design Internal

Internal Rafter Load Width = 12000 mm Internal Rafter Span = 11850 mm Try Rafter 2x300x45 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 =7.61 S1 Upward =7.61

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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$M_{1.35D}$	71.09 Kn-m	Capacity	34.92 Kn-m	Passing Percentage	**49.12 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	195.89 Kn-m	Capacity	46.56 Kn-m	Passing Percentage	**23.77 %**
$M_{0.9D-WnUp}$	-152.71 Kn-m	Capacity	-58.2 Kn-m	Passing Percentage	**38.11 %**
$V_{1.35D}$	24.00 Kn	Capacity	46.02 Kn	Passing Percentage	**191.75 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	66.12 Kn	Capacity	61.36 Kn	Passing Percentage	**92.80 %**
$V_{0.9D-WnUp}$	-51.55 Kn	Capacity	-76.7 Kn	Passing Percentage	**148.79 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 392.725 mm Limit by AS1170.0 Table C1 Span/250 = 48.00 mm
Deflection under Dead and Service Wind = 534.545 mm Limit by AS1170.0 Table C1 Span/120 = 100.00 mm

Reactions

Maximum downward =66.12 kn Maximum upward = -51.55 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 = 90 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 > -51.55 Kn

Rafter Design External

External Rafter Load Width = 6000 mm External Rafter Span = 3814 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)

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

$M_{1.35D}$	3.68 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	**128.26 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	10.15 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	**62.07 %**
$M_{0.9D-WnUp}$	-7.91 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	**99.49 %**
$V_{1.35D}$	3.86 Kn	Capacity	14.47 Kn	Passing Percentage	**374.87 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	10.64 Kn	Capacity	19.30 Kn	Passing Percentage	**181.39 %**
$V_{0.9D-WnUp}$	-8.30 Kn	Capacity	-24.12 Kn	Passing Percentage	**290.60 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 9.88 mm	Limit by AS1170.0 Table C1 Span/250 = 16.00 mm
Deflection under Dead and Service Wind = 12.10 mm	Limit by AS1170.0 Table C1 Span/120 = 33.33 mm

Reactions

Maximum downward =10.64 kn Maximum upward = -8.30 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 4

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

K11 = 14.9 fpj = 12.9 Mpa for Rafter with effective thickness = 50 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) = -25.20 kn > -8.30 Kn

Single Shear Capacity under short term loads = -21.67 Kn > -8.30 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2000 mm Intermediate Span = 5700 mm Try Intermediate 2x250x50 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 =0.97

K8 Upward =1.00 S1 Downward =12.68 S1 Upward =1.01

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

Capacity Checks

$M_{Wind+Snow}$	8.37 Kn-m	Capacity	12.02 Kn-m	Passing Percentage	**143.61 %**
$V_{0.9D-WnUp}$	5.87 Kn-m	Capacity	-40.2 Kn-m	Passing Percentage	**684.84 %**

Deflections

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

Deflection under Snow and Service Wind = 75.455 mm Limit by AS1170.0 Table C1 Span/120 = 47.50 mm

Reactions

Maximum = 5.87 kn

Girt Design Sides

Girt's Spacing = 1300 mm Girt's Span = 4000 mm Try Intermediate 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 =0.65 S1 Downward =9.63 S1 Upward =20.31

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

Capacity Checks

$M_{Wind+Snow}$	1.34 Kn-m	Capacity	1.54 Kn-m	Passing Percentage	**114.93 %**
$V_{0.9D-WnUp}$	1.34 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	**900.00 %**

Deflections

Modulus of Elasticity = 8000 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 31.97 mm Limit by AS1170.0 Table C1 Span/120 = 33.33 mm
Sag during installation =13.00 mm

Reactions

Maximum = 1.34 kn

Middle Pole Design

Geometry

275 SED H5 (Minimum 325 dia. at Floor Level)	Dry Use	Height	6200 mm
Area	82916 mm2	As	62186.71875 mm2
Ix	547372681 mm4	Zx	3368447 mm3
Iy	547372681 mm4	Zx	3368447 mm3
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 72 m2

Dead	18.00 Kn	Live	18.00 Kn
Wind	33.84 Kn	Snow	45.36 Kn
Moment wind	Kn-m	Moment snow	18.85 Kn-m
Phi	0.8	K8	1.00
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	1193.98 Kn	PhiMnx Wind	97.82 Kn-m	PhiVnx Wind	147.26 Kn
PhiNcx Dead	716.39 Kn	PhiMnx Dead	58.69 Kn-m	PhiVnx Dead	88.35 Kn
PhiNcx Snow	955.19 Kn	PhiMnx Snow	78.26 Kn-m	PhiVnx Snow	117.81 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 1.16 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 1.24 < 1 OK

Deflection at top under service lateral loads = 127.06 mm < 82.67 mm

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

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 =	600 mm	Pile Diameter
L =	1900 mm	Pile embedment length
f1 =	5250 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	105.58 Kn-m	Moment Snow =	Kn-m
Shear Wind =	20.11 Kn	Shear Snow =	18.85 Kn

Pile Properties

Safety Factory	0.55	
Hu =	8.55 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	26.00 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 4.06 < 1 OK

End Pole Design

Geometry For End Bay Pole

Ds =	600 mm	Pile Diameter
L =	2000 mm	Pile embedment length
f1 =	5250 mm	Distance at which the shear force is applied

f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 12 m2

Moment Wind =	26.39 Kn-m	Moment Snow =	4.71 Kn-m
Shear Wind =	5.03 Kn	Shear Snow =	4.71 Kn

Pile Properties

Safety Factory	0.55	
Hu =	9.83 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	30.02 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.88 < 1 OK

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

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 =	600 mm	Pile Diameter
L =	2000 mm	Pile embedment length
f1 =	5250 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	26.39 Kn-m	Moment Snow =	4.71 Kn-m
Shear Wind =	5.03 Kn	Shear Snow =	4.71 Kn

Pile Properties

Safety Factory	0.55	
Hu =	9.83 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	30.02 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.88 < 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(1900) x Ks(1.5) x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1900)

Skin Friction = 29.16 Kn

Weight of Pile + Pile Skin Friction = 31.82 Kn

Uplift on one Pile = 52.20 Kn

Uplift is ok