

Job No.: Kitset 8

Address: K7, K7, New Zealand

Date: 24/06/2025

Latitude: -35.725947

Longitude: 174.051067

Elevation: 34.5 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N0	Ground Snow Load	0 KPa	Roof Snow Load	0 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	NZ1	Terrain Category	2.34	Design Wind Speed	41.54 m/s
Wind Pressure	1.04 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 Open

For roof $C_{p,i} = 0.6504$

For roof $C_{p,e}$ from 0 m To 1.65 m $C_{p,e} = -0.98$ $p_e = -0.91$ KPa $p_{net} = -1.64$ KPa

For roof $C_{p,e}$ from 1.65 m To 3.30 m $C_{p,e} = -0.86$ $p_e = -0.80$ KPa $p_{net} = -1.53$ KPa

For wall Windward $C_{p,i} = 0.6504$ side Wall $C_{p,i} = -0.5578$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 20 m $C_{p,e} = 0.7$ $p_e = 0.65$ KPa $p_{net} = 1.27$ KPa

For side wall $C_{p,e}$ from 0 m To 3.30 m $C_{p,e} =$ $p_e = -0.60$ KPa $p_{net} = 0.02$ KPa

Maximum Upward pressure used in roof member Design = 1.64 KPa

Maximum Downward pressure used in roof member Design = 0.81 KPa

Maximum Wall pressure used in Design = 1.27 KPa

Maximum Racking pressure used in Design = 1.12 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 mm

Purlin Span = 3850 mm

Try Purlin 200x50 SG8 Dry

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 = 1.00

K8 Upward = 0.84 S1 Downward = 11.27 S1 Upward = 16.38

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

Capacity Checks

M _{1.35D}	0.56 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	398.21 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.09 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	142.11 %
M _{0.9D-WnUp}	-2.36 Kn-m	Capacity	-3.15 Kn-m	Passing Percentage	133.47 %
V _{1.35D}	0.58 Kn	Capacity	9.65 Kn	Passing Percentage	1663.79 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.92 Kn	Capacity	12.86 Kn	Passing Percentage	669.79 %
V _{0.9D-WnUp}	-2.45 Kn	Capacity	-16.08 Kn	Passing Percentage	656.33 %

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 = 11.10 mm Limit by Woolcock et al, 1999 Span/240 = 15.83 mm

Deflection under Dead and Service Wind = 9.90 mm Limit by Woolcock et al, 1999 Span/100 = 38.00 mm

Reactions

Maximum downward = 1.92 kn Maximum upward = -2.45 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 = 4000 mm Internal Rafter Span = 5350 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

M _{1.35D}	2.86 Kn-m	Capacity	10.08 Kn-m	Passing Percentage	352.45 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	5.31 Kn-m	Capacity	13.44 Kn-m	Passing Percentage	253.11 %

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M _{0.9D-WnUp}	10.56 Kn-m	Capacity	-16.8 Kn-m	Passing Percentage	159.09 %
V _{1.35D}	3.29 Kn	Capacity	28.94 Kn	Passing Percentage	879.64 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	6.13 Kn	Capacity	38.6 Kn	Passing Percentage	629.69 %
V _{0.9D-WnUp}	17.01 Kn	Capacity	-48.24 Kn	Passing Percentage	283.60 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 7 mm Limit by Woolcock et al, 1999 Span/240 = 22.92 mm

Deflection under Dead and Service Wind = 18.5 mm Limit by Woolcock et al, 1999 Span/100 = 55.00 mm

Reactions

Maximum downward = 6.13 kn Maximum upward = 17.01 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 = J5 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

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 100 mm

For Parallel to grain loading

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

Capacity under short term loads = 43.34 Kn > 17.01 Kn

Prop on Sides = 2 2/SG820050Dry 1000mm Reaction Prop = 12.07 Kn down 25.12 Kn Up

Prop Combined axial and bending ratios (M_y/Phi x M_{ny})+(N_c/Phi x N_{cy}) should be less than or equal to 1

For Short Term Load = 0.92 < 1 OK

For Medium Term Load = 0.55 < 1 OK

For Long Term Load = 0.40 < 1 OK

Prop Connection check

Effective width of Pole used in Calculations = 175 mm -20mm (Margin for chamfer)

Bolt Size = M12 Number of Bolts = 4

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

Angle of prop = 45 degree

Prop Connection Capacity under Short term loads: 49.69 Kn > 25.12 Kn OK

Prop Connection Capacity under Medium term loads: 39.75 Kn > 12.07 Kn OK

Prop Connection Capacity under Long term loads: 29.81 Kn > 6.54 Kn OK

Intermediate Design Sides

Intermediate Spacing = 2750 mm Intermediate Span = 3145 mm Try Intermediate 2x150x50 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 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =1.00 S1 Downward =9.63 S1 Upward =0.57

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

Capacity Checks

M _{Wind+Snow}	2.16 Kn-m	Capacity	4.2 Kn-m	Passing Percentage	194.44 %
V _{0.9D-WnUp}	2.75 Kn	Capacity	24.12 Kn	Passing Percentage	877.09 %

Deflections

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

Deflection under Snow and Service Wind = 29.31 mm Limit by Woolcock et al, 1999 Span/100 = 31.45 mm

Reactions

Maximum = 2.75 kn

Girt Design Front and Back

Girt's Spacing = 700 mm Girt's Span = 4000 mm Try Girt 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 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.92 S1 Downward =9.63 S1 Upward =14.36

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

Capacity Checks

M _{Wind+Snow}	1.78 Kn-m	Capacity	1.94 Kn-m	Passing Percentage	108.99 %
V _{0.9D-WnUp}	1.78 Kn	Capacity	12.06 Kn	Passing Percentage	677.53 %

Deflections

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

Deflection under Snow and Service Wind = 31.45 mm Limit by Woolcock et al, 1999 Span/100 = 40.00 mm

Sag during installation = 15.52 mm

Reactions

Maximum = 1.78 kn

Girt Design Sides

Girt's Spacing = 1300 mm Girt's Span = 2750 mm Try Girt 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 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.82 S1 Downward =9.63 S1 Upward =16.84

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

Capacity Checks

M _{Wind+Snow}	1.56 Kn-m	Capacity	1.73 Kn-m	Passing Percentage	110.90 %
V _{0.9D-WnUp}	2.27 Kn	Capacity	12.06 Kn	Passing Percentage	531.28 %

Deflections

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

Deflection under Snow and Service Wind = 13.05 mm Limit by Woolcock et al. 1999 Span/100 = 27.50 mm

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Sag during installation = 3.47 mm

Reactions

Maximum = 2.27 kn

Middle Pole Design

Geometry

175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	3300 mm
Area	27598 mm ²	As	20698.2421875 mm ²
Ix	60639381 mm ⁴	Zx	646820 mm ³
Iy	60639381 mm ⁴	Zy	646820 mm ³
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 11 m²

Dead	4.29 Kn	Live	3.08 Kn
Wind Down	9.98 Kn	Snow	0.00 Kn
Moment wind	5.86 Kn-m		
Phi	0.8	K8	1.00
K1 snow	0.8	K1 Dead	0.6
K1 wind	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	397.41 Kn	PhiMnx Wind	18.78 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	238.44 Kn	PhiMnx Dead	11.27 Kn-m	PhiVnx Dead	29.41 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\phi N_{cx}) = 0.69 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\phi N_{cx}) = 0.46 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 32.29 mm < 33.00 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 = $(1 - \sin(30)) / (1 + \sin(30))$
K_p = $(1 + \sin(30)) / (1 - \sin(30))$

Geometry For Middle Bay Pole

D_s = 0.6 mm Pile Diameter
L = 1600 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 = 5.86 Kn-m
Shear Wind = 4.02 Kn

Pile Properties

Safety Factory 0.55
H_u = 8.49 Kn Ultimate Lateral Strength of the Pile, Short pile
M_u = 13.91 Kn-m Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.47 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

150 SED H5 (Minimum 175 dia. at Floor Level)	Dry Use	Height	3300 mm
Area	20729 mm ²	As	15546.6796875 mm ²
I _x	34210793 mm ⁴	Z _x	421056 mm ³
I _y	34210793 mm ⁴	Z _y	421056 mm ³
Lateral Restraint	mm c/c		

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Loads

Total Area over Pole = 5.5 m²

Dead	1.38 Kn	Live	1.38 Kn
Wind Down	4.46 Kn	Snow	0.00 Kn
Moment Wind	5.43 Kn-m		
Phi	0.8	K8	0.66
K1 snow	0.8	K1 Dead	0.6
K1 wind	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	195.59 Kn	PhiMnx Wind	8.01 Kn-m	PhiVnx Wind	36.81 Kn
PhiNcx Dead	117.35 Kn	PhiMnx Dead	4.81 Kn-m	PhiVnx Dead	22.09 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.71 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.50 < 1$ OK

Deflection at top under service lateral loads = 31.14 mm < 35.91 mm

Ds =	0.6 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 = 5.5 m²

Moment Wind =	5.43 Kn-m
Shear Wind =	2.01 Kn

Pile Properties

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Safety Factor	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 = 0.69 < 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
$K_0 =$	$(1 - \sin(30)) / (1 + \sin(30))$				
$K_p =$	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For End Bay Pole

$D_s =$	0.6 mm	Pile Diameter
$L =$	1300 mm	Pile embedment length
$f_1 =$	2700 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	5.43 Kn-m
Shear Wind =	2.01 Kn

Pile Properties

Safety Factor	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 = 0.69 < 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

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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(1600) x Ks(1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1600)

Skin Friction = 20.68 Kn

Weight of Pile + Pile Skin Friction = 25.36 Kn

Uplift on one Pile = 15.56 Kn

Uplift is ok