

Job No.: Roebuck **Address:** 36 Montana Road, Bridge Pa, New Zealand **Date:** 8/17/2022
Latitude: -39.637935 **Longitude:** 176.762381 **Elevation:** 20.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N1	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	3.6 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	38.22 m/s
Wind Pressure	0.88 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 Pressures

Shed Type = Gable Open

For roof $C_{p,i} = -0.6$

For roof $C_{p,e}$ from 0 m To 3.60 m $C_{p,e} = -0.9$ $p_e = -0.70$ KPa $p_{net} = -1.10$ KPa

For roof $C_{p,e}$ from 3.6 m To 7.2 m $C_{p,e} = -0.5$ $p_e = -0.39$ KPa $p_{net} = -0.79$ KPa

For wall Windward $C_{p,i} = 0.47$ side Wall $C_{p,i} = -0.6$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 8.80 m $C_{p,e} = 0.7$ $p_e = 0.55$ KPa $p_{net} = 1.07$ KPa

For side wall $C_{p,e}$ from 0 m To 3.60 m $C_{p,e} =$ $p_e = -0.51$ KPa $p_{net} = 0.28$ KPa

Maximum Upward pressure used in roof member Design = 1.10 KPa

Maximum Downward pressure used in roof member Design = 0.38 KPa

Maximum Wall pressure used in Design = 1.07 KPa

Maximum Racking pressure used in Design = 0.93 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm Purlin Span = 3800 mm Try Purlin 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 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 0.68 S1 Downward = 9.63 S1 Upward = 19.79

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

Capacity Checks

M _{1.35D}	0.55 Kn-m	Capacity	1.41 Kn-m	Passing Percentage	256.36 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.53 Kn-m	Capacity	1.89 Kn-m	Passing Percentage	123.53 %
M _{0.9D-W_nUp}	-1.42 Kn-m	Capacity	-1.60 Kn-m	Passing Percentage	112.68 %
V _{1.35D}	0.58 Kn	Capacity	7.24 Kn	Passing Percentage	1248.28 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.16 Kn	Capacity	9.65 Kn	Passing Percentage	831.90 %
V _{0.9D-W_nUp}	-1.50 Kn	Capacity	-12.06 Kn	Passing Percentage	804.00 %

Deflections

Modulus of Elasticity = 8000 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 = 13.03 mm Limit by AS1170.0 Table C1 Span/250 = 15.20 mm

Deflection under Dead and Service Wind = 14.99 mm Limit by AS1170.0 Table C1 Span/120 = 31.67 mm

Reactions

Maximum downward = 1.16 kn Maximum upward = -1.50 kn

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

Rafter Design External

External Rafter Load Width = 2000 mm External Rafter Span = 4414 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

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M _{1.35D}	1.64 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	287.80 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	3.31 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	190.33 %
M _{0.9D-WnUp}	-4.26 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	184.74 %
V _{1.35D}	1.49 Kn	Capacity	14.47 Kn	Passing Percentage	971.14 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	3.00 Kn	Capacity	19.30 Kn	Passing Percentage	643.33 %
V _{0.9D-WnUp}	-3.86 Kn	Capacity	-24.12 Kn	Passing Percentage	624.87 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 4.82 mm Limit by AS1170.0 Table C1 Span/250 = 17.60 mm

Deflection under Dead and Service Wind = 5.54 mm Limit by AS1170.0 Table C1 Span/120 = 36.67 mm

Reactions

Maximum downward = 3.00 kn Maximum upward = -3.86 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

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 = $\phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s$ (Eq 4.12) = -25.20 kn > -3.86 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -3.86 Kn

Girt Design Front and Back

Girt's Spacing = 1300 mm

Girt's Span = 4000 mm

Try Intermediate 150x50 SG8 Dry

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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}	1.39 Kn-m	Capacity	1.54 Kn-m	Passing Percentage	110.79 %
V _{0.9D-WnUp}	1.39 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	867.63 %

Deflections

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

Deflection under Snow and Service Wind = 20.61 mm Limit by AS1170.0 Table C1 Span/120 = 33.33 mm

Sag during installation = 13.00 mm

Reactions

Maximum = 1.39 kn

Girt Design Sides

Girt's Spacing = 1300 mm Girt's Span = 4400 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 =0.61 S1 Downward =9.63 S1 Upward =21.30

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

Capacity Checks

M _{Wind+Snow}	1.68 Kn-m	Capacity	1.43 Kn-m	Passing Percentage	85.12 %
V _{0.9D-WnUp}	1.53 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	788.24 %

Deflections

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

Deflection under Snow and Service Wind = 30.17 mm Limit by AS1170.0 Table C1 Span/120 = 36.67 mm

Sag during installation = 19.03 mm

Reactions

Maximum = 1.53 kn

Middle Pole Design

Geometry

150 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	4100 mm
Area	31400 mm ²	As	23550 mm ²
Ix	78500000 mm ⁴	Zx	785000 mm ³
Iy	78500000 mm ⁴	Zy	785000 mm ³
Lateral Restraint	4100 mm c/c		

Loads

Total Area over Pole = 17.6 m²

Dead	4.40 Kn	Live	4.40 Kn
Wind	6.69 Kn	Snow	0.00 Kn
Moment wind	Kn-m		
Phi	0.8	K8	0.65
K1 snow	0.8	K1 Dead	0.6
K1 wind	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	291.93 Kn	PhiMnx Wind	14.72 Kn-m	PhiVnx Wind	55.77 Kn
PhiNcx Dead	175.16 Kn	PhiMnx Dead	8.83 Kn-m	PhiVnx Dead	33.46 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.67 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.43 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 25.73 mm < 54.67 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 = $(1 - \sin(30)) / (1 + \sin(30))$
K_p = $(1 + \sin(30)) / (1 - \sin(30))$

Geometry For Middle Bay Pole

D_s = 600 mm Pile Diameter
L = 1300 mm Pile embedment length
f₁ = 2700 mm Distance at which the shear force is applied
f₂ = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 9.02 Kn-m
Shear Wind = 3.34 Kn

Pile Properties

Safety Factory 0.55
H_u = 4.89 Kn Ultimate Lateral Strength of the Pile, Short pile
M_u = 7.84 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 1.15 < 1 OK

End Pole Design

Geometry For End Bay Pole

D_s = 600 mm Pile Diameter
L = 1300 mm Pile embedment length
f₁ = 2700 mm Distance at which the shear force is applied
f₂ = 0 mm Distance of top soil at rest pressure

Loads

Total Area over Pole = 4.4 m²

Moment Wind = 3.01 Kn-m
Shear Wind = 1.11 Kn

Pile Properties

Safety Factory 0.55
Hu = 4.89 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 7.84 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.38 < 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
 $K_0 = (1 - \sin(30)) / (1 + \sin(30))$
 $K_p = (1 + \sin(30)) / (1 - \sin(30))$

Geometry For End Bay Pole

Ds = 600 mm Pile Diameter
L = 1300 mm Pile embedment length
f1 = 2700 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 3.01 Kn-m
Shear Wind = 1.11 Kn

Pile Properties

Safety Factory 0.55
Hu = 4.89 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 7.84 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.38 < 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(1300) x Ks(1.5) x tan(30) x π x Dia of Pile(0.6) x Height of Pile(1300)

Skin Friction = 13.65 Kn

Weight of Pile + Pile Skin Friction = 17.23 Kn

Uplift on one Pile = 15.40 Kn

Uplift is ok