

Job No.: 2206022

Address: 162 Collingwood-Bainham Road,
Collingwood 7073, New Zealand

Date: 7/29/2022

Latitude: -40.685271

Longitude: 172.655811

Elevation: 16 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N2	Ground Snow Load	0 KPa	Roof Snow Load	0 KPa
Earthquake Zone	1	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind ARI	100 Years	Max Height	4 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	41.22 m/s
Wind Pressure	1.02 KPa	Lee Zone	NO	Ultimate ARI	100 Years
Wind Category	High				

Pressure Coefficients and Pressures

Shed Type = Mono Enclosed

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

For roof $C_{p,e}$ from 0 m To 1.88 m $C_{p,e} = -1$ $p_e = -0.92$ KPa $p_{net} = -0.925$ KPa

For roof $C_{p,e}$ from 1.88 m To 3.75 m $C_{p,e} = -0.85$ $p_e = -0.78$ KPa $p_{net} = -0.78$ 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 6.0 m $C_{p,e} = 0.7$ $p_e = 0.64$ KPa $p_{net} = 0.95$ KPa

For side wall $C_{p,e}$ from 0 m To 3.75 m $C_{p,e} =$ $p_e = -0.6$ KPa $p_{net} = -0.60$ KPa

Maximum Upward pressure used in roof member Design = 0.92 KPa

Maximum Downward pressure used in roof member Design = 0.49 KPa

Maximum Wall pressure used in Design = 0.95 KPa

Maximum Racking pressure used in Design = 1.1 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 4800 mm

Try Purlin 190x45 SG8

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 = 0.98

K8 Upward = 0.67 S1 Downward = 12.23 S1 Upward = 19.97

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

Capacity Checks

M _{1.35D}	0.87 Kn-m	Capacity	1.93 Kn-m	Passing Percentage	221.84 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.1 Kn-m	Capacity	2.57 Kn-m	Passing Percentage	122.38 %
M _{0.9D-WnUp}	-1.8 Kn-m	Capacity	-2.20 Kn-m	Passing Percentage	122.22 %
V _{1.35D}	0.73 Kn	Capacity	8.25 Kn	Passing Percentage	1130.14 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.71 Kn	Capacity	11.00 Kn	Passing Percentage	643.27 %
V _{0.9D-WnUp}	-1.50 Kn	Capacity	-13.75 Kn	Passing Percentage	916.67 %

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 = 18.14 mm Limit by AS1170.0 Table C1 Span/250 = 19.20 mm

Deflection under Dead and Service Wind = 22.52 mm Limit by AS1170.0 Table C1 Span/120 = 40.00 mm

Reactions

Maximum downward = 1.71 kn Maximum upward = -1.50 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 = 5000 mm Internal Rafter Span = 5850 mm Try Rafter 2x240x45 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 = 6.71 S1 Upward = 6.71

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

Capacity Checks

M _{1.35D}	7.22 Kn-m	Capacity	22.34 Kn-m	Passing Percentage	309.42 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	16.90 Kn-m	Capacity	29.8 Kn-m	Passing Percentage	176.33 %

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M _{0.9D-WnUp}	-14.87 Kn-m	Capacity	-37.24 Kn-m	Passing Percentage	250.44 %
V _{1.35D}	4.94 Kn	Capacity	36.82 Kn	Passing Percentage	745.34 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	11.55 Kn	Capacity	49.08 Kn	Passing Percentage	424.94 %
V _{0.9D-WnUp}	-10.16 Kn	Capacity	-61.36 Kn	Passing Percentage	603.94 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 19.975 mm Limit by AS1170.0 Table C1 Span/250 = 24.00 mm

Deflection under Dead and Service Wind = 27.56 mm Limit by AS1170.0 Table C1 Span/120 = 50.00 mm

Reactions

Maximum downward = 11.55 kn Maximum upward = -10.16 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 > -10.16 Kn

Rafter Design External

External Rafter Load Width = 2500 mm External Rafter Span = 5821 mm Try Rafter 240x45 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 = 0.94

K8 Upward =0.94 S1 Downward =13.82 S1 Upward =13.82

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

Capacity Checks

M _{1.35D}	3.57 Kn-m	Capacity	9.72 Kn-m	Passing Percentage	272.27 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	8.37 Kn-m	Capacity	12.96 Kn-m	Passing Percentage	154.84 %
M _{0.9D-W_nUp}	-7.36 Kn-m	Capacity	-16.20 Kn-m	Passing Percentage	220.11 %
V _{1.35D}	2.46 Kn	Capacity	18.41 Kn	Passing Percentage	748.37 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.75 Kn	Capacity	24.54 Kn	Passing Percentage	426.78 %
V _{0.9D-W_nUp}	-5.06 Kn	Capacity	-30.68 Kn	Passing Percentage	606.32 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 22.19 mm Limit by AS1170.0 Table C1 Span/250 = 24.00 mm

Deflection under Dead and Service Wind = 27.56 mm Limit by AS1170.0 Table C1 Span/120 = 50.00 mm

Reactions

Maximum downward =5.75 kn Maximum upward = -5.06 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 f_{pj} = 22.7 Mpa for Rafter with effective thickness = 45 mm

For Parallel to grain loading

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

Eccentric Load check

V = phi x k₁ x k₄ x k₅ x f_s x b x d_s (Eq 4.12) = -30.05 kn > -5.06 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -5.06 Kn

Intermediate Design Sides

Intermediate Spacing = 3000 mm Intermediate Span = 3600 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 = 0.66

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

Capacity Checks

M _{Wind+Snow}	2.31 Kn-m	Capacity	3.74 Kn-m	Passing Percentage	161.90 %
V _{0.9D-WnUp}	2.56 Kn-m	Capacity	20.26 Kn-m	Passing Percentage	791.41 %

Deflections

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

Deflection under Snow and Service Wind = 56.065 mm Limit by AS1170.0 Table C1 Span/120 = 30.00 mm

Reactions

Maximum = 2.56 kn

Girt Design Front and Back

Girt's Spacing = 1300 mm Girt's Span = 5000 mm Try Intermediate 190x45 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 = 0.65 S1 Downward = 12.23 S1 Upward = 20.38

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

Capacity Checks

M _{Wind+Snow}	1.93 Kn-m	Capacity	2.13 Kn-m	Passing Percentage	110.36 %
V _{0.9D-WnUp}	1.54 Kn-m	Capacity	13.75 Kn-m	Passing Percentage	892.86 %

Deflections

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

Deflection under Snow and Service Wind = 24.42 mm Limit by AS1170.0 Table C1 Span/120 = 41.67 mm

Sag during installation = 39.18 mm

Reactions

Maximum = 1.54 kn

Middle Pole Design

Geometry

150 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	3700 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	1100 mm c/c		

Loads

Total Area over Pole = 15 m²

Dead	3.75 Kn	Live	3.75 Kn
Wind	7.35 Kn	Snow	0.00 Kn
Moment wind	Kn-m		
Phi	0.8	K ₈	1.00
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	452.16 Kn	PhiM _{nx} Wind	22.80 Kn-m	PhiV _{nx} Wind	55.77 Kn
PhiN _{cx} Dead	271.30 Kn	PhiM _{nx} Dead	13.68 Kn-m	PhiV _{nx} Dead	33.46 Kn

Checks

$$(M_x/\phi M_{nx}) + (N/\phi N_{cx}) = 0.75 < 1 \text{ OK}$$

$$(M_x/\phi M_{nx})^2 + (N/\phi N_{cx}) = 0.55 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 47.10 \text{ mm} < 49.33 \text{ mm}$$

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

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

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

Geometry For Middle Bay Pole

Ds = 600 mm Pile Diameter
L = 1700 mm Pile embedment length
f1 = 3000 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 16.46 Kn-m
Shear Wind = 5.49 Kn

Pile Properties

Safety Factory 0.55
Hu = 9.31 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 16.87 Kn-m Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.98 < 1 \text{ OK}$$

End Pole Design

Geometry For End Bay Pole

Ds = 600 mm Pile Diameter
L = 1700 mm Pile embedment length
f1 = 3000 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Total Area over Pole = 7.5 m²

Moment Wind = 8.23 Kn-m

Shear Wind = 2.74 Kn

Pile Properties

Safety Factory 0.55

Hu = 9.31 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 16.87 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.49 < 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 = 1700 mm Pile embedment length

f1 = 3000 mm Distance at which the shear force is applied

f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 8.23 Kn-m

Shear Wind = 2.74 Kn

Pile Properties

Safety Factory 0.55

Hu = 9.31 Kn Ultimate Lateral Strength of the Pile, Short pile

Mu = 16.87 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = $0.49 < 1$ OK

Uplift Check

Density of Concrete = 24 Kn/m^3

Density of Timber Pole = 5 Kn/m^3

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

K_s (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(1700) x K_s (1.5) x $\tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1700)

Skin Friction = 23.34 Kn

Weight of Pile + Pile Skin Friction = 28.03 Kn

Uplift on one Pile = 10.43 Kn

Uplift is ok