

Job No.: SHEDCHAD J2421**Address:** 112 Wrights Road, Sheffield, New Zealand**Date:** 24/06/2024**Latitude:** -43.382154**Longitude:** 172.014428**Elevation:** 306.5 m**General Input**

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N4	Ground Snow Load	1.46 KPa	Roof Snow Load	1.02 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	45.87 m/s
Wind Pressure	1.26 KPa	Lee Zone	YES	Ultimate Snow ARI	50 Years
Wind Category	Very 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 $C_{p,i} = 0.6867$

For roof $C_{p,e}$ from 0 m To 3.75 m $C_{p,e} = -0.9$ $p_e = -0.57$ KPa $p_{net} = -1.10$ KPa

For roof $C_{p,e}$ from 3.75 m To 7.50 m $C_{p,e} = -0.5$ $p_e = -0.32$ KPa $p_{net} = -0.85$ KPa

For wall Windward $C_{p,i} = 0.6867$ side Wall $C_{p,i} = -0.6253$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 9 m $C_{p,e} = 0.7$ $p_e = 0.80$ KPa $p_{net} = 1.66$ KPa

For side wall $C_{p,e}$ from 0 m To 3.75 m $C_{p,e} =$ $p_e = -0.74$ KPa $p_{net} = 0.12$ KPa

Maximum Upward pressure used in roof member Design = 1.10 KPa

Maximum Downward pressure used in roof member Design = 0.97 KPa

Maximum Wall pressure used in Design = 1.66 KPa

Maximum Racking pressure used in Design = 1.37 KPa

Design Summary**Purlin Design**

Purlin Spacing = 800 mm

Purlin Span = 4350 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)

K1 Short term = 1 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 0.47 S1 Downward = 11.27 S1 Upward = 24.64

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	2.23 Kn-m	Passing Percentage	348.44 %
$M_{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}$	2.5 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	118.80 %
$M_{0.9D-W_nUp}$	-1.66 Kn-m	Capacity	-1.76 Kn-m	Passing Percentage	106.02 %
$V_{1.35D}$	0.59 Kn	Capacity	9.65 Kn	Passing Percentage	1635.59 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	2.30 Kn	Capacity	12.86 Kn	Passing Percentage	559.13 %
V _{0.9D-WnUp}	-1.52 Kn	Capacity	-16.08 Kn	Passing Percentage	1057.89 %

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 = 9.57 mm Limit by Woolcock et al, 1999 Span/240 = 17.92 mm

Deflection under Dead and Service Wind = 15.71 mm Limit by Woolcock et al, 1999 Span/100 = 43.00 mm

Reactions

Maximum downward = 2.30 kn Maximum upward = -1.52 kn

Number of Blocking = 0 if 0 then no blocking required, if 1 then one midspan blocking required

Girt Design Front and Back

Girt's Spacing = 600 mm

Girt's Span = 4500 mm

Try Girt 200x50 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 K₄ = 1 K₅ = 1 K₈ Downward = 1.00

K₈ Upward = 0.78 S₁ Downward = 11.27 S₁ Upward = 17.82

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

Capacity Checks

M _{Wind+Snow}	2.52 Kn-m	Capacity	2.90 Kn-m	Passing Percentage	115.08 %
V _{0.9D-WnUp}	2.24 Kn	Capacity	16.08 Kn	Passing Percentage	717.86 %

Deflections

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

Deflection under Snow and Service Wind = 38.44 mm Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Sag during installation = 24.86 mm

Reactions

Maximum = 2.24 kn

Girt Design Sides

Girt's Spacing = 600 mm

Girt's Span = 4500 mm

Try Girt 200x50 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 K₄ = 1 K₅ = 1 K₈ Downward = 1.00

K₈ Upward = 0.78 S₁ Downward = 11.27 S₁ Upward = 17.82

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

Capacity Checks

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M _{Wind+Snow}	2.52 Kn-m	Capacity	2.90 Kn-m	Passing Percentage	115.08 %
V _{0.9D-WnUp}	2.24 Kn	Capacity	16.08 Kn	Passing Percentage	717.86 %

Deflections

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

Deflection under Snow and Service Wind = 38.44 mm

Limit by Woolcock et al. 1999 Span/100 = 45.00 mm

Sag during installation = 24.86 mm

Reactions

Maximum = 2.24 kn

Middle Pole Design

Geometry

200 SED H5 (Minimum 225 dia. at Floor Level)	Dry Use	Height	3700 mm
Area	35448 mm ²	As	26585.7421875 mm ²
I _x	100042702 mm ⁴	Z _x	941578 mm ³
I _y	100042702 mm ⁴	Z _y	941578 mm ³
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 20.25 m²

Dead	5.06 Kn	Live	5.06 Kn
Wind Down	19.64 Kn	Snow	20.66 Kn
Moment wind	12.30 Kn-m	Moment snow	4.37 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	510.45 Kn	PhiM _{nx} Wind	27.34 Kn-m	PhiV _{nx} Wind	62.96 Kn
PhiN _{cx} Dead	306.27 Kn	PhiM _{nx} Dead	16.41 Kn-m	PhiV _{nx} Dead	37.77 Kn
PhiN _{cx} Snow	408.36 Kn	PhiM _{nx} Snow	21.87 Kn-m	PhiV _{nx} Snow	50.36 Kn

Checks

$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.52 < 1$ OK

$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.27 < 1$ OK

Deflection at top under service lateral loads = 27.62 mm < 37.00 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 =	1550 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 =	12.30 Kn-m	Moment Snow =	Kn-m
Shear Wind =	4.10 Kn	Shear Snow =	4.37 Kn

Pile Properties

Safety Factory	0.55	
Hu =	7.29 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	13.07 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.94 < 1 OK

End Pole Design**Geometry For End Bay Pole****Geometry**

175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	3700 mm
Area	27598 mm ²	As	20698.2421875 mm ²
Ix	60639381 mm ⁴	Zx	646820 mm ³
Iy	60639381 mm ⁴	Zx	646820 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 10.125 m²

Dead	2.53 Kn	Live	2.53 Kn
Wind Down	9.82 Kn	Snow	10.33 Kn
Moment Wind	6.15 Kn-m	Moment snow	2.18 Kn-m
Phi	0.8	K8	0.68
K1 snow	0.8	K1 Dead	0.6
K1wind	1		

Material

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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

PhiNcx Wind	271.57 Kn	PhiMnx Wind	12.84 Kn-m	PhiVnx Wind	49.01 Kn
PhiNcx Dead	162.94 Kn	PhiMnx Dead	7.70 Kn-m	PhiVnx Dead	29.41 Kn
PhiNcx Snow	217.26 Kn	PhiMnx Snow	10.27 Kn-m	PhiVnx Snow	39.21 Kn

Checks

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

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.30 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 24.57 \text{ mm} < 39.90 \text{ mm}$$

$D_s =$	0.6 mm	Pile Diameter
$L =$	1300 mm	Pile embedment length
$f_1 =$	3000 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

$$\text{Total Area over Pole} = 10.125 \text{ m}^2$$

Moment Wind =	6.15 Kn-m	Moment Snow =	2.18 Kn-m
Shear Wind =	2.05 Kn	Shear Snow =	2.18 Kn

Pile Properties

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

Checks

$$\text{Applied Forces/Capacities} = 0.77 < 1 \text{ OK}$$

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
$f_1 =$	3000 mm	Distance at which the shear force is applied
$f_2 =$	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	6.15 Kn-m	Moment Snow =	2.18 Kn-m
Shear Wind =	2.05 Kn	Shear Snow =	2.18 Kn

Pile Properties

Safety Factor	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 = 0.77 < 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(1550) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(1550)

Skin Friction = 19.40 Kn

Weight of Pile + Pile Skin Friction = 23.43 Kn

Uplift on one Pile = 17.72 Kn

Uplift is ok