Job No.: Aron Banner	**Address:** 183A Gumtown Road, Te Kamo, Whangārei 0185, New Zealand	**Date:** 20/03/2024
Latitude: -35.692252	**Longitude:** 174.21628	**Elevation:** 138 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	5 m
Wind Region	NZ1	Terrain Category	2.3	Design Wind Speed	42.79 m/s
Wind Pressure	1.1 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 Pressues

Shed Type = Mono Open

For roof Cp,i = 0.6499

For roof CP,e from 0 m To 5.0 m Cpe = -0.9 pe = -0.80 KPa pnet = -1.50 KPa

For roof CP,e from 5 m To 10 m Cpe = -0.5 pe = -0.45 KPa pnet = -1.15 KPa

For wall Windward Cp,i = 0.6499 side Wall Cp,i = -0.5569

For wall Windward and Leeward CP,e from 0 m To 15 m Cpe = 0.7 pe = 0.69 KPa pnet = 1.35 KPa

For side wall CP,e from 0 m To 5.0 m Cpe = pe = -0.64 KPa pnet = 0.02 KPa

Maximum Upward pressure used in roof member Design = 1.50 KPa

Maximum Downward pressure used in roof member Design = 0.55 KPa

Maximum Wall pressure used in Design = 1.35 KPa

Maximum Racking pressure used in Design = 0.99 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm Purlin Span = 5850 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 =0.48 S1 Downward =9.63 S1 Upward =24.45

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

Capacity Checks

$M_{1.35D}$	1.3 Kn-m	Capacity	1.26 Kn-m	Passing Percentage	**96.92 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	3.27 Kn-m	Capacity	1.68 Kn-m	Passing Percentage	**51.38 %**

$M_{0.9D\text{-}WnUp}$	-4.91 Kn-m	Capacity	-1.00 Kn-m	Passing Percentage	**20.37 %**
$V_{1.35D}$	0.89 Kn	Capacity	7.24 Kn	Passing Percentage	**813.48 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.24 Kn	Capacity	9.65 Kn	Passing Percentage	**430.80 %**
$V_{0.9D\text{-}WnUp}$	-3.36 Kn	Capacity	-12.06 Kn	Passing Percentage	**358.93 %**

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 = 84.45 mm Limit by Woolcock et al, 1999 Span/240 = 24.17 mm

Deflection under Dead and Service Wind = 109.08 mm Limit by Woolcock et al, 1999 Span/100 = 58.00 mm

Reactions

Maximum downward =2.24 kn Maximum upward = -3.36 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 = 6000 mm Internal Rafter Span = 7350 mm Try Rafter 2x360x45 LVL11

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 =8.40 S1 Upward =8.40

Shear Capacity of timber =5 MPa Bending Capacity of timber =38 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

$M_{1.35D}$	13.67 Kn-m	Capacity	34.4 Kn-m	Passing Percentage	**251.65 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	34.44 Kn-m	Capacity	45.86 Kn-m	Passing Percentage	**133.16 %**
$M_{0.9D\text{-}WnUp}$	-51.66 Kn-m	Capacity	-57.32 Kn-m	Passing Percentage	**110.96 %**
$V_{1.35D}$	7.44 Kn	Capacity	52.1 Kn	Passing Percentage	**700.27 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	18.74 Kn	Capacity	69.46 Kn	Passing Percentage	**370.65 %**
$V_{0.9D\text{-}WnUp}$	-28.11 Kn	Capacity	-86.84 Kn	Passing Percentage	**308.93 %**

Deflections

Modulus of Elasticity = 9900 MPa NZS3603 Amt 4, Table 2.3

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 19.265 mm Limit by Woolcock et al, 1999 Span/240 = 31.25 mm

Deflection under Dead and Service Wind = 27.65 mm Limit by Woolcock et al, 1999 Span/100 = 75.00 mm

Reactions

Maximum downward =18.74 kn Maximum upward = -28.11 kn

Rafter to Pole Connection check

Bolt Size = M16 Number of Bolts = 3

Second page

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 = 76.25 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 = 68.64 Kn > -28.11 Kn

Rafter Design External

External Rafter Load Width = 3000 mm External Rafter Span = 7562 mm Try Rafter 360x45 LVL11

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 =0.81

K8 Upward =0.81 S1 Downward =17.01 S1 Upward =17.01

Shear Capacity of timber =5 MPa Bending Capacity of timber =38 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

$M_{1.35D}$	7.24 Kn-m	Capacity	14.01 Kn-m	Passing Percentage	**193.51 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	18.23 Kn-m	Capacity	18.68 Kn-m	Passing Percentage	**102.47 %**
$M_{0.9D-WnUp}$	-27.34 Kn-m	Capacity	-23.35 Kn-m	Passing Percentage	**85.41 %**
$V_{1.35D}$	3.83 Kn	Capacity	26.05 Kn	Passing Percentage	**680.16 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	9.64 Kn	Capacity	34.73 Kn	Passing Percentage	**360.27 %**
$V_{0.9D-WnUp}$	-14.46 Kn	Capacity	-43.42 Kn	Passing Percentage	**300.28 %**

Deflections

Modulus of Elasticity = 9900 MPa NZS3603 Amt 4, Table 2.3

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 21.41 mm Limit by Woolcock et al, 1999 Span/240= 31.25 mm

Deflection under Dead and Service Wind = 27.65 mm Limit by Woolcock et al, 1999 Span/100 = 75.00 mm

Reactions

Maximum downward =9.64 kn Maximum upward = -14.46 kn

Rafter to Pole Connection check

Bolt Size = M16 Number of Bolts = 3

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 fpj = 22.7 Mpa for Rafter with effective thickness = 45 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) = -44.10 kn > -14.46 Kn

Single Shear Capacity under short term loads = -34.32 Kn > -14.46 Kn

Girt Design Front and Back

Girt's Spacing = 0 mm   Girt's Span = 3000 mm   Try Girt SG8 Dry

Moisture Condition = Wet (Moisture in timber is less than 18% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1   K4 =1   K5 =1   K8 Downward =NaN

K8 Upward =NaN   S1 Downward =NaN   S1 Upward =NaN

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

Capacity Checks

$M_{Wind+Snow}$	0.00 Kn-m	Capacity	NaN Kn-m	Passing Percentage	**NaN %**
$V_{0.9D-WnUp}$	0.00 Kn-m	Capacity	0.00 Kn-m	Passing Percentage	**NaN %**

Deflections

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

Deflection under Snow and Service Wind = NaN mm   Limit by Woolcock et al, 1999 Span/100 = 30.00 mm
Sag during installation = NaN mm

Reactions

Maximum = 0.00 kn

Girt Design Sides

Girt's Spacing = 0 mm   Girt's Span = 3750 mm   Try Girt SG8 Dry

Moisture Condition = Wet (Moisture in timber is less than 18% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1   K4 =1   K5 =1   K8 Downward =NaN

K8 Upward =NaN   S1 Downward =NaN   S1 Upward =NaN

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

Capacity Checks

$M_{Wind+Snow}$	0.00 Kn-m	Capacity	NaN Kn-m	Passing Percentage	**NaN %**
$V_{0.9D-WnUp}$	0.00 Kn-m	Capacity	0.00 Kn-m	Passing Percentage	**NaN %**

Deflections

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

Deflection under Snow and Service Wind = NaN mm	Limit by Woolcock et al. 1999 Span/100 = 37.50 mm
Sag during installation =NaN mm	

Reactions

Maximum = 0.00 kn

Middle Pole Design

Geometry

275 SED H5 HIGH DENSITY (Minimum 300 dia. at Floor Level)	Dry Use	Height	4700 mm
Area	64885 mm2	As	48663.8671875 mm2
Ix	335197731 mm4	Zx	2331810 mm3
Iy	335197731 mm4	Zx	2331810 mm3
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 45 m2

Dead	11.25 Kn	Live	11.25 Kn
Wind Down	24.75 Kn	Snow	0.00 Kn
Moment wind	18.52 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 =	49.725 MPa	fs =	2.84 MPa
fc =	28.125 MPa	fp =	8.66 MPa
ft =	29.64 MPa	E =	12874 MPa

Capacities

PhiNcx Wind	1459.92 Kn	PhiMnx Wind	92.76 Kn-m	PhiVnx Wind	110.56 Kn
PhiNcx Dead	875.95 Kn	PhiMnx Dead	55.66 Kn-m	PhiVnx Dead	66.34 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.23 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.07 < 1 OK

Deflection at top under service lateral loads = 14.17 mm < 47.00 mm

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

Assumed 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 =	0.6 mm	Pile Diameter
L =	1800 mm	Pile embedment length
f1 =	3750 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	18.52 Kn-m
Shear Wind =	4.94 Kn

Pile Properties

Safety Factory	0.55	
Hu =	9.36 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	20.82 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.89 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

275 SED H5 HIGH DENSITY (Minimum 300 dia. at Floor Level)	Dry Use	Height	4800 mm
Area	64885 mm2	As	48663.8671875 mm2
Ix	335197731 mm4	Zx	2331810 mm3
Iy	335197731 mm4	Zx	2331810 mm3
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 22.5 m2

Dead	5.63 Kn	Live	5.63 Kn
Wind Down	12.38 Kn	Snow	0.00 Kn
Moment Wind	9.26 Kn-m		
Phi	0.8	K8	0.83
K1 snow	0.8	K1 Dead	0.6
K1wind	1		

Material

Peeling	Steaming	Normal	Dry Use
fb =	49.725 MPa	fs =	2.84 MPa
fc =	28.125 MPa	fp =	8.66 MPa
ft =	29.64 MPa	E =	12874 MPa

Capacities

PhiNcx Wind	1210.65 Kn	PhiMnx Wind	76.92 Kn-m	PhiVnx Wind	110.56 Kn
PhiNcx Dead	726.39 Kn	PhiMnx Dead	46.15 Kn-m	PhiVnx Dead	66.34 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.14 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.03 < 1 OK

Deflection at top under service lateral loads = 7.52 mm < 49.88 mm

Ds =	0.6 mm	Pile Diameter
L =	1800 mm	Pile embedment length
f1 =	3750 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Total Area over Pole = 22.5 m2

Moment Wind =	9.26 Kn-m
Shear Wind =	2.47 Kn

Pile Properties

Safety Factory	0.55	
Hu =	9.36 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	20.82 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.44 < 1 OK

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

Assumed 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 =	0.6 mm	Pile Diameter
L =	1800 mm	Pile embedment length
f1 =	3750 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	9.26 Kn-m
Shear Wind =	2.47 Kn

Pile Properties

Safety Factory	0.55

Hu =	9.36 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	20.82 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.44 < 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(1800) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1800)

Skin Friction = 26.17 Kn

Weight of Pile + Pile Skin Friction = 29.32 Kn

Uplift on one Pile = 57.37 Kn

Uplift is ok