Job No.: 990 Dartmoor Road **Address:** 990 Dartmoor Road **Date:** 8/3/2022

Latitude: -39.477357 **Longitude:** 176.702111 **Elevation:** 103.5 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 ARI	100 Years	Max Height	4 m
Wind Region	NZ2	Terrain Category	2.35	Design Wind Speed	49.28 m/s
Wind Pressure	1.46 KPa	Lee Zone	NO	Ultimate ARI	100 Years
Wind Category	Very High				

Pressure Coefficients and Pressues

Shed Type = Gable Enclosed

For roof Cp,i = -0.3

For roof CP,e from 0 m To 4 m Cpe = -0.9 pe = -1.18 KPa pnet = -1.18 KPa

For roof CP,e from 4 m To 8 m Cpe = -0.5 pe = -0.66 KPa pnet = -0.66 KPa

For wall Windward Cp,i = 0 side Wall Cp,i = 0

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

For side wall CP,e from 0 m To 0 m Cpe = pe = 0 KPa pnet = 0 KPa

Maximum Upward pressure used in roof member Design = 1.18 KPa

Maximum Downward pressure used in roof member Design = 0.70 KPa

Maximum Wall pressure used in Design = 0 KPa

Maximum Racking pressure used in Design = 0.92 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm Purlin Span = 4500 mm Try Purlin 250x50 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 =0.97

K8 Upward =0.36 S1 Downward =12.68 S1 Upward =28.35

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

Capacity Checks

$M_{1.35D}$	0.77 Kn-m	Capacity	3.51 Kn-m	Passing Percentage	**455.84 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.28 Kn-m	Capacity	4.67 Kn-m	Passing Percentage	**204.82 %**
$M_{0.9D-WnUp}$	-2.18 Kn-m	Capacity	-2.18 Kn-m	Passing Percentage	**100.00 %**
$V_{1.35D}$	0.68 Kn	Capacity	12.06 Kn	Passing Percentage	**1773.53 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	2.02 Kn	Capacity	16.08 Kn	Passing Percentage	**796.04 %**
$V_{0.9D-WnUp}$	-1.93 Kn	Capacity	-20.10 Kn	Passing Percentage	**1041.45 %**

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 = 5.54 mm	Limit by AS1170.0 Table C1 Span/250 = 18.00 mm
Deflection under Dead and Service Wind = 7.84 mm	Limit by AS1170.0 Table C1 Span/120 = 37.50 mm

Reactions

Maximum downward =2.02 kn Maximum upward = -1.93 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 = 4700 mm Internal Rafter Span = 17850 mm Try Rafter 2x400x45 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 =8.88 S1 Upward =8.88

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

Capacity Checks

$M_{1.35D}$	15.1 Kn-m	Capacity	55.3 Kn-m	Passing Percentage	**366.23 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	35.60 Kn-m	Capacity	73.72 Kn-m	Passing Percentage	**207.08 %**
$M_{0.9D-WnUp}$	66 Kn-m	Capacity	-92.16 Kn-m	Passing Percentage	**139.64 %**

$V_{1.35D}$	11.67 Kn	Capacity	61.36 Kn	Passing Percentage	**525.79 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	29 Kn	Capacity	81.82 Kn	Passing Percentage	**282.14 %**
$V_{0.9D\text{-}WnUp}$	52 Kn	Capacity	-102.26 Kn	Passing Percentage	**196.65 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 37 mm	Limit by AS1170.0 Table C1 Span/250 = 72.00 mm
Deflection under Dead and Service Wind = 115 mm	Limit by AS1170.0 Table C1 Span/120 = 150.00 mm

Reactions

Maximum downward =29 kn   Maximum upward = 52 kn

Rafter to Pole Connection check

Bolt Size = M20 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

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 81.25 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 = 85.81 Kn > 52 Kn

Prop on Sides = 2   2/30063LVL13   1300mm   Reaction Prop = 71.00 Kn down 123.00 Kn Up

Prop Combined axial and bending ratios (My/Phi x Mny)+(Nc/Phi x Ncy) should be less than or equal to 1

For Short Term Load = 0.82 < 1 OK

For Medium Term Load = 0.59 < 1 OK

For Long Term Load = 0.33 < 1 OK

Prop Connection check

Effective width of Pole used in Calculations = 250 mm -20mm (Margin for chamfer)

Bolt Size = M20 Number of Bolts = 4

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 100 mm

Angle of prop = 45 degree

Prop Connection Capacity under Short term loads: 160.95 Kn > 123 Kn OK

Prop Connection Capacity under Medium term loads: 128.76 Kn > 71 Kn OK

Prop Connection Capacity under Long term loads: 96.57 Kn > 29.2 Kn OK

Rafter Design External

External Rafter Load Width = 2350 mm External Rafter Span = 4317 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

$M_{1.35D}$	1.85 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	**255.14 %**
$M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	5.47 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	**115.17 %**
$M_{0.9D-WnUp}$	-5.23 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	**150.48 %**
$V_{1.35D}$	1.71 Kn	Capacity	14.47 Kn	Passing Percentage	**846.20 %**
$V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$	5.07 Kn	Capacity	19.30 Kn	Passing Percentage	**380.67 %**
$V_{0.9D-WnUp}$	-4.84 Kn	Capacity	-24.12 Kn	Passing Percentage	**498.35 %**

Deflections

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 6.20 mm Limit by AS1170.0 Table C1 Span/250 = 18.00 mm

Deflection under Dead and Service Wind = 8.78 mm Limit by AS1170.0 Table C1 Span/120 = 37.50 mm

Reactions

Maximum downward =5.07 kn Maximum upward = -4.84 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 x k1 x k4 x k5 x fs x b x ds .... (Eq 4.12) = -25.20 kn > -4.84 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -4.84 Kn

Middle Pole Design

Geometry

250 SED H5 (Minimum 300 dia. at Floor Level)	Dry Use	Height	3300 mm
Area	70650 mm2	As	52987.5 mm2
Ix	397406250 mm4	Zx	2649375 mm3
Iy	397406250 mm4	Zx	2649375 mm3
Lateral Restraint	3300 mm c/c		

Loads

Total Area over Pole = 42.3 m2

Dead	8.50 Kn	Live	10.50 Kn
Wind	29.40 Kn	Snow	0.00 Kn
Moment wind	71 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 =	36.3 MPa	fs =	2.96 MPa
fc =	18 MPa	fp =	7.2 MPa
ft =	22 MPa	E =	9257 MPa

Capacities

PhiNcx Wind	1014.92 Kn	PhiMnx Wind	76.75 Kn-m	PhiVnx Wind	125.47 Kn
PhiNcx Dead	608.95 Kn	PhiMnx Dead	46.05 Kn-m	PhiVnx Dead	75.28 Kn

Checks

(Mx/PhiMnx)+(N/phiNcx) = 0.97 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.90 < 1 OK

Deflection at top under service lateral loads = 6.52 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))				
Kp =	(1+sin(30)) / (1-sin(30))				

Geometry For Middle Bay Pole

Ds =	600 mm	Pile Diameter
L =	1300 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 =	0.00 Kn-m
Shear Wind =	4.31 Kn

Pile Properties

Safety Factory	0.55	
Hu =	4.55 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.02 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.95 < 1 OK

End Pole Design

Geometry For End Bay Pole

Ds =	600 mm	Pile Diameter
L =	1300 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 = 5.2875 m2

Moment Wind =	2.59 Kn-m
Shear Wind =	0.86 Kn

Pile Properties

Safety Factory	0.55	
Hu =	4.55 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.02 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.32 < 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 =	3000 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	2.59 Kn-m
Shear Wind =	0.86 Kn

Pile Properties

Safety Factory	0.55	
Hu =	4.55 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	8.02 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.32 < 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(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 = 15.76 Kn

Uplift on one Pile = 40.40 Kn

Uplift is ok