**Job Number:**

Issue:

***BWhite Consulting Ltd***

## PRODUCER STATEMENT-PS1-DESIGN

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

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

AT: **188 Govan Wilson Road, Whangaripo, 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 **Great Northern Construction** and numbered **A101-A114 Rev-1** dated **03/04/204** together with the following specfication, and other documents set out in the schedule attached to this statement: **Design Featured Report Dated 04/04/2024 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 Auckland 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 presons 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: **04/04/2024**

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

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:** 04/04/2024

BWhite Consulting Ltd

18B Jules Crescent,

Bell Block New Plymouth 4312

New Zealand

File No:

**DESIGN FEATURES SUMMARY FOR PROPOSED NEW FARM SHED 188 GOVAN WILSON ROAD, WHANGARIPO, 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 | 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 & EQ ARI | 100 Years | Max Height | 3.6 m |
| Wind Region | NZ1 | Terrain Category | 3.0 | Design Wind Speed | 50.01 m/s |
| Wind Pressure | 1.5 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.:** | Great Northern Construction | **Address:** | 188 Govan Wilson Road, Whangaripo, New Zealand | **Date:** | 04/04/2024 |
| **Latitude:** | -36.303938 | **Longitude:** | 174.667795 | **Elevation:** | 222.5 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 | C |
| Importance Level | 1 | Ultimate wind & Earthquake ARI | 100 Years | Max Height | 3.6 m |
| Wind Region | NZ1 | Terrain Category | 3.0 | Design Wind Speed | 50.01 m/s |
| Wind Pressure | 1.5 KPa | Lee Zone | NO | Ultimate Snow ARI | 50 Years |
| Wind Category | extra 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 = 0.6649

For roof CP,e from 0 m To 3.30 m Cpe = -0.9 pe = -1.12 KPa pnet = -2.12 KPa

For roof CP,e from 3.30 m To 6.60 m Cpe = -0.5 pe = -0.62 KPa pnet = -1.62 KPa

For wall Windward Cp,i = 0.6649 side Wall Cp,i = -0.5849

For wall Windward and Leeward CP,e from 0 m To 8 m Cpe = 0.7 pe = 0.95 KPa pnet = 1.76 KPa

For side wall CP,e from 0 m To 3.30 m Cpe = pe = -0.88 KPa pnet = -0.07 KPa

Maximum Upward pressure used in roof member Design = 2.12 KPa

Maximum Downward pressure used in roof member Design = 0.98 KPa

Maximum Wall pressure used in Design = 1.76 KPa

Maximum Racking pressure used in Design = 1.63 KPa

**Design Summary**

**Purlin Design**

| | | |
|---|---|---|
| Purlin Spacing = 800 mm | Purlin Span = 4350 mm | Try Purlin 240x45 SG8 |

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 =0.79 S1 Downward =13.82 S1 Upward =17.44

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 | 2.73 Kn-m | Passing Percentage | **426.56 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 2.42 Kn-m | Capacity | 3.64 Kn-m | Passing Percentage | **150.41 %** |
| $M_{0.9D-WnUp}$ | -3.59 Kn-m | Capacity | -3.85 Kn-m | Passing Percentage | **107.24 %** |
| $V_{1.35D}$ | 0.59 Kn | Capacity | 10.42 Kn | Passing Percentage | **1766.10 %** |
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 2.23 Kn | Capacity | 13.89 Kn | Passing Percentage | **622.87 %** |
| $V_{0.9D-WnUp}$ | -3.30 Kn | Capacity | -17.37 Kn | Passing Percentage | **526.36 %** |

**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 = 6.15 mm | Limit by Woolcock et al, 1999 Span/240 = 17.92 mm |
| Deflection under Dead and Service Wind = 10.15 mm | Limit by Woolcock et al, 1999 Span/100 = 43.00 mm |

#### Reactions

Maximum downward =2.23 kn   Maximum upward = -3.30 kn

Number of Blocking = 2   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 = 7850 mm   Try Rafter 2x360x63 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 =5.90   S1 Upward =5.90

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

#### Capacity Checks

| | | | | | |
|---|---|---|---|---|---|
| $M_{1.35D}$ | 11.70 Kn-m | Capacity | 48.16 Kn-m | Passing Percentage | **411.62 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 44.37 Kn-m | Capacity | 64.2 Kn-m | Passing Percentage | **144.69 %** |
| $M_{0.9D-WnUp}$ | -65.69 Kn-m | Capacity | -80.26 Kn-m | Passing Percentage | **122.18 %** |
| $V_{1.35D}$ | 5.96 Kn | Capacity | 72.94 Kn | Passing Percentage | **1223.83 %** |
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 22.61 Kn | Capacity | 97.26 Kn | Passing Percentage | **430.16 %** |
| $V_{0.9D-WnUp}$ | -33.47 Kn | Capacity | -121.56 Kn | Passing Percentage | **363.19 %** |

#### Deflections

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

k2 for Long Term Loads = 2

| | |
|---|---|
| Deflection under Dead and Live Load = 13.36 mm | Limit by Woolcock et al, 1999 Span/240 = 33.33 mm |
| Deflection under Dead and Service Wind = 24.495 mm | Limit by Woolcock et al, 1999 Span/100 = 80.00 mm |

#### Reactions

Maximum downward =22.61 kn   Maximum upward = -33.47 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

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 80 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K11 = 12.6 fpj = 22.7 Mpa for Rafter with effective thickness = 126 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 = 77.63 Kn > -33.47 Kn

### Rafter Design External

External Rafter Load Width = 2250 mm   External Rafter Span = 7822 mm   Try Rafter 360x63 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 =0.98

K8 Upward =0.98   S1 Downward =12.10   S1 Upward =12.10

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{1.35D}$ | 5.81 Kn-m | Capacity | 23.68 Kn-m | Passing Percentage | **407.57 %** |
| $M_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 22.03 Kn-m | Capacity | 31.57 Kn-m | Passing Percentage | **143.30 %** |
| $M_{0.9D-WnUp}$ | -32.61 Kn-m | Capacity | -39.46 Kn-m | Passing Percentage | **121.01 %** |
| $V_{1.35D}$ | 2.97 Kn | Capacity | 36.47 Kn | Passing Percentage | **1227.95 %** |
| $V_{1.2D+1.5L\ 1.2D+Sn\ 1.2D+WnDn}$ | 11.26 Kn | Capacity | 48.63 Kn | Passing Percentage | **431.88 %** |
| $V_{0.9D-WnUp}$ | -16.68 Kn | Capacity | -60.78 Kn | Passing Percentage | **364.39 %** |

**Deflections**

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

k2 for Long Term Loads = 2

Deflection under Dead and Live Load = 14.85 mm Limit by Woolcock et al, 1999 Span/240= 33.33 mm

Deflection under Dead and Service Wind = 24.50 mm Limit by Woolcock et al, 1999 Span/100 = 80.00 mm

**Reactions**

Maximum downward =11.26 kn Maximum upward = -16.68 kn

**Rafter to Pole Connection check**

Bolt Size = M12 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 = 63 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) = -66.15 kn > -16.68 Kn

Single Shear Capacity under short term loads = -21.83 Kn > -16.68 Kn

## Intermediate Design Sides

Intermediate Spacing = 4000 mm Intermediate Span = 3150 mm Try Intermediate 2x190x45 SG8

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 =0.98

K8 Upward =1.00 S1 Downward =12.23 S1 Upward =0.72

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

**Capacity Checks**

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 4.37 Kn-m | Capacity | 6.06 Kn-m | Passing Percentage | **138.67 %** |
| $V_{0.9D-WnUp}$ | 5.54 Kn | Capacity | 27.5 Kn | Passing Percentage | **496.39 %** |

**Deflections**

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

Deflection under Snow and Service Wind = 32.485 mm Limit by Woolcock et al, 1999 Span/100 = 31.50 mm

**Reactions**

Maximum = 5.54 kn

## Girt Design Front and Back

Girt's Spacing = 600 mm          Girt's Span = 4500 mm          Try Girt 190x45 SG8

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 =0.98

K8 Upward =0.95     S1 Downward =12.23     S1 Upward =13.67

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

#### Capacity Checks

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 2.67 Kn-m | Capacity | 2.87 Kn-m | Passing Percentage | **107.49 %** |
| $V_{0.9D-WnUp}$ | 2.38 Kn | Capacity | 13.75 Kn | Passing Percentage | **577.73 %** |

#### Deflections

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

Deflection under Snow and Service Wind = 32.72 mm          Limit by Woolcock et al, 1999 Span/100 = 45.00 mm
Sag during installation = 30.70 mm

#### Reactions

Maximum = 2.38 kn

## Girt Design Sides

Girt's Spacing = 600 mm          Girt's Span = 4000 mm          Try Girt 190x45 SG8

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 =0.98

K8 Upward =0.90     S1 Downward =12.23     S1 Upward =14.88

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

#### Capacity Checks

| | | | | | |
|---|---|---|---|---|---|
| $M_{Wind+Snow}$ | 2.11 Kn-m | Capacity | 2.74 Kn-m | Passing Percentage | **129.86 %** |
| $V_{0.9D-WnUp}$ | 2.11 Kn | Capacity | 13.75 Kn | Passing Percentage | **651.66 %** |

#### Deflections

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

Deflection under Snow and Service Wind = 20.43 mm          Limit by Woolcock et al. 1999 Span/100 = 40.00 mm
Sag during installation =19.16 mm

#### Reactions

Maximum = 2.11 kn

## Middle Pole Design

#### Geometry

| | | | |
|---|---|---|---|
| 200 SED H5 (Minimum 225 dia. at Floor Level) | Dry Use | Height | 3240 mm |
| Area | 35448 mm2 | As | 26585.7421875 mm2 |
| Ix | 100042702 mm4 | Zx | 941578 mm3 |
| Iy | 100042702 mm4 | Zx | 941578 mm3 |
| Lateral Restraint | 1300 mm c/c | | |

#### Loads

Total Area over Pole = 18 m2

| | | | |
|---|---|---|---|
| Dead | 4.50 Kn | Live | 4.50 Kn |
| Wind Down | 17.64 Kn | Snow | 0.00 Kn |
| Moment wind | 17.78 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 | 510.45 Kn | PhiMnx Wind | 27.34 Kn-m | PhiVnx Wind | 62.96 Kn |
| PhiNcx Dead | 306.27 Kn | PhiMnx Dead | 16.41 Kn-m | PhiVnx Dead | 37.77 Kn |

**Checks**

(Mx/PhiMnx)+(N/phiNcx) = 0.70 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.47 < 1 OK

Deflection at top under service lateral loads = 31.46 mm < 32.40 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 = | 2000 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 = | 17.78 Kn-m |
| Shear Wind = | 6.58 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 15.17 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 25.64 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.69 < 1 OK

### End Pole Design

**Geometry For End Bay Pole**

**Geometry**

| | | | |
|---|---|---|---|
| 200 SED H5 (Minimum 225 dia. at Floor Level) | Dry Use | Height | 3400 mm |
| Area | 35448 mm2 | As | 26585.7421875 mm2 |

| | | | |
|---|---|---|---|
| Ix | 100042702 mm4 | Zx | 941578 mm3 |
| Iy | 100042702 mm4 | Zx | 941578 mm3 |
| Lateral Restraint | mm c/c | | |

**Loads**

Total Area over Pole = 18 m2

| | | | |
|---|---|---|---|
| Dead | 4.50 Kn | Live | 4.50 Kn |
| Wind Down | 17.64 Kn | Snow | 0.00 Kn |
| Moment Wind | 8.89 Kn-m | | |
| Phi | 0.8 | K8 | 0.86 |
| 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 | 438.87 Kn | PhiMnx Wind | 23.51 Kn-m | PhiVnx Wind | 62.96 Kn |
| PhiNcx Dead | 263.32 Kn | PhiMnx Dead | 14.11 Kn-m | PhiVnx Dead | 37.77 Kn |

**Checks**

(Mx/PhiMnx)+(N/phiNcx) = 0.44 < 1 OK

(Mx/PhiMnx)^2+(N/phiNcx) = 0.20 < 1 OK

Deflection at top under service lateral loads = 17.44 mm < 35.91 mm

| | | |
|---|---|---|
| Ds = | 0.6 mm | Pile Diameter |
| L = | 1400 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 = 18 m2

| | |
|---|---|
| Moment Wind = | 8.89 Kn-m |
| Shear Wind = | 3.29 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 5.96 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 9.63 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.92 < 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 = | 1400 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 = | 8.89 Kn-m |
| Shear Wind = | 3.29 Kn |

**Pile Properties**

| | | |
|---|---|---|
| Safety Factory | 0.55 | |
| Hu = | 5.96 Kn | Ultimate Lateral Strength of the Pile, Short pile |
| Mu = | 9.63 Kn-m | Ultimate Moment Capacity of Pile |

**Checks**

Applied Forces/Capacities = 0.92 < 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(2000) x Ks(1.5) x 0.5 x tan(30) x Pi x Dia of Pile(0.6) x Height of Pile(2000)

Skin Friction = 32.31 Kn

Weight of Pile + Pile Skin Friction = 37.50 Kn

Uplift on one Pile = 34.11 Kn

Uplift is ok