

Job Number:

**BWhite
Consulting Ltd**

Issue:

PRODUCER STATEMENT-PS1-DESIGN

ISSUED BY: **BWhite Consulting Ltd (Design Engineer: Bevan White)**

TO BE SUPPLIED TO: **Waimakariri District Council** IN RESPECT OF: **Proposed NEW Farm Shed**

AT: **91 Pembertons Road, Sefton, New Zealand**

LEGAL DESCRIPTION

We have been engaged by **Ezequote Pty Ltd** to provide **Specific Structural Engineering Design** services in respect of the requirements of Clause(s) **B1** of the Building Code for part only (as specified in the attachment to this statement), of the proposed building work.

☐ ALL ☒ Part only as specified: Purlins, Rafters, Girts, Poles, Columns, Pole embedment and all connections

The design has been prepared in accordance with compliance documents to NZ Building Code issued by Ministry of Business, Innovation & Employment Clauses **B1/VM1 and B1/VM4**

The proposed building work covered by the producer statement is described on **Ezequote** drawings title **5115022111** and numbered **A101-A116 Rev-1** dated **06/02/2024** together with the following specification, and other documents set out in the schedule attached to this statement: **Design Featured Report Dated 18/03/2024 and numbered "Second Page"**

On behalf of BWhite Consulting Ltd, and subject to:

1. Site verification of the following design assumptions: **an Ultimate foundation bearing pressure of 300 kPa in accordance with NZS3604:2011**
2. **The building has a design life of 50 years and am Importance Level 1**
3. **Unless specifically noted, compliance of the drawings to None-Specific codes such as NZS3604 and NZS4229 have not been checked by this practice**
4. **This Certificate does not cover any other building code clause including weather tightness**
5. **Inspections of the building to be completed by Waimakariri District Council. As BWhite Consulting Ltd are not undertaking inspections, we cannot issue a producer Statement-PS4- Construction Review.**
6. **This Producer Statement- Design is valid for a building consent issued within 1 year from the date of issue**
7. All proprietary products meeting their performance specification requirements

I believe on reasonable grounds that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the follow level of construction monitoring/observation:

☒ CM1 ☐ CM2 ☐ CM3 ☐ CM4 ☐ CM5 or as per agreement with owner/developer (**stated above**)

I, Bevan White am CPEng **108276** I am Member of Engineering New Zealand and hold the following qualification: **BE.Civil**

BWhite Consulting Ltd holds a current policy of Professional Indemnity Insurance no less than \$200,000.

Signed by **Bevan White** on behalf of **BWhite Consulting Ltd** Dated: **18/03/2024**

Email: bwhitecpeng@gmail.com Phone: 0211-979786

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Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of \$200,000.

This form is to accompany Form 2 of the Building (Forms) Regulations 2004 for the application of a Building Consent

Date: 18/03/2024

***BWhite
Consulting Ltd***

18B Jules Crescent,

Bell Block New Plymouth 4312

New Zealand

File No:

DESIGN FEATURES SUMMARY FOR PROPOSED NEW FARM SHED 91 PEMBERTONS ROAD, SEFTON, NEW ZEALAND

Site Specific Loads

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	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & EQ ARI	100 Years	Max Height	3.6 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	38.22 m/s
Wind Pressure	0.88 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years

Timber

Sawn Timber to be graded to the properties of SG6 and SG8 or better as mentioned on plans, with moisture content of 18% or less for dry and 25% or less for wet.

The following standards have been used in the design of this structure

- NZS 3603:1993 Timber Structures Standard
- NZS 3604:2011 Timber Framed Buildings. Standards New Zealand, 2011
- NZS 3404:1997 Steel Structures
- AS/NZS 1170 2003 Structural Design Actions
- AS/NZS 1170.2 2021 Structural Design Actions- Wind Action
- Branz. "Engineering Basis of NZS 3604". April 2013

Yours Faithfully

BWhite CONSULTING LTD

Bevan White

Director | BE Civil . CMengNZ CPEng

Email: bwhitecpeng@gmail.com Contact: 0211 979 786

Job No.: 5115022111
Latitude: -43.23804

Address: 91 Pemberton Road, Sefton, New Zealand
Longitude: 172.667712

Date: 18/03/2024
Elevation: 32 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	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	2	Subsoil Category	D	Exposure Zone	C
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	3.6 m
Wind Region	NZ2	Terrain Category	2.0	Design Wind Speed	38.22 m/s
Wind Pressure	0.88 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 $C_{p,i} = -0.3$

For roof $C_{p,e}$ from 0 m To 1.65 m $C_{p,e} = -0.94$ $p_e = -0.74$ KPa $p_{net} = -0.74$ KPa

For roof $C_{p,e}$ from 1.65 m To 3.30 m $C_{p,e} = -0.88$ $p_e = -0.69$ KPa $p_{net} = -0.69$ KPa

For wall Windward $C_{p,i} = -0.3$ side Wall $C_{p,i} = -0.3$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 6 m $C_{p,e} = 0.7$ $p_e = 0.55$ KPa $p_{net} = 0.81$ KPa

For side wall $C_{p,e}$ from 0 m To 3.30 m $C_{p,e} =$ $p_e = -0.51$ KPa $p_{net} = -0.51$ KPa

Maximum Upward pressure used in roof member Design = 0.74 KPa

Maximum Downward pressure used in roof member Design = 0.42 KPa

Maximum Wall pressure used in Design = 0.81 KPa

Maximum Racking pressure used in Design = 0.94 KPa

Design Summary

Purlin Design

Purlin Spacing = 900 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

M1.35D	0.72 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	309.72 %
M1.2D+1.5L 1.2D+S _n 1.2D+W _n D _n	1.98 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	150.00 %
M0.9D-W _n U _p	-1.1 Kn-m	Capacity	-1.76 Kn-m	Passing Percentage	160.00 %
V1.35D	0.66 Kn	Capacity	9.65 Kn	Passing Percentage	1462.12 %

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V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.82 Kn	Capacity	12.86 Kn	Passing Percentage	706.59 %
V _{0.9D-WnUp}	-1.01 Kn	Capacity	-16.08 Kn	Passing Percentage	1592.08 %

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 = 10.76 mm Limit by Woolcock et al, 1999 Span/240 = 17.92 mm

Deflection under Dead and Service Wind = 12.74 mm Limit by Woolcock et al, 1999 Span/100 = 43.00 mm

Reactions

Maximum downward = 1.82 kn Maximum upward = -1.01 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 = 4500 mm Internal Rafter Span = 5850 mm Try Rafter 2x240x45 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 = 6.71 S₁ Upward = 6.71

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

Capacity Checks

M _{1.35D}	6.50 Kn-m	Capacity	19.9 Kn-m	Passing Percentage	306.15 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	17.90 Kn-m	Capacity	26.54 Kn-m	Passing Percentage	148.27 %
M _{0.9D-WnUp}	-9.91 Kn-m	Capacity	-33.18 Kn-m	Passing Percentage	334.81 %
V _{1.35D}	4.44 Kn	Capacity	36.82 Kn	Passing Percentage	829.28 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	12.24 Kn	Capacity	49.08 Kn	Passing Percentage	400.98 %
V _{0.9D-WnUp}	-6.78 Kn	Capacity	-61.36 Kn	Passing Percentage	905.01 %

Deflections

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

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 17.98 mm Limit by Woolcock et al, 1999 Span/240 = 25.00 mm

Deflection under Dead and Service Wind = 23.635 mm Limit by Woolcock et al, 1999 Span/100 = 60.00 mm

Reactions

Maximum downward = 12.24 kn Maximum upward = -6.78 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

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

Factor of Safety = 0.7

For Perpendicular to grain loading

$K_{11} = 12.6$ fpj = 22.7 Mpa for Rafter with effective thickness = 90 mm

For Parallel to grain loading

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

Capacity under short term loads = 29.11 Kn > -6.78 Kn

Rafter Design External

External Rafter Load Width = 2250 mm

External Rafter Span = 5830 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)

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 = 0.94

K_8 Upward = 0.94 S_1 Downward = 13.93 S_1 Upward = 13.93

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

Capacity Checks

$M_{1.35D}$	3.23 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	146.13 %
$M_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	8.89 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	70.87 %
$M_{0.9D-W_nUp}$	-4.92 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	159.96 %
$V_{1.35D}$	2.21 Kn	Capacity	14.47 Kn	Passing Percentage	654.75 %
$V_{1.2D+1.5L \ 1.2D+S_n \ 1.2D+W_nD_n}$	6.10 Kn	Capacity	19.30 Kn	Passing Percentage	316.39 %
$V_{0.9D-W_nUp}$	-3.38 Kn	Capacity	-24.12 Kn	Passing Percentage	713.61 %

Deflections

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

k_2 for Long Term Loads = 2

Deflection under Dead and Live Load = 18.75 mm

Limit by Woolcock et al, 1999 Span/240 = 25.00 mm

Deflection under Dead and Service Wind = 22.19 mm

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

Reactions

Maximum downward = 6.10 kn Maximum upward = -3.38 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

$K_{11} = 14.9$ fpj = 12.9 Mpa for Rafter with effective thickness = 50 mm

For Parallel to grain loading

$K_{11} = 2.0$ $f_{c,j} = 36.1$ 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) = -25.20 kn > -3.38 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -3.38 Kn

Intermediate Design Front and Back

Intermediate Spacing = 2250 mm Intermediate Span = 3450 mm Try Intermediate 2x200x50 SG8 Dry

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 = 1.00

K_8 Upward = 1.00 S_1 Downward = 11.27 S_1 Upward = 0.70

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

Capacity Checks

$M_{Wind+Snow}$	3.01 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	247.84 %
$V_{0.9D-WnUp}$	3.49 Kn-m	Capacity	-32.16 Kn-m	Passing Percentage	921.49 %

Deflections

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

Deflection under Snow and Service Wind = 19.715 mm Limit by Woolcock et al, 1999 Span/100 = 34.50 mm

Reactions

Maximum = 3.49 kn

Intermediate Design Sides

Intermediate Spacing = 3000 mm Intermediate Span = 3150 mm Try Intermediate 2x200x50 SG8 Dry

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 = 1.00

K_8 Upward = 1.00 S_1 Downward = 11.27 S_1 Upward = 0.67

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

Capacity Checks

$M_{Wind+Snow}$	1.67 Kn-m	Capacity	7.46 Kn-m	Passing Percentage	446.71 %
$V_{0.9D-WnUp}$	2.13 Kn-m	Capacity	32.16 Kn-m	Passing Percentage	1509.86 %

Deflections

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

Deflection under Snow and Service Wind = 18.255 mm Limit by Woolcock et al, 1999 Span/100 = 31.50 mm

Reactions

Maximum = 2.13 kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 2250 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 =0.89 S1 Downward =9.63 S1 Upward =15.23

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

Capacity Checks

M _{Wind+Snow}	0.46 Kn-m	Capacity	1.87 Kn-m	Passing Percentage	406.52 %
V _{0.9D-WnUp}	0.82 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	1470.73 %

Deflections

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

Deflection under Snow and Service Wind = 4.59 mm

Limit by Woolcock et al, 1999 Span/100 = 22.50 mm

Sag during installation = 1.55 mm

Reactions

Maximum = 0.82 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 3000 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 =0.79 S1 Downward =9.63 S1 Upward =17.59

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

Capacity Checks

M _{Wind+Snow}	0.82 Kn-m	Capacity	1.65 Kn-m	Passing Percentage	201.22 %
V _{0.9D-WnUp}	1.09 Kn-m	Capacity	12.06 Kn-m	Passing Percentage	1106.42 %

Deflections

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

Deflection under Snow and Service Wind = 14.51 mm

Limit by Woolcock et al. 1999 Span/100 = 30.00 mm

Sag during installation =4.91 mm

Reactions

Maximum = 1.09 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
I _x	60639381 mm ⁴	Z _x	646820 mm ³
I _y	60639381 mm ⁴	Z _y	646820 mm ³
Lateral Restraint	3400 mm c/c		

Loads

Total Area over Pole = 13.5 m²

Dead	3.38 Kn	Live	3.38 Kn
Wind Down	5.67 Kn	Snow	8.51 Kn
Moment wind	10.25 Kn-m	Moment snow	3.64 Kn-m
Phi	0.8	K ₈	0.76
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	302.65 Kn	PhiM _{nx} Wind	14.30 Kn-m	PhiV _{nx} Wind	49.01 Kn
PhiN _{cx} Dead	181.59 Kn	PhiM _{nx} Dead	8.58 Kn-m	PhiV _{nx} Dead	29.41 Kn
PhiN _{cx} Snow	242.12 Kn	PhiM _{nx} Snow	11.44 Kn-m	PhiV _{nx} Snow	39.21 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.77 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.57 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 30.49 \text{ mm} < 33.00 \text{ mm}$$

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
K ₀ =	(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 =	1500 mm	Pile embedment length
f _l =	2700 mm	Distance at which the shear force is applied

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$f_2 =$ 0 mm Distance of top soil at rest pressure

Loads

Moment Wind =	10.25 Kn-m	Moment Snow =	Kn-m
Shear Wind =	3.80 Kn	Shear Snow =	3.64 Kn

Pile Properties

Safety Factory	0.55		
$H_u =$	7.16 Kn	Ultimate Lateral Strength of the Pile, Short pile	
$M_u =$	11.65 Kn-m	Ultimate Moment Capacity of Pile	

Checks

Applied Forces/Capacities = 0.88 < 1 OK

End Pole Design

Geometry For End Bay Pole

Geometry

175 SED H5 (Minimum 200 dia. at Floor Level)	Dry Use	Height	3300 mm
Area	27598 mm ²	A_s	20698.2421875 mm ²
I_x	60639381 mm ⁴	Z_x	646820 mm ³
I_y	60639381 mm ⁴	Z_y	646820 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 13.5 m²

Dead	3.38 Kn	Live	3.38 Kn
Wind Down	5.67 Kn	Snow	8.51 Kn
Moment Wind	5.13 Kn-m	Moment snow	1.82 Kn-m
Φ	0.8	K ₈	0.79
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

ΦH_{Ncx} Wind	312.90 Kn	ΦH_{Mnx} Wind	14.79 Kn-m	ΦH_{Vnx} Wind	49.01 Kn
ΦH_{Ncx} Dead	187.74 Kn	ΦH_{Mnx} Dead	8.87 Kn-m	ΦH_{Vnx} Dead	29.41 Kn
ΦH_{Ncx} Snow	250.32 Kn	ΦH_{Mnx} Snow	11.83 Kn-m	ΦH_{Vnx} Snow	39.21 Kn

Checks

$$(M_x/\phi M_{nx}) + (N/\phi N_{cx}) = 0.40 < 1 \text{ OK}$$

$$(M_x/\phi M_{nx})^2 + (N/\phi N_{cx}) = 0.18 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 16.59 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 = 13.5 m²

Moment Wind =	5.13 Kn-m	Moment Snow =	1.82 Kn-m
Shear Wind =	1.90 Kn	Shear Snow =	1.82 Kn

Pile Properties

Safety Factory	0.55	
Hu =	4.89 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	7.84 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.65 < 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 =	2700 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	5.13 Kn-m	Moment Snow =	1.82 Kn-m
Shear Wind =	1.90 Kn	Shear Snow =	1.82 Kn

Pile Properties

Safety Factory	0.55	
Hu =	4.89 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	7.84 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = $0.65 < 1$ OK

Uplift Check

Density of Concrete = 24 Kn/m^3

Density of Timber Pole = 5 Kn/m^3

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

K_s (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 (1500) x K_s (1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile (0.6) x Height of Pile (1500)

Skin Friction = 18.17 Kn

Weight of Pile + Pile Skin Friction = 22.56 Kn

Uplift on one Pile = 6.95 Kn

Uplift is ok