



association of
consulting and
engineering



PRODUCER STATEMENT – PS1 DESIGN

BUILDING CODE CLAUSE(S): B1

JOB NUMBER: 233840

ISSUED BY: STRATUM CONSULTANTS LTD
(Engineering Design Firm)

TO: FRANCINE ANATASIA MURAAHI AND LEAH KANIHANA TARATU
(Owner/Developer)

TO BE SUPPLIED TO: ROTORUA LAKES COUNCIL
(Building Consent Authority)

IN RESPECT OF: DESIGN FOR PILED FOUNDATIONS FOR PROPOSED RESIDENTIAL DWELLING
(Description of Building Work)

AT: 13 ROSS ROAD, WESTERN HEIGHTS, ROTORUA
(Address, Town/City)

LEGAL DESCRIPTION: LOT 2 DP 567116

N/A ☐

We have been engaged by the owner/developer referred to above to provide (Extent of Engagement):
STRUCTURAL ENGINEERING DESIGN AS NOTED IN OUR DESIGN FEATURES REPORT.

in respect of the requirements of the Clause(s) of the Building Code specified above for Part only, as specified in the
Schedule, of the proposed building work.

The design carried out by us has been prepared in accordance with:

- ☒ Compliance documents issued by the Ministry of Business, Innovation & Employment (Verification method/acceptable solution) AS1 / VM1/ VM4 and/or;
- ☐ Alternative solution as per the attached Schedule.

The proposed building work covered by this producer statement is described on the drawings specified in the Schedule, together with the specification, and other documents set out in the Schedule.

On behalf of the Engineering Design Firm, and subject to:

- Site verification of the following design assumptions: GEOTECH REPORT AS NOTED IN THE DESIGN FEATURES REPORT.
- All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that:

- the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the Schedule, will comply with the relevant provisions of the Building Code and that;
- the persons who have undertaken the design have the necessary competency to do so.

I recommend the CM 3 level of **construction monitoring**.

I, (Name of Engineering Design Professional) STEPHEN BOS, am:

- ☒ CPEng number 154367
- and hold the following qualifications NZCE, BE, CMEngNZ, CPEng

The Engineering Design Firm holds a current policy of Professional Indemnity Insurance no less than \$200,000
The Engineering Design Firm is not a member of ACE New Zealand.

SIGNED BY (Name of Engineering Design Professional): STEPHEN BOS
(Signature below):

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ON BEHALF OF (Engineering Design Firm): STRATUM CONSULTANTS LTD

Date: 24.10.2024

Note: This statement has been prepared solely for the Building Consent Authority named above and shall not be relied upon by any other person or entity. Any liability in relation to this statement accrues to the Engineering Design Firm only. As a condition of reliance on this statement, the Building Consent Authority accepts that the total maximum amount of liability of any kind arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in tort or otherwise, 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.

SCHEDULE to PS1

Please include an itemised list of all referenced documents, drawings, or other supporting materials in relation to this producer statement below:

- PS1
- Certificate of Design Work
- Construction Monitoring Schedule
- Design Features Report
- Plans and Details
- Loading Summary
- Pile Design

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GUIDANCE ON USE OF PRODUCER STATEMENTS

Information on the use of Producer Statements and Construction Monitoring Guidelines can be found on the Engineering New Zealand website

<https://www.engineeringnz.org/engineer-tools/engineering-documents/producer-statements/>

Producer statements were first introduced with the Building Act 1991. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects (NZIA), Institution of Professional Engineers New Zealand (now Engineering New Zealand), Association of Consulting and Engineering New Zealand (ACE NZ) in consultation with the Building Officials Institute of New Zealand (BOINZ). The original suite of producer statements has been revised at the date of this form to ensure standard use within the industry.

The producer statement system is intended to provide Building Consent Authorities (BCAs) with part of the reasonable grounds necessary for the issue of a Building Consent or a Code Compliance Certificate, without necessarily having to duplicate review of design or construction monitoring undertaken by others.

PS1 DESIGN Intended for use by a suitably qualified independent engineering design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent;

PS2 DESIGN REVIEW Intended for use by a suitably qualified independent engineering design review professional where the BCA accepts an independent design professional's review as the basis for establishing reasonable grounds to issue a Building Consent;

PS3 CONSTRUCTION Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:2013 or Schedules E1/E2 of NZIA's SCC 2011²

PS4 CONSTRUCTION REVIEW Intended for use by a suitably qualified independent engineering construction monitoring professional who either undertakes or supervises construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate.

This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACE New Zealand and Engineering New Zealand to interpret the Producer Statement.

Competence of Engineering Professional

This statement is made by an engineering firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its personnel.

The person signing the Producer Statement on behalf of the engineering firm will have a professional qualification and proven current competence through registration on a national competence-based register such as a Chartered Professional Engineer (CPEng).

Membership of a professional body, such as Engineering New Zealand provides additional assurance of the designer's standing within the profession. If the engineering firm is a member of ACE New Zealand, this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term "suitably qualified independent engineering professional".

Professional Indemnity Insurance

As part of membership requirements, ACE New Zealand requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI Insurance minimum stated on the front of this form reflects standard practice for the relationship between the BCA and the engineering firm.

Professional Services during Construction Phase

There are several levels of service that an engineering firm may provide during the construction phase of a project (CM1-CM5 for engineers³). The building Consent Authority is encouraged to require that the service to be provided by the engineering firm is appropriate for the project concerned.

Requirement to provide Producer Statement PS4

Building Consent Authorities should ensure that the applicant is aware of any requirement for producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design Firm's engagement.

Refer Also:

- 1 Conditions of Contract for Building & Civil Engineering Construction NZS 3910: 2013
- 2 NZIA Standard Conditions of Contract SCC 2011
- 3 Guideline on the Briefing & Engagement for Consulting Engineering Services (ACE New Zealand/Engineering New Zealand 2004)
- 4 PN01 Guidelines on Producer Statements

www.acenz.org.nz
www.engineeringnz.org

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CERTIFICATE OF DESIGN WORK

MEMORANDUM FROM LICENSED BUILDING PRACTITIONER

Section 30C and Section 45, Building Act 2004

The Building

Street address 13 Ross Road

Suburb Western Heights Town/city Rotorua

Postcode Building consent no. N/A

The Owner

Name(s) Francine Anatasia Muraahi, Leah Kanihana Taratu

Email Phone

Address

Basis for providing this memorandum

I am providing this memorandum in my role as the **specialist** designer who carried out or supervised specific Primary structure elements of restricted building work (RBW) design work as described in this memorandum. Other designers will provide memoranda covering the remaining RBW design work. Refer also to the attached PSI.

Identification of restricted building work (RBW) design work

I, Stephen Bos carried out or supervised the following RBW design work:

Primary structure: B1

Design work that is RBW	Description (as required) and reference to plans and specifications	Carried out or supervised
Foundations and subfloor framing ☒	Piled Foundation Design	Supervised
Retaining walls ☐		Supervised
Beams ☐		Supervised
Portal ☐		Supervised
Bracing ☒	Subfloor Bracing	Supervised
Other (primary) ☐		Supervised

Note: SED = Elements subject to Specific Engineering Design outside of the scope of NZS3604:2011, unless otherwise noted.

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Initial  Date 24/10/2024

Waivers and modifications

Are waivers or modifications of the Building Code required?

No

If yes, please provide details of the waivers or modifications:

Building Code clause

Waiver/modification required

Issued by

Name	Stephen Bos	Design entity/company	Stratum Consultants Ltd
Chartered status	CPEng	Chartered no.	154367
Email	stephen.bos@stratum.nz	Website	Stratum Consultants
Phone (daytime)	(07) 571 4500	Phone (after hours)	
Mobile			
Postal address			
Physical address	Level 1, Rydal House, 29 Grey St		

Declaration

I, Stephen Bos, LBP state that I have applied the skills and care reasonably required of a competent design professional in carrying out or supervising the RBW described in this memorandum and that based on this, I certify that the RBW described in this memorandum:

- complies with the Building Code; or
- complies with the Building Code subject to any waiver or modification of the Building Code described in this memorandum.

Signature



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CONSTRUCTION MONITORING SCHEDULE

RESIDENTIAL

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Schedule of inspections for

Address 13 Ross Road, Rotorua

We confirm that **Stratum Consultants** have been engaged to undertake construction monitoring of the specific engineering design items to an Engineering New Zealand/ACENZ CM 3 level and propose to undertake at least the following site inspections:

No.	Item of inspection	Timeframe
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(Delete any that do not apply)

1	Pile Footings	Pre-pour
2	Pile connections	While all connections are clearly visible, pre-line and prior to building in to such an extent that remediation work could not be carried out.

Notes:

- The above items of inspection are the minimum required to enable **Stratum Consultants** to issue a PS4 – Producer Statement Construction Review for the specific engineering design items.
- The above items of inspection do not cover work constructed in accordance with NZS 3604:2011, for which inspections are to be undertaken by the Building Consent Authority.
- The Contractor/Builder is to provide **Stratum Consultants** at least 24 hours' notice of the requirement for an inspection. The above timeframes are indicative, the Engineer and Contractor are to agree the timing of inspection prior to work commencing on site.
- A copy of this inspection schedule is to be held on site during the works, and the Contractor/Builder is to provide reasonable and safe access to enable works to be inspected according to the schedule.
- The above schedule does not necessarily represent the actual number of inspections to be undertaken. The number of inspections will depend on the construction method, sequence of the works and whether or not unforeseen conditions or difficulties are encountered on site.

DESIGN FEATURES REPORT

This template covers the standard engineering design features of a residential build. You may need to supplement this template with additional information depending on the scope of the project. While the template has been prepared with assistance from industry professionals, and reviewed by Engineering New Zealand staff, it is not intended to replace your professional engineering skill and judgement. Engineering New Zealand does not accept any liability in relation to the use of, or reliance on, this template.

These calculations pertain to **Piled foundations for proposed new residence**

at **13 Ross Road, Rotorua**

and cover the following design aspects:

- 1) Piled foundation Design.
- 2) Subfloor bracing and piled foundations.

Standards referenced

Building designed to support the loads of AS/NZS 1170.
Timber designed to NZS3603
Concrete designed to NZS3101

Wind loads

Wind zone = **High wind zone in accordance with NZS3604, with a wind speed of 39.15 m/s**

Snow loads

Not applicable

Permanent actions (dead loads) and live loads

Dead loads

	Roof	Floor	External walls	Internal walls
Description	Lightweight roofing	Timber Framed Floor	Timber framed	Timber framed
Unit load	0.35kPa	0.35kPa	0.35kPa	0.3kPa

Live loads (Refer table 3.1 & 3.2 Part 1 AS/NZS 1170)

	Roof	Floor	Deck	Garage
Distributed load	0.25kPa	1.5kPa		
Point load	1.4kN	1.8kN		

*Denotes reductions allowable in specific cases

Barrier loads

Designed using requirements of clauses 3.6 and 3.8 of AS/NZS 1170.1 as modified by B1/VM1 (clauses 2.2.7 and 2.2.8) with imposed actions as specified in Table 3.3 of AS/NZS 1170.1.

Ductility and deflection

Using a ductility factor of $m = 1.0$ due to elastic nature of cantilevered bracing posts.
Cantilever posts designed to meet $H/300$ deflection limits

Soil class and seismic coefficient

Soil class D has been considered.

NZS 3604 bracing elements		SED bracing elements	
Soil class =		Soil class =	D
$S_p =$		$S_p =$	1
$C_d(T_1) =$		$C_d(T_1) =$	0.72

Soil parameters

Ultimate Bearing Capacity = $\rho_u =$ 300kPa @ 1.7m BGL

Design Bearing Strength = $\rho_{bds} =$ 150kPa @ 1.7m BGL

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Soil Type	ϕ (degrees)	Density γ (kN/m ³)
-	-	-
-	-	-

Liquefaction risk (select from dropdown) Low

Foundations

As per the Geotechnical Assessment Report (V2) by Stratum Consultants Ltd Dated 14 April 2021 Ref 233840.
The upper soils are not considered to provide full lateral constraint, so deepened piles are to be designed by a structural engineer using a reduced friction angle of 25° for the upper soils. Bored piles should be founded at least 0.4m below the very loose to loose sands, approximately 1.5 to 1.7m bgl across the site. This depth should be confirmed during construction.

Corrosion

External areas

	Timber	Structural Steel	Concrete	Masonry
Zone	NZS3603	-	-	-
Provision	H5 for members within the ground	-	-	-

Sheltered areas

	Timber	Structural Steel	Concrete	Masonry
Zone	NZS3603	-	-	-
Provision	H3.2 for external members with 400mm ground clearance H1.2 internal	-	-	-

22 October 2024

A-Francine Muraahi and Leah Taratu

Compliance with Building Code Clause B2 – Durability
13 Ross Road, Rotorua

To the Building Official,

Rotorua Lakes Council

The purpose of this letter is to demonstrate how compliance with Clause B2 (Durability) of the Building Code will be achieved for the above project. We can confirm that for specifically designed structural elements that are included within our design documentation:

Material	Means of compliance	Details
Structural timber	B2/AS1	Timber treatment for the piles has been selected in accordance with NZS3603, Table 7.1
Timber fixings	B2/AS1	Timber fixings have been selected in accordance with NZS3604, Section 4
Other		N/A

Yours faithfully

Stratum Consultants Ltd

Prepared by:

Daniel Archbold

Structural Engineer

BE (Hons)

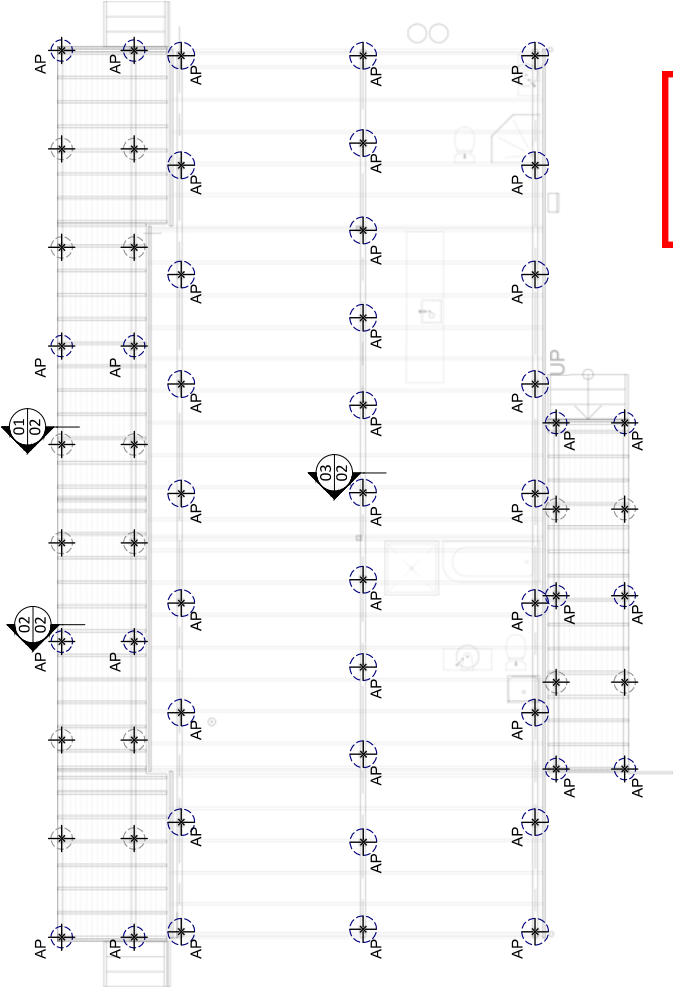
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GENERAL NOTES

1. THESE STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL ARCHITECTURAL DRAWINGS AND SPECIFICATIONS. THE ENGINEER IS TO BE INFORMED OF ANY DISCREPANCIES.
2. SET OUT OF STRUCTURAL MEMBERS AS PER ARCHITECTURAL DRAWINGS UNLESS NOTED OTHERWISE.
3. DURING CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A STABLE CONDITION AND ENSURING NO PART IS OVERSTRESSED UNDER CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL DESIGN AND PROVIDE PROPPING TO SUPPORT ALL CAST-IN-SITU AND PRECAST CONCRETE WORK UNTIL SUCH CONCRETE HAS REACHED THE REQUIRED STRENGTH TO BE SELF SUPPORTING. (TYPICALLY FOR A MINIMUM OF 14 DAYS AFTER POURING).
4. WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE RELEVANT NEW ZEALAND STANDARDS AND LOCAL AUTHORITY REGULATIONS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.

TIMBER

1. ALL STRUCTURAL TIMBER WORK SHALL COMPLY WITH NZS 3603 AND NZS 3604
2. TIMBER FRAMING SHALL BE RADIATA PINE MSG 8 GRADE, NZTPA H1.2 TREATED, UNLESS OTHERWISE NOTED.
3. ALL TIMBER IN CONTACT WITH CONCRETE SHALL BE PROTECTED WITH A DPM LAYER.
4. ALL MEMBERS FORMED BY PAIRS (OR MORE) OF TIMBERS TO BE NAILED TOGETHER AT 150 CRS, STAGGERED, ALTERNATE SIDES.
5. ALL TIMBER SHALL BE NEW, SOUND AND FREE FROM DEFECTS AND SHALL HAVE A MOISTURE CONTENT OF NOT MORE THAN 18% AT THE TIME OF INSTALLATION, SEASONED OR DRY TIMBER STORED ON SITE SHALL BE PROTECTED FROM WEATHER AT ALL TIMES.
6. ALL NAILS, BOLTS, FASTENERS, CONNECTORS AND OTHER HARDWARE SHALL BE HOT DIP GALVANISED AFTER MANUFACTURE UNLESS SPECIFIED OTHERWISE. ALL HARDWARE SHALL BE SECURED WITH FASTENERS WHICH ARE COMPATIBLE WITH THE HARDWARE IN MATERIALS AND FINISH AND COMPLY WITH THE HARDWARE MANUFACTURER'S RECOMMENDATION. ALL FIXINGS THROUGH H3 OR HIGHER TREATED TIMBER TO BE STAINLESS STEEL UNO.
7. BOLTS SHALL BE GRADE 4.6 COMPLETE WITH WASHERS UNDER BOTH HEAD AND NUT. ALL WASHERS SHALL BE 50 x 50 x 4mm. COACH SCREWS SHALL HAVE WASHERS UNDER THE HEAD
8. COACH SCREWS: THE DIAMETER OF THE HOLE FOR THE SHANK OF A COACH SCREW SHALL BE NOT LESS THAN THE SHANK DIAMETER AND SHALL NOT EXCEED IT BY MORE THAN 1.5 mm. THE DIAMETER OF THE HOLE FOR THE THREADED PORTION SHALL NOT EXCEED THE ROOT DIAMETER OF THE SCREW, AND ITS DEPTH SHALL BE AT LEAST TWO DIAMETERS GREATER THAN THE INTENDED DEPTH TO WHICH THE SCREW IS TO BE DRIVEN. COACH SCREWS SHALL NOT BE HAMMERED INTO PLACE BUT TURNED WITH A WRENCH.
9. ALL H3.2, H4 OR H5 TREATED TIMBER CUT ON SITE SHALL BE TREATED WITH "METALEX" ON THE CUT SURFACE.
10. ANCHOR PILES, WHERE SPECIFIED, SHALL BE PROOF TESTED TO THE REQUIREMENTS OF NZS3605:2001.



SUBFLOOR LEGEND

- Anchor pile to deck and dwelling. Refer to detail 02 and 03, sheet 02.
- All other piles to be Ordinary Piles (OP): H6 125x125 as per detail 01, sheet 02

FIXINGS:
ALL FIXING TO BE MIN 304 STAINLESS STEEL

NOTES/KEY:

1. CONFIRM ALL DIMENSIONS PRIOR TO CONSTRUCTION.

DRAWN BY: DA

CHECKED BY: SB

DESIGNED BY: DA

APPROVED BY: SB

OFFICE: TAURANGA

CONTACT: 07 571 4800

FRANCINE MURAAHI AND LEAH TARATU

13 ROSS ROAD

ROTORUA

FOUNDATION PLAN

ORIGINAL DWG. SIZE A3

SCALE: 1:100@A3

DRAWING No. 233840-STR-0001

SHEET No. SD1

ISSUE A

Stratum

CONSULTANTS

Job Title Francine Muraahi and Leah Taratu
Site Address 13 Ross Road
City Rotorua
Job No. 233840

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By DA

Stratum
CONSULTANTS

LOADING SUMMARY

LOADINGS IN ACCORDANCE WITH NZS 1170

Importance Level = 2, Normal Structures and structures not falling into other levels
Design Life = 50 Years

1. CALCULATION OF WIND ACTIONS

1.1 SITE WIND SPEED

$$V_{sit,\beta} = V_R M_d (M_{z,cat} M_s M_t)$$

Regional Wind Speed	$V_R =$	37.0	m/s
Regional Wind Speed	$V_R =$	45.0	m/s
Wind Direction Multiplier	$M_d =$	1.0	
Terrain/Height Multiplier	$M_{z,cat} =$	0.87	
Shielding Multiplier	$M_s =$	1.0	

Eqn 2.2

Region A7, R=25 (Design Life=50, AEP=1/25)
Region A7, R=500 (Design Life=50, AEP=1/500)
Any Wind Direction
Terrain Category 2.5

Topographic Multiplier	$M_t =$	1.0	
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Ult $V_{sit,\beta} =$ 39.15 m/s 140.94 Km/hr **Ser** $V_{sit,\beta} =$ 32.19 m/s
Wind Zone: **High** **Equivalent to NZS3604:2011**

1.2 DESIGN WIND PRESSURE

$$p = (0.5\rho_{air}) [V_{des,\theta}]^2 C_{fig} C_{dyn}$$

Eqn 2.4(1)

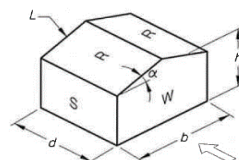
Density of air	$\rho_{air} =$	1.2	kg/m ³
Site Wind Speed	$V_{des,\theta} =$	39.2	m/s
	$C_{fig} = C_{pn}, k_p$		
	$K_a, K_c, K_l, K_p =$	1	
	$C_{dyn} =$	1.0	

From 2.2

for external pressures

Walls - windward

$C_{p,e} =$	0.7	Table 5.2(A)
$C_{p,i} =$	-0.3	Table 5.2(B)
$C_{fig} \text{ combined} =$	1.0	

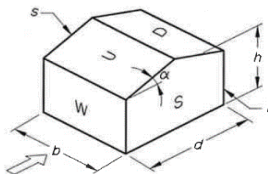


$d =$	16.6	m
$b =$	7.0	m
$h =$	3.8	m
$\alpha =$	3.0	

$\theta =$	90
$d/b =$	2.37
$h/d =$	0.23
$b/d =$	0.42

Walls - leeward

$C_{p,e} =$	-0.5	Table 5.2(A)
$C_{p,i} =$	0.0	Table 5.2(B)
$C_{fig} \text{ combined} =$	-0.5	



$d =$	7.0	m
$b =$	16.6	m
$h =$	3.8	m
$\alpha =$	3.0	

$\theta =$	0
$d/b =$	0.42
$h/d =$	0.54
$b/d =$	2.37

Roof (R) - 90 deg

$C_{p,e} =$	-0.9
-------------	------

Roof (U) - 0 deg

$C_{p,e} =$	-0.9
-------------	------

Roof (D) - 0 deg

$C_{p,e} =$	-0.9
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	ULS	SLS
p walls $_W =$	0.92 kPa	0.62 kPa
p walls $_L =$	-0.46 kPa	-0.31 kPa
p roof $_R =$	-0.83 kPa	-0.56 kPa
p roof $_U =$	-0.83 kPa	-0.56 kPa
p roof $_D =$	-0.83 kPa	-0.56 kPa

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2. CALCULATION OF EARTHQUAKE ACTIONS

2.1 ELASTIC SITE SPECTRA

$C = C_h(T) Z R N(T,D)$ Eqn 3.1(1)
Estimate of Building Period $T_1 = 0.4$ Seconds
Spectral Shape Factor $C_h(T) = 3.0$ Class D - Deep Soil, $T_1 \leq 0.4$ seconds (assumed)
Hazard Factor $Z = 0.24$ Rotorua
Return Period $R_u = 1$ Ultimate - 1:500 return period (Table 3.5)
Return Period $R_s = 0.25$ Use 0.25 although no AEP specified for Serviceability
Near Fault Factor $N(T,D) = 1.00$

 $C_u = 0.72$ $C_s = 0.18$

2.2 HORIZONTAL DESIGN ACTION COEFFICIENTS

$C_d(T_1) = C(T_1) S_p / k_\mu$ Eqn 5.2(1)
Ordnate of Elastic Site Spectrum $C_u(T_1) = 0.72$ From Eqn 3.1(1)
 $C_s(T_1) = 0.18$
Structural Performance Factor $S_p = 1.3-0.3\mu$ 4.4.2 $S_p = 0.7$ except where $1 < \mu < 2.0$
Structural Ductility Factor $\mu = 1$ Ultimate Category 3 (Section 12 NZS 3404)
 $\mu = 1$ Serviceability
 $S_p = 1$ Ultimate
 $S_p = 0.7$ Serviceability
Inelastic Spectrum Scaling Factor $k_\mu = \frac{(\mu-1) T_1 + 1}{0.7}$ where $T < 0.7s$
 $k_\mu = 1.00$ Ultimate
 $k_\mu = 1.00$ Serviceability

 $C_d(T_1) = 0.72$ Ultimate
 $C_d(T_1) = 0.13$ Serviceability

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CANTILEVERED POST DESIGN - ACROSS

Design for the foundation piles to support the proposed house.
Piles in the across direction will be critical, because it will attract a greater amount of wind load.

BRACING DEMAND

a) SEISMIC WEIGHTS

$W_i = \Sigma G_i + \psi_E Q_i$
 $\psi_E = 0.3$

	G	Q	WIDTH	LENGTH	ψ_E	WG	WQ ψ_E
ROOF	0.350	0.250	8.200	17.400		49.94	0.00
INTERNAL WALL	0.300		2.450	34.000		24.99	0.00
EXTERNAL WALL	0.300		2.450	48.000		35.28	0.00
FLOOR	0.350	1.500	7.250	16.600	0.300	42.12	54.16
TOTAL						152.33	54.16

KN

Wi = 206.49 KN

b) Seismic Actions Coefficients (refer loadings page)

$C_d(T_1) =$	0.72	ULS	Using a ductility factor of $m = 1.0$ due to elastic nature of cantilevered bracing posts.
$C_d(T_1) =$	0.13	SLS	
No. Posts	27		
$F_{H, EQ} = C_d(T_1) \cdot W_i / \text{No. Posts}$			
=	5.5 kN	ULS	Each pile fixing to have a 12kN lumberlok connection =>> $\phi Q_n = 9.6 \text{ kN}$ >> $F_{H, max}$ (where $\phi = 0.8$) =>> OK
=	1.0 kN	SLS	

LATERAL WIND DEMAND

R =	0.80	m	ROOF RISE ABOVE EAVES
w_{c1} =	16.60	m	BRACING LINE WIDTH 1
w_{c2} =	16.60	m	BRACING LINE WIDTH 2
H_{wall} =	3.00	m	WALL HEIGHT

$$p = (0.5\rho_{air}) [V_{des, \theta}]^2 C_{fig} C_{dyn}$$

$$= 0.920 C_{fig} C_{dyn} \text{ kPa}$$

$$F_{H, wind/ Roof} = p (c_{p, w} - c_{p, l}) (w_{c1} + w_{c1}) / 2 R$$

$$= -2.44 \text{ kN}$$

$C_{p, U}$	$C_{p, D}$
-0.800	-0.600

$$F_{H, wind/ Wall} = p (c_{p, e (w)} - c_{p, e (L)}) H_w (w_{c1} + w_{c2}) / 2$$

$$= 55.0 \text{ kN}$$

$C_{p, e (w)}$	$C_{p, e (L)}$
0.700	-0.500

$$F_{H, wind} = 57.4 \text{ kN}$$

$$N_{o, piles} = 27$$

Shared over number of piles extending from the ground level

$$F_{H, wind/ pile} = F_{H, wind} N_{o, piles}$$

$$= 2.1 \text{ kN, ULS}$$

$$= 1.4 \text{ kN, SLS}$$

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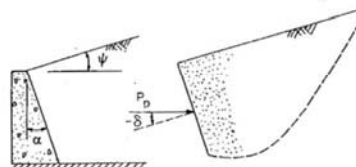
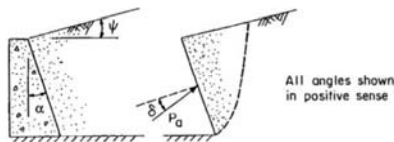
233840

By

DA

Stratum
CONSULTANTS
Table 3.1: Values of K_A and K_P for logarithmic spiral failure surfaces

K_A								K_P							
δ , deg	ψ , deg	α , deg	ϕ , deg					δ , deg	ψ , deg	α , deg	ϕ , deg				
			20	25	30	35	40				20	25	30	35	40
-10	-15	-10	0.37	0.30	0.24	0.19	0.14	-10	-15	-10	1.32	1.66	2.05	2.52	3.09
		0	0.42	0.35	0.29	0.24	0.19			0	1.09	1.33	1.56	1.82	2.09
		10	0.45	0.39	0.34	0.29	0.24			10	0.87	1.03	1.17	1.30	1.33
	0	-10	0.42	0.34	0.27	0.21	0.16		0	-10	2.33	2.96	3.82	5.00	6.68
		0	0.49	0.41	0.33	0.27	0.22			0	2.04	2.46	3.00	3.69	4.59
		10	0.55	0.47	0.40	0.34	0.28			10	1.74	1.89	2.33	2.70	3.14
15	0	-10	0.55	0.41	0.32	0.23	0.17	15	0	-10	3.36	4.56	6.30	8.98	12.2
		0	0.65	0.51	0.41	0.32	0.25			0	2.99	3.86	5.04	6.72	10.4
		10	0.75	0.60	0.49	0.41	0.34			10	2.63	3.23	3.97	4.98	6.37
	-15	-10	0.31	0.26	0.21	0.17	0.14		-15	-10	1.95	2.90	4.39	6.97	11.8
		0	0.37	0.31	0.26	0.23	0.19			0	1.62	2.31	3.35	5.04	7.99
		10	0.41	0.36	0.31	0.27	0.25			10	1.29	1.79	2.50	3.58	5.09
ϕ^*	0	-10	0.37	0.30	0.24	0.19	0.15	$-\phi^*$	0	-10	3.45	5.17	8.17	13.8	25.5
		0	0.44	0.37	0.30	0.26	0.22			0	3.01	4.29	6.42	10.2	17.5
		10	0.50	0.43	0.38	0.33	0.30			10	2.57	3.50	4.98	7.47	12.0
	15	-10	0.50	0.37	0.29	0.22	0.17		15	-10	4.95	7.95	13.5	24.8	50.4
		0	0.61	0.48	0.37	0.32	0.25			0	4.42	6.72	10.8	18.6	39.6
		10	0.72	0.58	0.46	0.42	0.35			10	3.88	5.62	8.51	13.8	24.3



LATERAL STRENGTH OF PILE

SHORT HEAD PILE IN CONHESIONLESS SOIL

NOTE FOR SELECTION OF K_P

- 1) - Identify ϕ for soil (as per Page 1)
- 2) - Identify backslope of post (as per Page 1)
- 3) take θ as 0 as looking at the lower soil below base of post (where ground is level)
- 4) Interpolate delta δ between value of ϕ and 0 given on ratio assigned for friction on back of wall

Ratio ϕ to Delta	$\phi = 25$	As per Williams and Waite (1993)
	0.5	
ground slope $\psi =$	$\alpha = 0$	
	0	
K_P at $\delta = 0 =$	2.46	at base of Post
K_P at $\delta = \phi =$	4.29	

Therefore $K_P = 3.38$

$$H_u = K_P D_s L^3 \gamma / \{2 (f + L)\}$$

WHERE

$H_u =$ ULTIMATE LATERAL STRENGTH OF PILE (kN)	
$K_P =$ COEFFICIENT OF PASSIVE EARTH PRESSURE	
$=$	3.375
$=$	3.38
$\phi_{SOIL} =$	25.00°
$D_s =$	0.50 m
$L =$	1.0 m
$\gamma =$	16.0 kN/m ³
$f =$	0.45 m
$f =$	0.45 m
$\Phi_{pp} =$	0.8

$H_u = 7.4$ kN per pile

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LOCATION OF MAXIMUM PILE SHAFT MOMENT

MEASURED FROM THE GROUND SURFACE

$$g_s = \{ 2 H_u / (3 K_p \gamma D_s) \}^{1/2}$$

$$= 0.43 \text{ m}$$

MAXIMUM PILE SHAFT MOMENT

$$M^* = H_u [2/3 \{ 2 H_u / (3 K_p D_s G) \}^{1/2} + f]$$

$$= 5.5 \text{ kNm}$$

POLE SIZE

$$M^*_{\text{pole}} = (f + g_s) \times V^*_{\text{max}}$$

$$= 4.84 \text{ kNm} \quad \text{MOMENT IN POLE}$$

Timber 125 x 125 mm SG8 Pile

As per NZS3605:2001, Anchor piles are to be proof tested to meet a minimum bending moment strength of 6kNm

This equates to a bending strength $f_b = 23 \text{ MPa}$

$$f_b = 23 \text{ MPa} \quad Z = 0.33 \text{ mm}^3 \times 10^6$$

$$\Rightarrow \phi M_n = \phi * k_1 * k_4 * k_8 * f_b * Z$$

$$k_1 = 1.00 \quad k_4 = 1.00 \quad k_8 = 1.00$$

$$\phi M_b = 6.0 \text{ kNm} > M^* \text{ OK}$$

CHECK SERVICEABILITY

$$E = 4400 \text{ MPa}$$

$$I = 20.35 \times 10^6 \text{ mm}^4$$

$$p_{\text{sls}} = \frac{M^*}{I} \times \frac{L^3}{3EI} = 0.39 \text{ mm} \quad \text{Ok less than } L/200$$

NUMBER OF BRACED PILES REQUIRED

FOR LATERAL RESISTANCE

$$P^* = 5.5 \text{ kN}$$

$$H_u = 7.4 \text{ kN}$$

=>> OK FOR LATERAL RESISTANCE

FOR BENDING

$$M^* = 4.8 \text{ kNm}$$

$$\phi M_n = 5.99 \text{ kNm}$$

=>> OK FOR BENDING

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Check Bearing Capacity

Internal Piles

UDL(kN/m)		G	Q	WIDTH	BREADTH	WG	WQ
	ROOF					0.00	0.00
	INTERNAL WALL	0.350		2.450	2.050	1.76	0.00
	FLOOR	0.400	1.500	3.300	2.050	2.71	10.15
	TOTAL					4.46	10.15

LOAD COMBINATIONS ULTIMATE $w_u = 1.2G + 1.5Q =$ 20.58 KN

External Piles

UDL(kN/m)		G	Q	WIDTH	BREADTH	WG	WQ
	ROOF	0.350	0.250	3.900	2.050	2.80	2.00
	EXTERNAL WALL	0.450		2.450	2.050	2.26	0.00
	FLOOR	0.400	1.500	2.200	2.050	1.80	6.77
	TOTAL					6.86	8.76

LOAD COMBINATIONS ULTIMATE $w_u = 1.2G + 1.5Q =$ 21.38 KN

LOADING (1.2G+1.5Q) =

21.38 KN (maximum)

Pile Weight ($\pi \times d^2/4 \times l \times (24 \text{ kN/m}^3)$ =

8.011 KN

29.392 KN

HOLE DIAMETER = 0.50 m

HOLE DEPTH = 1.7 m

FACTORED ULTIMATE BEARING CAPACITY (kPa) =

150

(ULS END BEARING = 300 kPa)

$B_{req} = (R \times 4 / \phi_{UBC} \pi)^{1/2} =$

499 mm

=> **PILE DIAMETER OK**

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DECK PILES - NORTH EAST **CANTILEVERED POST DESIGN**

Design for the foundation piles to support the proposed deck.

BRACING DEMAND

a) SEISMIC WEIGHTS

$$W_i = \sum G_i + \psi_E Q_i$$

$$\psi_E = 0.3$$

	G	Q	WIDTH	LENGTH	ψ_E	WG	WQ ψ_E
ROOF						0.00	0.00
INTERNAL WALL						0.00	0.00
BARRIER						0.00	0.00
DECK	0.350	2.000	1.700	10.200	0.300	6.07	10.40
TOTAL						6.07	10.40

KN

$$W_i = 16.47 \text{ KN}$$

b) Seismic Actions Coefficients (refer loadings page)

$$C_d(T_1) = 0.72$$

ULS

Using a ductility factor of $m = 1.0$ due to elastic nature of cantilevered bracing posts.

$$C_d(T_1) = 0.13$$

SLS

$$\text{No. Posts} = 8$$

$$F_{H,EQ} = C_d(T_1) \cdot W_i / \text{No. Posts}$$

$$= 1.5 \text{ kN}$$

ULS

Each pile fixing to have a 6kN lumberlok connection

$$= 0.3 \text{ kN}$$

SLS

$$\Rightarrow \phi Q_n = 4.8 \text{ kN} \Rightarrow F_{H,max}$$

(where $\phi = 0.8$)

$\Rightarrow$ OK

LATERAL WIND DEMAND

Deck has now walls or roof, therefore wind can be neglected.

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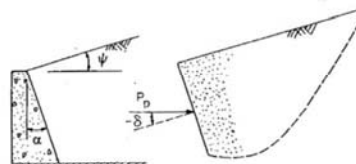
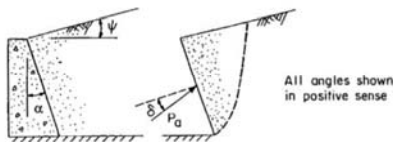
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DECK PILES - NORTH EAST

Table 3.1: Values of K_A and K_P for logarithmic spiral failure surfaces

K_A								K_P							
δ , deg	ψ , deg	α , deg	ϕ , deg					δ , deg	ψ , deg	α , deg	ϕ , deg				
			20	25	30	35	40				20	25	30	35	40
-10	-15	-10	0.37	0.30	0.24	0.19	0.14	-10	-15	-10	1.32	1.66	2.05	2.52	3.09
		0	0.42	0.35	0.29	0.24	0.19			0	1.09	1.33	1.56	1.82	2.09
		10	0.45	0.39	0.34	0.29	0.24			10	0.87	1.03	1.17	1.30	1.33
	0	-10	0.42	0.34	0.27	0.21	0.16		0	-10	2.33	2.96	3.82	5.00	6.68
		0	0.49	0.41	0.33	0.27	0.22			0	2.04	2.46	3.00	3.69	4.59
		10	0.55	0.47	0.40	0.34	0.28			10	1.74	1.89	2.33	2.70	3.14
15	0	-10	0.55	0.41	0.32	0.23	0.17	15	0	-10	3.36	4.56	6.30	8.98	12.2
		0	0.65	0.51	0.41	0.32	0.25			0	2.99	3.86	5.04	6.72	10.4
		10	0.75	0.60	0.49	0.41	0.34			10	2.63	3.23	3.97	4.98	6.37
	-15	-10	0.31	0.26	0.21	0.17	0.14		-15	-10	1.95	2.90	4.39	6.97	11.8
		0	0.37	0.31	0.26	0.23	0.19			0	1.62	2.31	3.35	5.04	7.99
		10	0.41	0.36	0.31	0.27	0.25			10	1.29	1.79	2.50	3.58	5.09
ϕ^*	0	-10	0.37	0.30	0.24	0.19	0.15	$-\phi^*$	0	-10	3.45	5.17	8.17	13.8	25.5
		0	0.44	0.37	0.30	0.26	0.22			0	3.01	4.29	6.42	10.2	17.5
		10	0.50	0.43	0.38	0.33	0.30			10	2.57	3.50	4.98	7.47	12.0
	15	-10	0.50	0.37	0.29	0.22	0.17		15	-10	4.95	7.95	13.5	24.8	50.4
		0	0.61	0.48	0.37	0.32	0.25			0	4.42	6.72	10.8	18.6	39.6
		10	0.72	0.58	0.48	0.42	0.35			10	3.88	5.62	8.51	13.8	24.3



LATERAL STRENGTH OF PILE

SHORT HEAD PILE IN CONHESIONLESS SOIL

NOTE FOR SELECTION OF K_P

- 1) - Identify ϕ for soil (as per Page 1)
- 2) - Identify backslope of post (as per Page 1)
- 3) take θ as 0 as looking at the lower soil below base of post (where ground is level)
- 4) Interpolate delta δ between value of ϕ and 0 given on ratio assigned for friction on back of wall

Ratio ϕ to Delta	$\phi = 25$	As per Williams and Waite (1993)
	0.5	
$\alpha =$	0	
ground slope $\psi =$	0	
	at base of Post	
K_P at $\delta = 0 =$	2.46	
K_P at $\delta = \phi =$	4.29	

Therefore $K_P = 3.38$

$$H_u = K_P D_s L^3 \gamma / \{2 (f + L)\}$$

WHERE

$H_u =$ ULTIMATE LATERAL STRENGTH OF PILE (kN)	
$K_P =$ COEFFICIENT OF PASSIVE EARTH PRESSURE	
$=$	3.375
$=$	3.38
$\phi_{SOIL} =$	25.00°
$D_s =$	0.40 m
$L =$	1.1 m
$\gamma =$	16.0 kN/m ³
$f =$	0.45 m
$f =$	0.45 m
$\Phi_{pp} =$	0.8

$H_u = 7.4$ kN per pile

PILE DIAMETER
LENGTH OF PILE SHAFT

HEIGHT ABOVE GROUND OF APPLIED LOAD
 $f + 0.0$ m FOR UNSUPPORTED HEIGHT

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DECK PILES - NORTH EAST

LOCATION OF MAXIMUM PILE SHAFT MOMENT

MEASURED FROM THE GROUND SURFACE

$$g_s = \{ 2 H_u / (3 K_p \gamma D_s) \}^{1/2}$$

$$= 0.48 \text{ m}$$

MAXIMUM PILE SHAFT MOMENT

$$M^* = H_u [2/3 \{ 2 H_u / (3 K_p D_s G) \}^{1/2} + f]$$

$$= 5.7 \text{ kNm}$$

POLE SIZE

$$M^*_{\text{pole}} = (f + g_s) \times V^*_{\text{max}}$$

$$= 1.38 \text{ kNm} \quad \text{MOMENT IN POLE}$$

Timber 125 x 125 mm SG8 Pile

As per NZS3605:2001, Anchor piles are to be proof tested to meet a minimum bending moment strength of 6kNm

This equates to a bending strength $f_b = 23 \text{ MPa}$

$$f_b = 23 \text{ MPa} \quad Z = 0.33 \text{ mm}^3 \times 10^6$$

$$\Rightarrow \phi M_n = \phi * k_1 * k_4 * k_8 * f_b * Z$$

$$k_1 = 1.00 \quad k_4 = 1.00 \quad k_8 = 1.00$$

$$\phi M_b = 6.0 \text{ kNm} > M^* \quad \text{OK}$$

CHECK SERVICEABILITY

$$E = 4400 \text{ MPa}$$

$$I = 20.35 \times 10^6 \text{ mm}^4$$

$$p_{sls} = \Delta^3 / 3EI = 0.07 \text{ mm} \quad \text{Ok less than } L/200$$

NUMBER OF BRACED PILES REQUIRED

FOR LATERAL RESISTANCE

$$P^* = 1.5 \text{ kN}$$

$$H_u = 7.4 \text{ kN}$$

=>> OK FOR LATERAL RESISTANCE

FOR BENDING

$$M^* = 1.4 \text{ kNm}$$

$$\phi M_n = 5.99 \text{ kNm}$$

=>> OK FOR BENDING

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DECK PILES - NORTH EAST

Check Bearing Capacity

Deck Piles

UDL(kN/m)	G	Q	WIDTH	BREADTH	WG	WQ
ROOF					0.00	0.00
BARRIER					0.00	0.00
DECK	0.350	2.000	1.000	1.850	0.65	3.70
TOTAL					0.65	3.70

LOAD COMBINATIONS ULTIMATE $w_u = 1.2G + 1.5Q = 6.33$ KN

LOADING $(1.2G + 1.5Q) = 6.33$ KN (maximum)
 Pile Weight $(\pi \times d^2/4 \times l \times 24 \text{ kN/m}^3) = 5.127$ KN
 11.454 KN

HOLE DIAMETER = 0.40 m
 HOLE DEPTH = 1.7 m

FACTORED ULTIMATE BEARING CAPACITY (kPa) = 150 (ULS END BEARING = 300 kPa)

$B_{req} = (R \times 4 / \phi UBC \pi)^{1/2} = 312$ mm

=> 'PILE DIAMETER OK

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DECK PILES - SOUTH WEST

CANTILEVERED POST DESIGN

Design for the foundation piles to support the proposed deck.

BRACING DEMAND

a) SEISMIC WEIGHTS

$$W_i = \sum G_i + \psi_E Q_i$$

$$\psi_E = 0.3$$

	G	Q	WIDTH	LENGTH	ψ_E	WG	WQ ψ_E
ROOF						0.00	0.00
INTERNAL WALL						0.00	0.00
BARRIER						0.00	0.00
DECK	0.350	2.000	1.500	6.650	0.300	3.49	5.99
TOTAL						3.49	5.99

KN

$$W_i = 9.48 \text{ KN}$$

b) Seismic Actions Coefficients (refer loadings page)

$$C_d(T_1) = 0.72$$

ULS

Using a ductility factor of $m = 1.0$ due to elastic nature of cantilevered bracing posts.

$$C_d(T_1) = 0.13$$

SLS

$$\text{No. Posts} = 6$$

$$F_{H,EQ} = C_d(T_1) \cdot W_i / \text{No. Posts}$$

$$= 1.1 \text{ kN}$$

ULS

Each pile fixing to have a 6kN lumberlok connection

$$= 0.2 \text{ kN}$$

SLS

$$\Rightarrow \phi Q_n = 4.8 \text{ kN} \gg F_{H,max}$$

(where $\phi = 0.8$)

$\Rightarrow$ OK

LATERAL WIND DEMAND

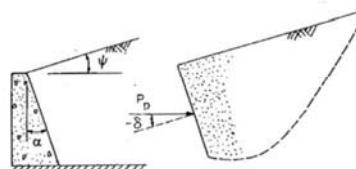
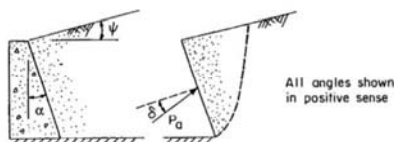
Deck has now walls or roof, therefore wind can be neglected.

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DECK PILES - SOUTH WEST

Table 3.1: Values of K_A and K_P for logarithmic spiral failure surfaces

K_A								K_P							
δ , deg	ψ , deg	α , deg	ϕ , deg					δ , deg	ψ , deg	α , deg	ϕ , deg				
			20	25	30	35	40				20	25	30	35	40
-10	-15	-10	0.37	0.30	0.24	0.19	0.14	-10	-15	-10	1.32	1.66	2.05	2.52	3.09
		0	0.42	0.35	0.29	0.24	0.19			0	1.09	1.33	1.56	1.82	2.09
		10	0.45	0.39	0.34	0.29	0.24			10	0.87	1.03	1.17	1.30	1.33
	0	-10	0.42	0.34	0.27	0.21	0.16		0	-10	2.33	2.96	3.82	5.00	6.68
		0	0.49	0.41	0.33	0.27	0.22			0	2.04	2.46	3.00	3.69	4.59
		10	0.55	0.47	0.40	0.34	0.28			10	1.74	1.89	2.33	2.70	3.14
15	0	-10	0.55	0.41	0.32	0.23	0.17	15	0	-10	3.36	4.56	6.30	8.98	12.2
		0	0.65	0.51	0.41	0.32	0.25			0	2.99	3.86	5.04	6.72	10.4
		10	0.75	0.60	0.49	0.41	0.34			10	2.63	3.23	3.97	4.98	6.37
	-15	-10	0.31	0.26	0.21	0.17	0.14		-15	-10	1.95	2.90	4.39	6.97	11.8
		0	0.37	0.31	0.26	0.23	0.19			0	1.62	2.31	3.35	5.04	7.99
		10	0.41	0.36	0.31	0.27	0.25			10	1.29	1.79	2.50	3.58	5.09
ϕ^*	0	-10	0.37	0.30	0.24	0.19	0.15	$-\phi^*$	0	-10	3.45	5.17	8.17	13.8	25.5
		0	0.44	0.37	0.30	0.26	0.22			0	3.01	4.29	6.42	10.2	17.5
		10	0.50	0.43	0.38	0.33	0.30			10	2.57	3.50	4.98	7.47	12.0
	15	-10	0.50	0.37	0.29	0.22	0.17		15	-10	4.95	7.95	13.5	24.8	50.4
		0	0.61	0.48	0.37	0.32	0.25			0	4.42	6.72	10.8	18.6	39.6
		10	0.72	0.58	0.48	0.42	0.35			10	3.88	5.62	8.51	13.8	24.3



LATERAL STRENGTH OF PILE

SHORT HEAD PILE IN CONHESIONLESS SOIL

NOTE FOR SELECTION OF K_P

- 1) - Identify ϕ for soil (as per Page 1)
- 2) - Identify backslope of post (as per Page 1)
- 3) take θ as 0 as looking at the lower soil below base of post (where ground is level)
- 4) Interpolate delta δ between value of ϕ and 0 given on ratio assigned for friction on back of wall

Ratio ϕ to Delta	$\phi = 25$	As per Williams and Waite (1993)
	0.5	
ground slope $\psi =$	$\alpha = 0$	
	0	
K_P at $\delta = 0 =$	2.46	at base of Post
K_P at $\delta = \phi =$	4.29	

Therefore $K_P = 3.38$

$$H_u = K_P D_s L^3 \gamma / \{2 (f + L)\}$$

WHERE

$H_u =$ ULTIMATE LATERAL STRENGTH OF PILE (kN)	
$K_P =$ COEFFICIENT OF PASSIVE EARTH PRESSURE	
$=$	3.375
$=$	3.38
$\phi_{SOIL} =$	25.00°
$D_s =$	0.40 m
$L =$	1.1 m
$\gamma =$	16.0 kN/m ³
$f =$	0.45 m
$f =$	0.45 m
$\Phi_{pp} =$	0.8

$H_u = 7.4$ kN per pile

PILE DIAMETER
LENGTH OF PILE SHAFT

HEIGHT ABOVE GROUND OF APPLIED LOAD
 $f + 0.0$ m FOR UNSUPPORTED HEIGHT

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DECK PILES - SOUTH WEST

LOCATION OF MAXIMUM PILE SHAFT MOMENT

$$\begin{aligned} \text{MEASURED FROM THE GROUND SURFACE} \\ g_s = \{ 2 H_u / (3 K_p \gamma D_s) \} ^{1/2} \\ = 0.48 \text{ m} \end{aligned}$$

MAXIMUM PILE SHAFT MOMENT

$$\begin{aligned} M^* = H_u [2/3 \{ 2 H_u / (3 K_p D_s G) \} ^{1/2} + f] \\ = 5.7 \text{ kNm} \end{aligned}$$

POLE SIZE

$$\begin{aligned} M^*_{\text{pole}} = (f + g_s) \times V^*_{\text{max}} \\ = 1.06 \text{ kNm} \quad \text{MOMENT IN POLE} \end{aligned}$$

Timber 125 x 125 mm SG8 Pile

As per NZS3605:2001, Anchor piles are to be proof tested to meet a minimum bending moment strength of 6kNm

This equates to a bending strength $f_b = 23 \text{ MPa}$

$$f_b = 23 \text{ MPa} \quad Z = 0.33 \text{ mm}^3 \times 10^6$$

$$\Rightarrow \phi M_n = \phi * k_1 * k_4 * k_8 * f_b * Z$$

$$k_1 = 1.00 \quad k_4 = 1.00 \quad k_8 = 1.00$$

$$\phi M_b = 6.0 \text{ kNm} > M^* \quad \text{OK}$$

CHECK SERVICEABILITY

$$\begin{aligned} E &= 4400 \text{ MPa} \\ I &= 20.35 \times 10^6 \text{ mm}^4 \end{aligned}$$

$$p_{sls} \Delta^3 / 3EI = 0.06 \text{ mm} \quad \text{Ok less than } L/200$$

NUMBER OF BRACED PILES REQUIRED

FOR LATERAL RESISTANCE

$$\begin{aligned} P^* &= 1.1 \text{ kN} \\ H_u &= 7.4 \text{ kN} \end{aligned}$$

=>> OK FOR LATERAL RESISTANCE

FOR BENDING

$$\begin{aligned} M^* &= 1.1 \text{ kNm} \\ \phi M_n &= 5.99 \text{ kNm} \end{aligned}$$

=>> OK FOR BENDING

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DECK PILES - SOUTH WEST

Check Bearing Capacity

Deck Piles

UDL(kN/m)	G	Q	WIDTH	BREADTH	WG	WQ
ROOF					0.00	0.00
BARRIER					0.00	0.00
DECK	0.350	2.000	0.750	1.625	0.43	2.44
TOTAL					0.43	2.44

LOAD COMBINATIONS ULTIMATE $w_u = 1.2G + 1.5Q =$ 4.17 KN

LOADING (1.2G+1.5Q) = 4.17 KN (maximum)
Pile Weight ($\pi \times d^2/4 \times l \times (24 \text{ kN/m}^3)$) = 5.127 KN

9.295 KN

HOLE DIAMETER = 0.40 m
HOLE DEPTH = 1.7 m

FACTORED ULTIMATE BEARING CAPACITY (kPa) = 150 (ULS END BEARING = 300 kPa)

$B_{req} = (R \times 4 / \phi UBC \pi)^{1/2} =$ 281 mm

=> 'PILE DIAMETER OK

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