

Job No.: GSH215B

Address: 18 Waimea Valley Road, Mandeville 9776,
New Zealand

Date: 8/9/2022

Latitude: -45.992236

Longitude: 168.803215

Elevation: 105.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N5	Ground Snow Load	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	1	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 = Mono Free

For roof $C_{p,i} = -0.3$

For roof $C_{p,e}$ from 0 m To 1.65 m $C_{p,e} = -0.94$ $p_e = -0.74$ KPa $p_{net} = -0.744$ KPa

For roof $C_{p,e}$ from 1.65 m To 3.30 m $C_{p,e} = -0.88$ $p_e = -0.69$ KPa $p_{net} = -0.69$ KPa

For wall Windward $C_{p,i} = 0$ side Wall $C_{p,i} = 0$

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

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

Maximum Upward pressure used in roof member Design = 0.74 KPa

Maximum Downward pressure used in roof member Design = 0.42 KPa

Maximum Wall pressure used in Design = 0 KPa

Maximum Racking pressure used in Design = 0.47 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 4300 mm

Try Purlin 200x50 SG8 Dry

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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 = 0.47 S1 Downward = 11.27 S1 Upward = 24.64

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

Capacity Checks

M _{1.35D}	0.7 Kn-m	Capacity	2.39 Kn-m	Passing Percentage	341.43 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.93 Kn-m	Capacity	3.18 Kn-m	Passing Percentage	164.77 %
M _{0.9D-W_nUp}	-1.07 Kn-m	Capacity	-1.88 Kn-m	Passing Percentage	175.70 %
V _{1.35D}	0.65 Kn	Capacity	9.65 Kn	Passing Percentage	1484.62 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	1.80 Kn	Capacity	12.86 Kn	Passing Percentage	714.44 %
V _{0.9D-W_nUp}	-1.00 Kn	Capacity	-16.08 Kn	Passing Percentage	1608.00 %

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 = 9.01 mm Limit by AS1170.0 Table C1 Span/250 = 17.20 mm

Deflection under Dead and Service Wind = 10.67 mm Limit by AS1170.0 Table C1 Span/120 = 35.83 mm

Reactions

Maximum downward = 1.80 kn Maximum upward = -1.00 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 = 4500 mm Internal Rafter Span = 5850 mm Try Rafter 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 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 1.00 S1 Downward = 6.81 S1 Upward = 6.81

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

Capacity Checks

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M1.35D	6.50 Kn-m	Capacity	11.32 Kn-m	Passing Percentage	174.15 %
M1.2D+1.5L 1.2D+Sn 1.2D+WnDn	17.90 Kn-m	Capacity	15.08 Kn-m	Passing Percentage	84.25 %
M0.9D-WnUp	-9.91 Kn-m	Capacity	-18.86 Kn-m	Passing Percentage	190.31 %
V1.35D	4.44 Kn	Capacity	28.94 Kn	Passing Percentage	651.80 %
V1.2D+1.5L 1.2D+Sn 1.2D+WnDn	12.24 Kn	Capacity	38.6 Kn	Passing Percentage	315.36 %
V0.9D-WnUp	-6.78 Kn	Capacity	-48.24 Kn	Passing Percentage	711.50 %

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 16.875 mm Limit by AS1170.0 Table C1 Span/250 = 24.00 mm

Deflection under Dead and Service Wind = 22.19 mm Limit by AS1170.0 Table C1 Span/120 = 50.00 mm

Reactions

Maximum downward = 12.24 kn Maximum upward = -6.78 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

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 60 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K11 = 14.9 fpj = 12.9 Mpa for Rafter with effective thickness = 100 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 = 21.67 Kn > -6.78 Kn

Rafter Design External

External Rafter Load Width = 2250 mm External Rafter Span = 5830 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}	3.23 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	146.13 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	8.89 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	70.87 %
M _{0.9D-W_nUp}	-4.92 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	159.96 %
V _{1.35D}	2.21 Kn	Capacity	14.47 Kn	Passing Percentage	654.75 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	6.10 Kn	Capacity	19.30 Kn	Passing Percentage	316.39 %
V _{0.9D-W_nUp}	-3.38 Kn	Capacity	-24.12 Kn	Passing Percentage	713.61 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 18.75 mm Limit by AS1170.0 Table C1 Span/250 = 24.00 mm

Deflection under Dead and Service Wind = 22.19 mm Limit by AS1170.0 Table C1 Span/120 = 50.00 mm

Reactions

Maximum downward =6.10 kn Maximum upward = -3.38 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 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 50 mm

For Parallel to grain loading

K₁₁ = 2.0 f_{cj} = 36.1 Mpa for Pole with effective thickness = 100 mm

Eccentric Load check

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$V = \phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots$ (Eq 4.12) = -25.20 kn > -3.38 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -3.38 Kn

Middle Pole Design

Geometry

150 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	3300 mm
Area	31400 mm ²	As	23550 mm ²
I _x	78500000 mm ⁴	Z _x	785000 mm ³
I _y	78500000 mm ⁴	Z _y	785000 mm ³
Lateral Restraint	3300 mm c/c		

Loads

Total Area over Pole = 13.5 m²

Dead	3.38 Kn	Live	3.38 Kn
Wind	5.67 Kn	Snow	8.51 Kn
Moment wind	Kn-m	Moment snow	3.64 Kn-m
Phi	0.8	K ₈	0.84
K ₁ snow	0.8	K ₁ Dead	0.6
K ₁ wind	1		

Material

Peeling	Steaming	Normal	Dry Use
f _b =	36.3 MPa	f _s =	2.96 MPa
f _c =	18 MPa	f _p =	7.2 MPa
f _t =	22 MPa	E =	9257 MPa

Capacities

PhiN _{cx} Wind	378.83 Kn	PhiM _{nx} Wind	19.10 Kn-m	PhiV _{nx} Wind	55.77 Kn
PhiN _{cx} Dead	227.30 Kn	PhiM _{nx} Dead	11.46 Kn-m	PhiV _{nx} Dead	33.46 Kn
PhiN _{cx} Snow	303.06 Kn	PhiM _{nx} Snow	15.28 Kn-m	PhiV _{nx} Snow	44.61 Kn

Checks

$(M_x/\phi M_{nx}) + (N/\phi N_{cx}) = 0.31 < 1$ OK

$(M_x/\phi M_{nx})^2 + (N/\phi N_{cx}) = 0.12 < 1$ OK

Deflection at top under service lateral loads = 11.78 mm < 44.00 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 = 5.13 Kn-m Moment Snow = Kn-m
Shear Wind = 1.90 Kn Shear Snow = 3.64 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 = 0.74 < 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 = 6.75 m²

Moment Wind = 2.56 Kn-m Moment Snow = 1.82 Kn-m

Shear Wind = 0.95 Kn Shear Snow = 1.82 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 = 0.37 < 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 = 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 = 2.56 Kn-m Moment Snow = 1.82 Kn-m
Shear Wind = 0.95 Kn Shear Snow = 1.82 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 = 0.37 < 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 Pi 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 = 6.95 Kn

Uplift is ok