

Job No.: 643087

Address: 62A TAHANGA RD, KAINGAROA, New Zealand

Date: 04/03/2024

Latitude: -35.002544

Longitude: 173.342064

Elevation: 57 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	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	6 m
Wind Region	NZ1	Terrain Category	2.0	Design Wind Speed	41.21 m/s
Wind Pressure	1.02 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 Pressures

Shed Type = Mono Enclosed

For roof $C_{p,i} = -0.5574$

For roof $C_{p,e}$ from 0 m To 5.50 m $C_{p,e} = -0.9$ $p_e = -0.65$ KPa $p_{net} = -1.02$ KPa

For roof $C_{p,e}$ from 5.50 m To 11 m $C_{p,e} = -0.5$ $p_e = -0.36$ KPa $p_{net} = -0.73$ KPa

For wall Windward $C_{p,i} = 0.4551$ side Wall $C_{p,i} = -0.5574$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 12 m $C_{p,e} = 0.7$ $p_e = 0.64$ KPa $p_{net} = 1.21$ KPa

For side wall $C_{p,e}$ from 0 m To 5.50 m $C_{p,e} =$ $p_e = -0.60$ KPa $p_{net} = -0.03$ KPa

Maximum Upward pressure used in roof member Design = 1.02 KPa

Maximum Downward pressure used in roof member Design = 0.66 KPa

Maximum Wall pressure used in Design = .21 KPa

Maximum Racking pressure used in Design = 1.11 KPa

Design Summary

Purlin Design

Purlin Spacing = 700 mm

Purlin Span = 4650 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)

K1 Short term = 1 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 0.98

K8 Upward = 0.69 S1 Downward = 12.23 S1 Upward = 19.55

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

Capacity Checks

$M_{1.35D}$	0.64 Kn-m	Capacity	1.79 Kn-m	Passing Percentage	279.69 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	1.85 Kn-m	Capacity	2.38 Kn-m	Passing Percentage	128.65 %
$M_{0.9D-W_nUp}$	-1.5 Kn-m	Capacity	-2.10 Kn-m	Passing Percentage	140.00 %

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V _{1.35D}	0.55 Kn	Capacity	8.25 Kn	Passing Percentage	1500.00 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.56 Kn	Capacity	11.00 Kn	Passing Percentage	705.13 %
V _{0.9D-WnUp}	-1.29 Kn	Capacity	-13.75 Kn	Passing Percentage	1065.89 %

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 = 14.21 mm

Limit by Woolcock et al, 1999 Span/240 = 19.17 mm

Deflection under Dead and Service Wind = 19.66 mm

Limit by Woolcock et al, 1999 Span/100 = 46.00 mm

Reactions

Maximum downward = 1.56 kn Maximum upward = -1.29 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 = 4800 mm

Internal Rafter Span = 11850 mm

Try Rafter 2x450x63 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 = 6.68 S₁ Upward = 6.68

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

Capacity Checks

M _{1.35D}	28.44 Kn-m	Capacity	91.56 Kn-m	Passing Percentage	321.94 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	80.88 Kn-m	Capacity	122.08 Kn-m	Passing Percentage	150.94 %
M _{0.9D-WnUp}	-66.98 Kn-m	Capacity	-152.6 Kn-m	Passing Percentage	227.83 %
V _{1.35D}	9.60 Kn	Capacity	96.64 Kn	Passing Percentage	1006.67 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	27.30 Kn	Capacity	128.86 Kn	Passing Percentage	472.01 %
V _{0.9D-WnUp}	-22.61 Kn	Capacity	-161.08 Kn	Passing Percentage	712.43 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 33.245 mm

Limit by Woolcock et al, 1999 Span/240 = 50.00 mm

Deflection under Dead and Service Wind = 51.1 mm

Limit by Woolcock et al, 1999 Span/100 = 120.00 mm

Reactions

Maximum downward = 27.30 kn Maximum upward = -22.61 kn

Rafter to Pole Connection check

Bolt Size = M16 Number of Bolts = 3

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Second page

Joint Group for Rafters = J2 Joint Group for Pole = J5

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 80 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

$K_{11} = 12.6 \text{ f}_{pj} = 22.7 \text{ Mpa}$ for Rafter with effective thickness = 126 mm

For Parallel to grain loading

$K_{11} = 2.0 \text{ f}_{cj} = 36.1 \text{ Mpa}$ for Pole with effective thickness = 100 mm

Capacity under short term loads = 77.63 Kn > -22.61 Kn

Rafter Design External

External Rafter Load Width = 2400 mm

External Rafter Span = 11842 mm

Try Rafter 450x63 LVL13

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K_1 Short term = 1 K_1 Medium term = 0.8 K_1 Long term = 0.6 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.95

K_8 Upward = 0.95 S_1 Downward = 13.57 S_1 Upward = 13.57

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

Capacity Checks

$M_{1.35D}$	14.20 Kn-m	Capacity	43.42 Kn-m	Passing Percentage	305.77 %
$M_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	40.39 Kn-m	Capacity	57.89 Kn-m	Passing Percentage	143.33 %
$M_{0.9D-W_nUp}$	-33.45 Kn-m	Capacity	-72.37 Kn-m	Passing Percentage	216.35 %
$V_{1.35D}$	4.80 Kn	Capacity	48.32 Kn	Passing Percentage	1006.67 %
$V_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	13.64 Kn	Capacity	64.43 Kn	Passing Percentage	472.36 %
$V_{0.9D-W_nUp}$	-11.30 Kn	Capacity	-80.54 Kn	Passing Percentage	712.74 %

Deflections

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

k_2 for Long Term Loads = 2

Deflection under Dead and Live Load = 36.94 mm

Limit by Woolcock et al, 1999 Span/240 = 50.00 mm

Deflection under Dead and Service Wind = 51.10 mm

Limit by Woolcock et al, 1999 Span/100 = 120.00 mm

Reactions

Maximum downward = 13.64 kn Maximum upward = -11.30 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

$K_{11} = 12.6 \text{ fpj} = 22.7 \text{ Mpa}$ for Rafter with effective thickness = 63 mm

For Parallel to grain loading

$K_{11} = 2.0 \text{ fcj} = 36.1 \text{ Mpa}$ for Pole with effective thickness = 100 mm

Eccentric Load check

$V = \phi \times k_1 \times k_4 \times k_5 \times f_s \times b \times d_s \dots\dots\dots$ (Eq 4.12) = -91.15 kn > -11.30 Kn

Single Shear Capacity under short term loads = -14.56 Kn > -11.30 Kn

Intermediate Design Sides

Intermediate Spacing = 6000 mm

Intermediate Span = 5349 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)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.98

K_8 Upward = 1.00 S_1 Downward = 12.23 S_1 Upward = 0.94

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

Capacity Checks

$M_{\text{Wind+Snow}}$	2.25 Kn-m	Capacity	6.06 Kn-m	Passing Percentage	269.33 %
$V_{0.9D-WnUp}$	1.69 Kn-m	Capacity	27.5 Kn-m	Passing Percentage	1627.22 %

Deflections

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

Deflection under Snow and Service Wind = 48.36 mm

Limit by Woolcock et al, 1999 Span/100 = 53.49 mm

Reactions

Maximum = 1.69 kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 4800 mm

Try Girt 190x45 SG8

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K_1 Short term = 1 $K_4 = 1$ $K_5 = 1$ K_8 Downward = 0.98

K_8 Upward = 0.36 S_1 Downward = 12.23 S_1 Upward = 28.24

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

Capacity Checks

$M_{\text{Wind+Snow}}$	0.54 Kn-m	Capacity	1.11 Kn-m	Passing Percentage	205.56 %
$V_{0.9D-WnUp}$	0.45 Kn-m	Capacity	13.75 Kn-m	Passing Percentage	3055.56 %

Deflections

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

Deflection under Snow and Service Wind = 7.58 mm

Limit by Woolcock et al, 1999 Span/100 = 48.00 mm

Sag during installation = 39.74 mm

Reactions

Maximum = 0.45 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 6000 mm

Try Girt 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 =0.29 S1 Downward =12.23 S1 Upward =31.57

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

Capacity Checks

$M_{Wind+Snow}$	0.85 Kn-m	Capacity	0.89 Kn-m	Passing Percentage	104.71 %
$V_{0.9D-WnUp}$	0.57 Kn-m	Capacity	13.75 Kn-m	Passing Percentage	2412.28 %

Deflections

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

Deflection under Snow and Service Wind = 18.51 mm

Limit by Woolcock et al. 1999 Span/100 = 60.00 mm

Sag during installation =97.01 mm

Reactions

Maximum = 0.57 kn

Middle Pole Design

Geometry

250 SED H5 (Minimum 275 dia. at Floor Level)	Dry Use	Height	5640 mm
Area	54091 mm ²	As	40568.5546875 mm ²
I _x	232952248 mm ⁴	Z _x	1774874 mm ³
I _y	232952248 mm ⁴	Z _y	1774874 mm ³
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 28.8 m²

Dead	7.20 Kn	Live	7.20 Kn
Wind Down	19.01 Kn	Snow	0.00 Kn
Moment wind	35.87 Kn-m		
Phi	0.8	K8	1.00
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

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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	778.92 Kn	PhiMnx Wind	51.54 Kn-m	PhiVnx Wind	96.07 Kn
PhiNcx Dead	467.35 Kn	PhiMnx Dead	30.93 Kn-m	PhiVnx Dead	57.64 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.74 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.53 < 1$ OK

Deflection at top under service lateral loads = 79.10 mm < 56.40 mm

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

Assumed Soil Properties

Gamma	18 Kn/m ³	Friction angle	30 deg	Cohesion	0 Kn/m ³
K0 =	$(1 - \sin(30)) / (1 + \sin(30))$				
Kp =	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For Middle Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1300 mm	Pile embedment length
f1 =	4500 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	35.87 Kn-m
Shear Wind =	7.97 Kn

Pile Properties

Safety Factory	0.55	
Hu =	3.38 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.68 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 4.13 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

250 SED H5 (Minimum 275 dia. at Floor Level)	Dry Use	Height	5800 mm
Area	54091 mm ²	As	40568.5546875 mm ²

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Ix	232952248 mm ⁴	Zx	1774874 mm ³
Iy	232952248 mm ⁴	Zy	1774874 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 28.8 m²

Dead	7.20 Kn	Live	7.20 Kn
Wind Down	19.01 Kn	Snow	0.00 Kn
Moment Wind	17.94 Kn-m		
Phi	0.8	K8	0.57
K1 snow	0.8	K1 Dead	0.6
K1 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	444.90 Kn	PhiM _{nx} Wind	29.44 Kn-m	PhiV _{nx} Wind	96.07 Kn
PhiN _{cx} Dead	266.94 Kn	PhiM _{nx} Dead	17.66 Kn-m	PhiV _{nx} Dead	57.64 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.68 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.45 < 1$ OK

Deflection at top under service lateral loads = 41.97 mm < 59.85 mm

D _s =	0.6 mm	Pile Diameter
L =	1300 mm	Pile embedment length
f ₁ =	4500 mm	Distance at which the shear force is applied
f ₂ =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 28.8 m²

Moment Wind =	17.94 Kn-m
Shear Wind =	3.99 Kn

Pile Properties

Safety Factory	0.55	
H _u =	3.38 Kn	Ultimate Lateral Strength of the Pile, Short pile
M _u =	8.68 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = $2.07 < 1$ OK

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

Assumed Soil Properties

Gamma	18 Kn/m ³	Friction angle	30 deg	Cohesion	0 Kn/m ³
K0 =	$(1 - \sin(30)) / (1 + \sin(30))$				
Kp =	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For End Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1300 mm	Pile embedment length
f1 =	4500 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	17.94 Kn-m
Shear Wind =	3.99 Kn

Pile Properties

Safety Factory	0.55	
Hu =	3.38 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.68 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = $2.07 < 1$ 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 0.5 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 = 16.26 Kn

Uplift on one Pile = 22.90 Kn

Uplift is ok