

Appendix D Liquefaction Assessment

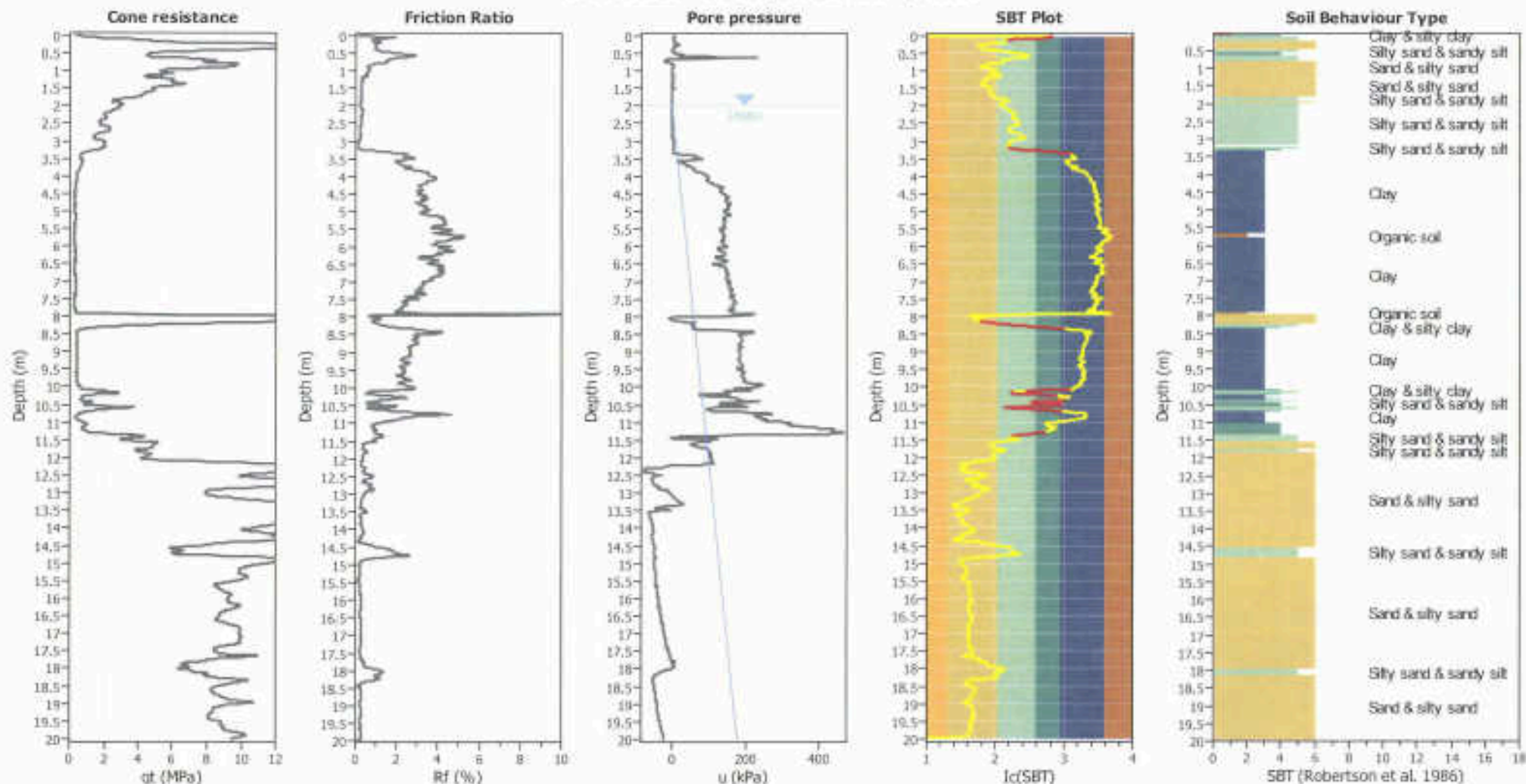


RRD002G1T2

Document Number: RDC-992919

Date Registered: 25/2/2020

CPT basic interpretation plots



Input parameters and analysis data

Analysis method: BS1 (2014)
 Fines correction method: BS1 (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.30
 Depth to water table (in situ): 2.00 m

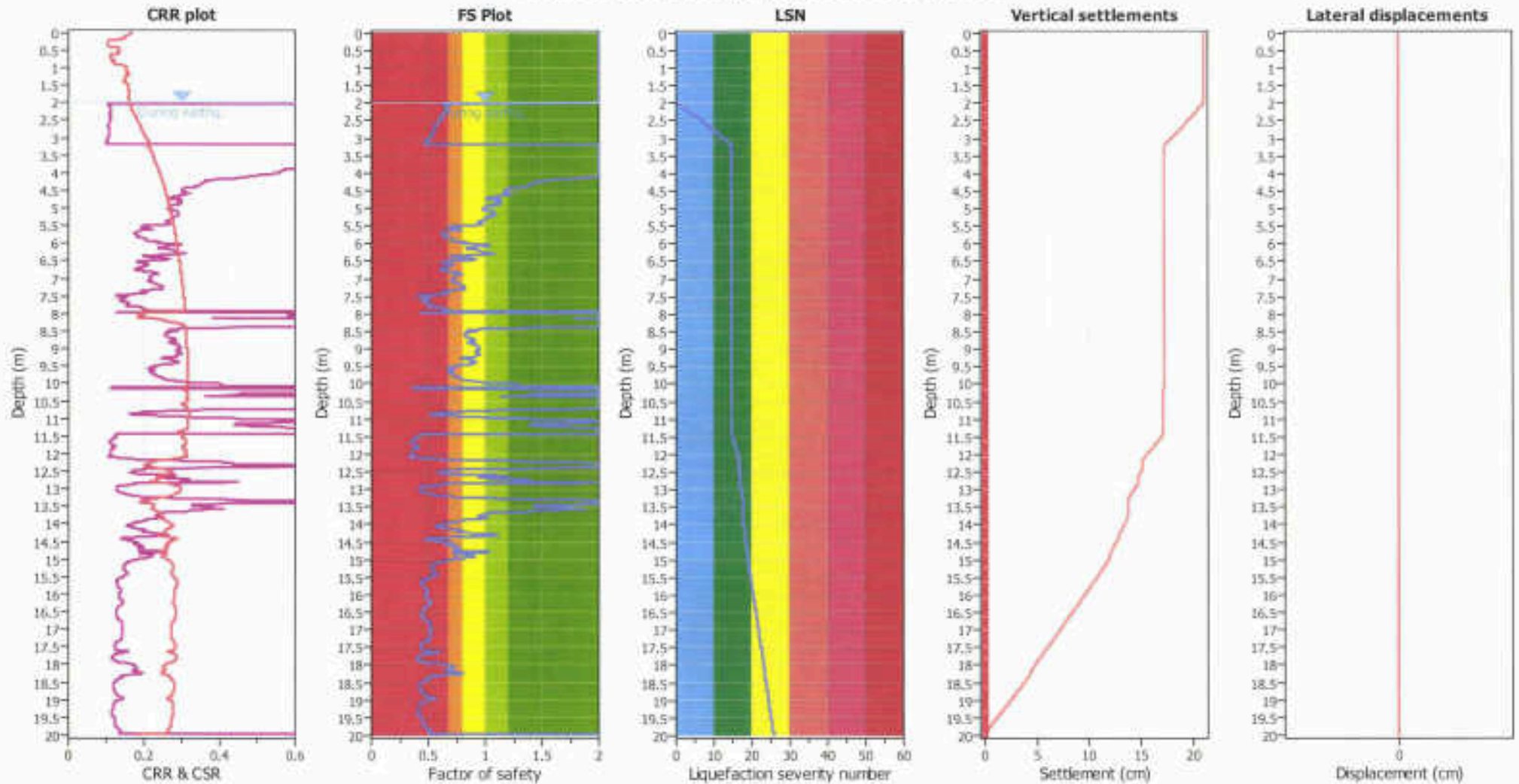
Depth to GWT (ortho.): 2.00 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: 14.00 kN/m³
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect: applied: Yes
 K_v applied: Yes
 Clay like behavior applied: Sand & Clay
 Limit depth applied: No
 Limit depth: N/A

SBT legend

- | | | |
|---------------------------|-----------------------------|----------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	BSI (2014)	Depth to GWT (earthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	BSI (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_{α} applied:	Yes
Earthquake magnitude M_w :	6.00	Unit weight calculation:	14.00 kN/m ³	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.30	Use fill:	No	Limit depth applied:	No
Depth to water table (mstu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

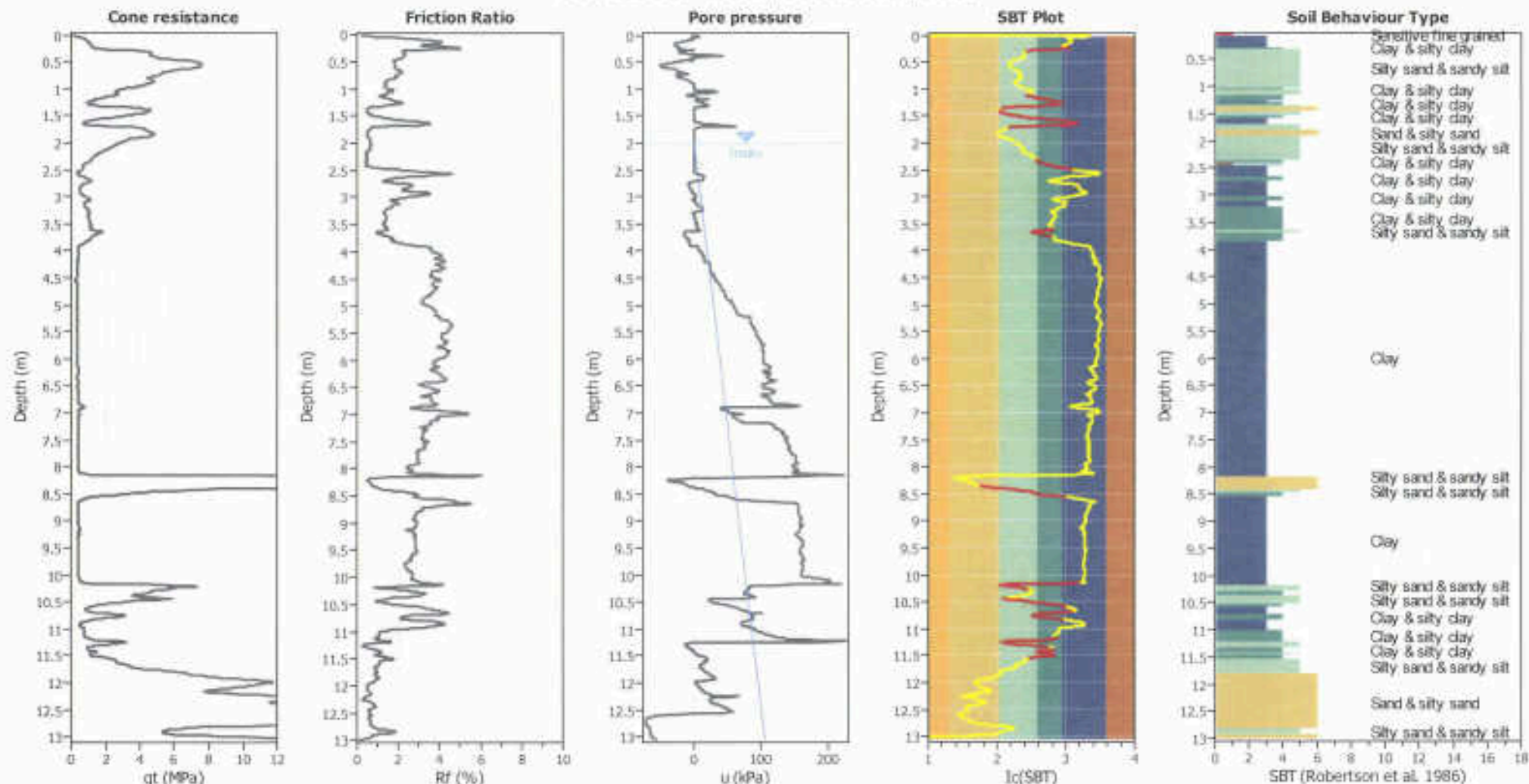
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Orange	Major expression of liquefaction
Yellow	Moderate to severe exp. of liquefaction
Green	Moderate expression of liquefaction
Dark Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

CPT basic interpretation plots



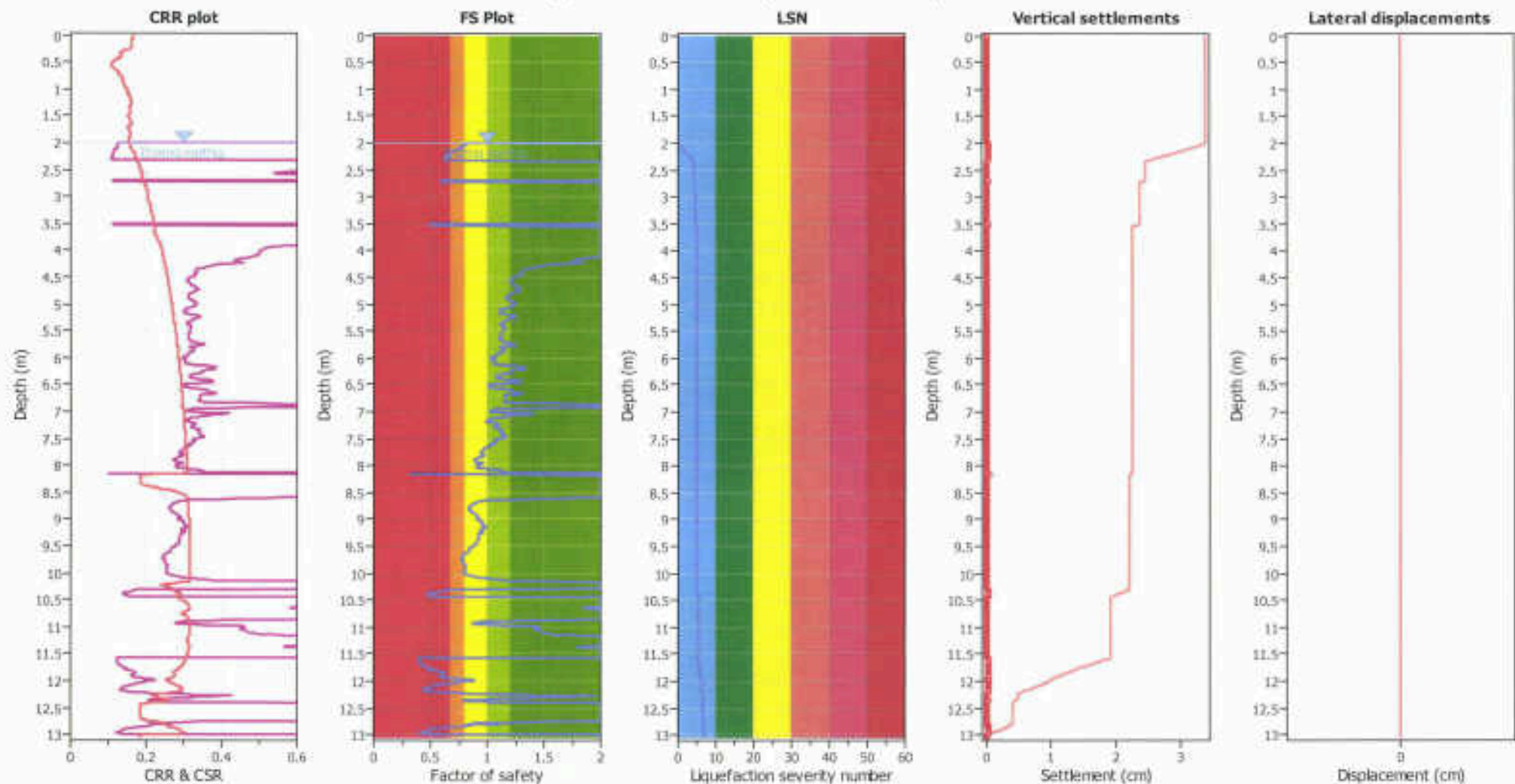
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (orthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_p applied:	Yes
Earthquake magnitude M_w :	6.00	Unit weight calculation:	14.00 kN/m ³	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.30	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on Ic value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.30
 Depth to water table (inst): 2.00 m

Depth to GWT (earth.): 2.00 m
 Average results interval: 3
 Ic cut-off value: 2.60
 Unit weight calculation: 14.00 kN/m³
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sand & Clay
 Limit depth applied: No
 Limit depth: N/A

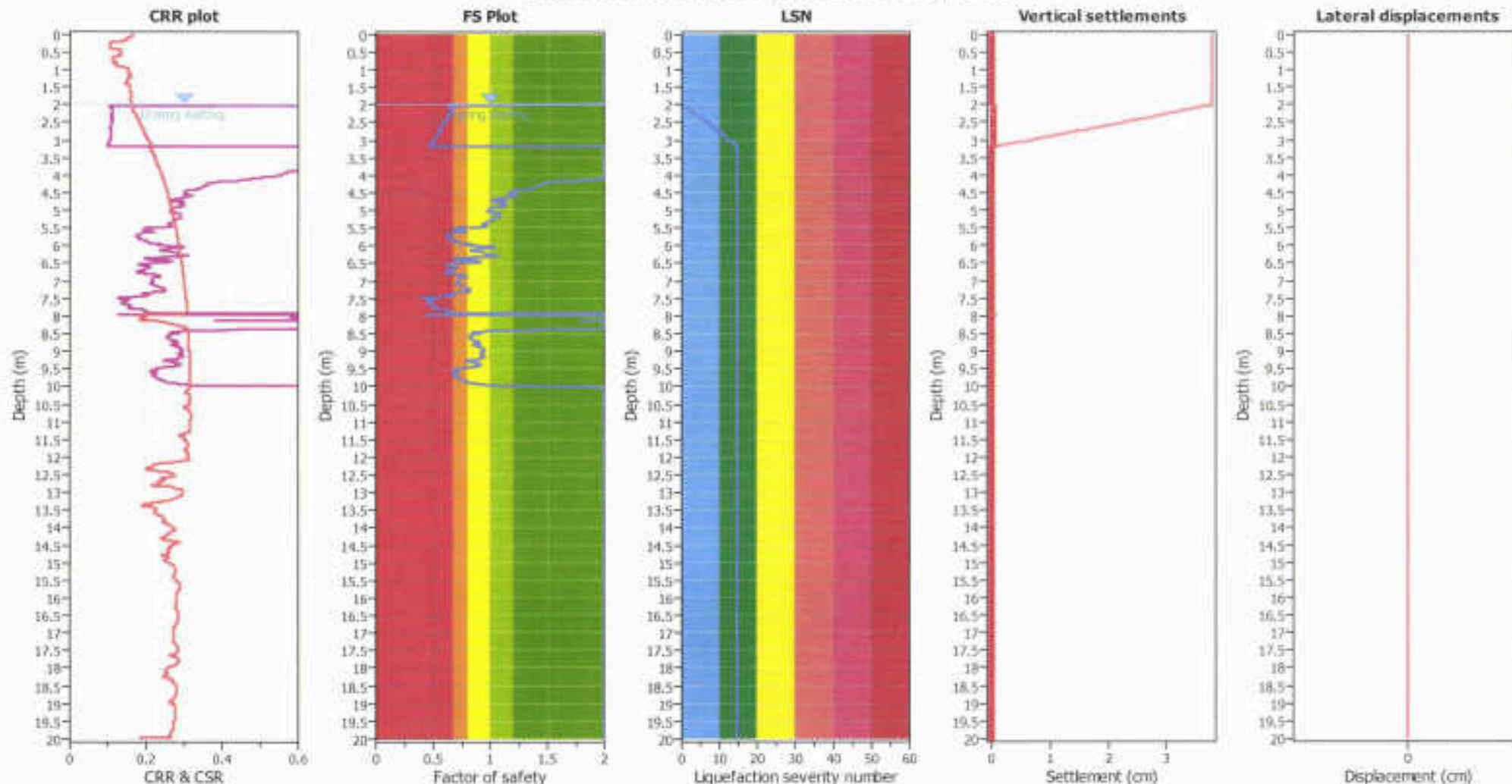
F.S. color scheme

Almost certain it will liquefy
 Very likely to liquefy
 Liquefaction and no liq. are equally likely
 Unlike to liquefy
 Almost certain it will not liquefy

LSN color scheme

Severe damage
 Major expression of liquefaction
 Moderate to severe exp. of liquefaction
 Moderate expression of liquefaction
 Minor expression of liquefaction
 Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on 1c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.30
 Depth to water table (instu): 2.00 m

Depth to GWT (erth.): 2.00 m
 Average results interval: 3
 1c cut-off value: 2.60
 Unit weight calculation: 14.00 kN/m³
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect, applied: Yes
 K_{α} applied: Yes
 Clay like behavior applied: Sand & Clay
 Limit depth applied: Yes
 Limit depth: 10.00 m

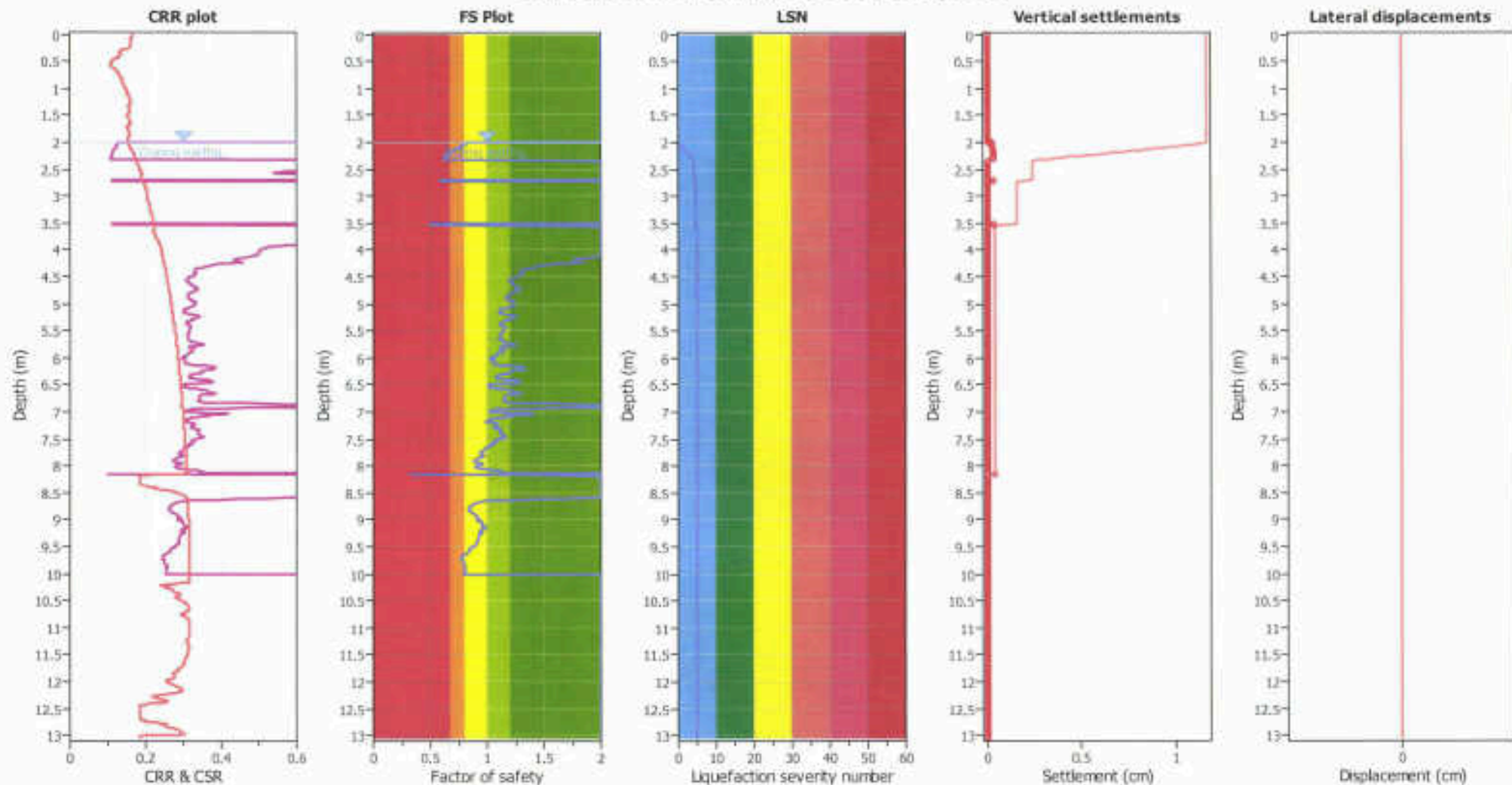
F.S. color scheme

Almost certain it will liquefy
 Very likely to liquefy
 Liquefaction and no lg. are equally likely
 Unlike to liquefy
 Almost certain it will not liquefy

LSN color scheme

Severe damage
 Major expression of liquefaction
 Moderate to severe exp. of liquefaction
 Moderate expression of liquefaction
 Minor expression of liquefaction
 Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&J (2014)
 Fines correction method: B&J (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.30
 Depth to water table (resu): 2.00 m

Depth to GWT (earthq.): 2.00 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: 14.00 kN/m³
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sand & Clay
 Limit depth applied: Yes
 Limit depth: 10.00 m

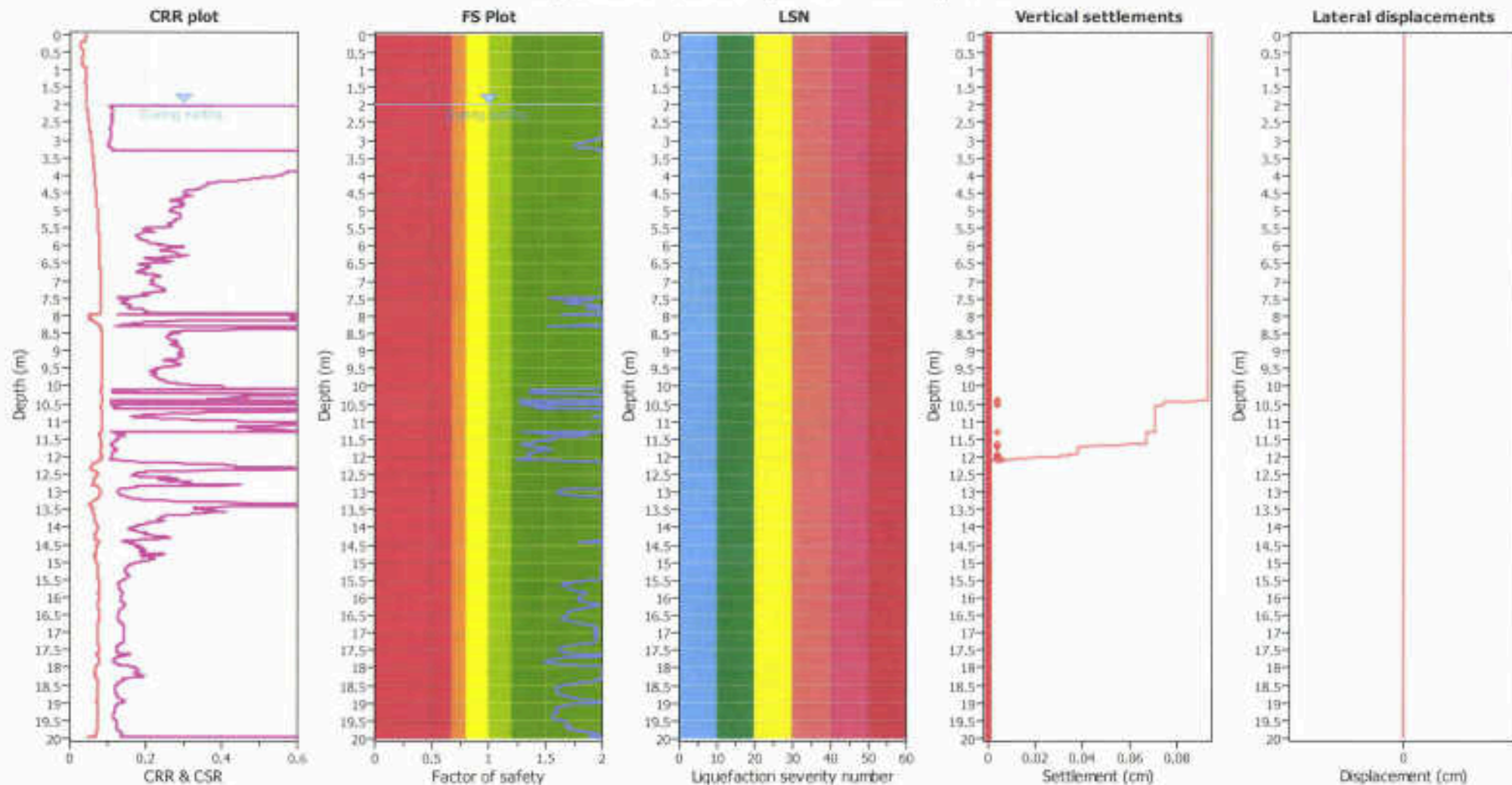
F.S. color scheme

Almost certain it will liquefy
 Very likely to liquefy
 Liquefaction and no liq. are equally likely
 Unlikely to liquefy
 Almost certain it will not liquefy

LSN color scheme

Severe damage
 Major expression of liquefaction
 Moderate to severe exp. of liquefaction
 Moderate expression of liquefaction
 Minor expression of liquefaction
 Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B8I (2014)
 Fines correction method: B8I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.08
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 2.00 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: 14.00 kN/m³
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: No
 K_s applied: Yes
 Clay like behavior applied: Sand & Clay
 Limit depth applied: No
 Limit depth: N/A

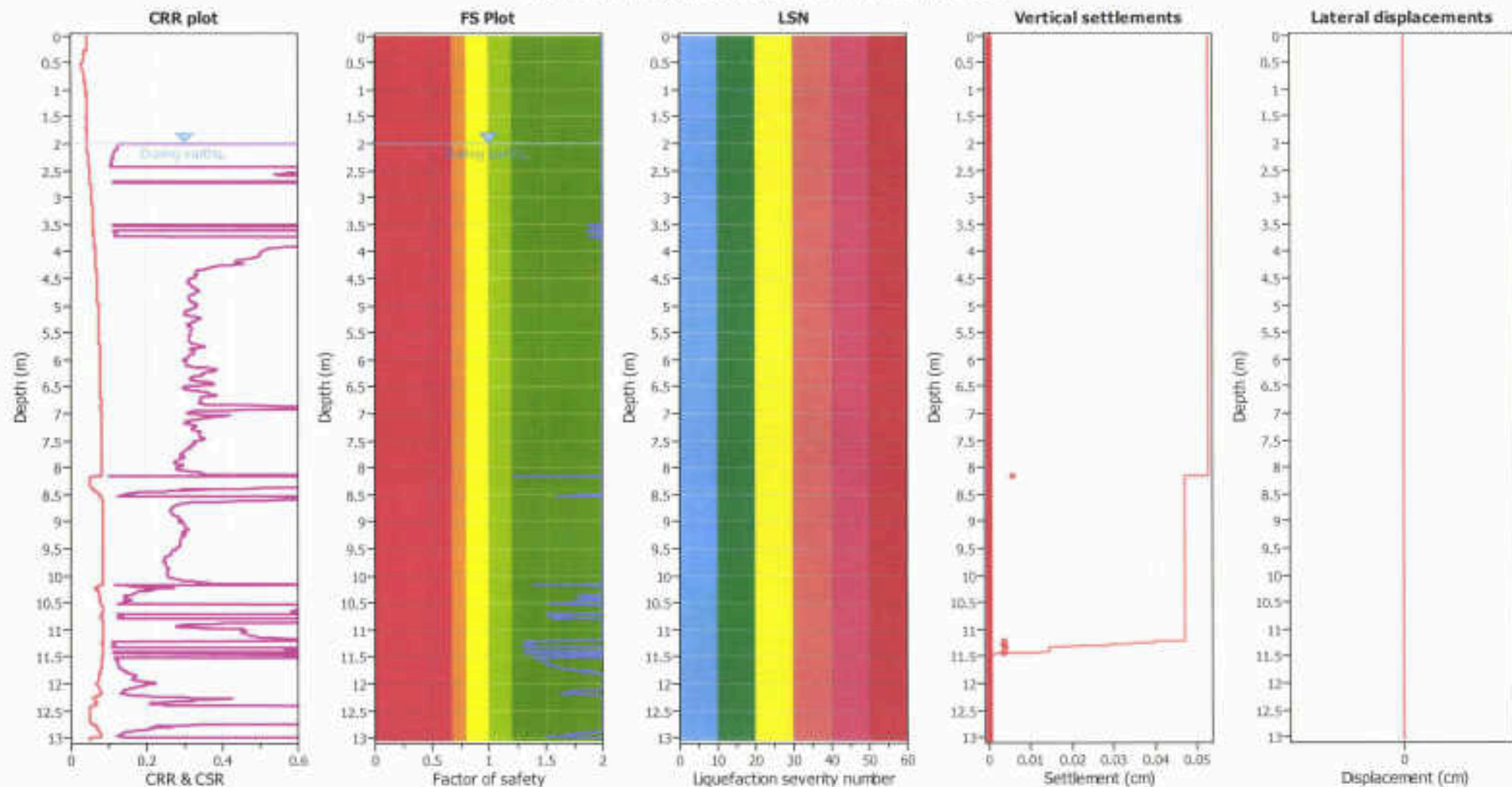
F.S. color scheme

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 Very likely to liquefy
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LSN color scheme

Severe damage
 Major expression of liquefaction
 Moderate to severe exp. of liquefaction
 Moderate expression of liquefaction
 Minor expression of liquefaction
 Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect, applied:	No
Points to test:	Based on I _c value	I _c cut-off value:	2.60	K _u applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	14.00 kN/m ³	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.08	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
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Structural Design Calculations for:

Lot 70

16 Oakland Place

Ngongotaha

Bay of Plenty

Job #: 76541rev01 (#87826)

July 2019

Date : 6/07/2019
 Designer : AAF
 Checker : NL
 Job Number : 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
 Description : EDGE BEAM

Loadings



Tributary Roof and Floor Lengths

WALLS

Lower:	20 Series	▼	Solid	▼
			(North/South Taupo)	
	Light	▼	=	400 kg/m ²
			=	3.92 kPa
	Height	=		0.70 m
	Load/m	=		2.75 kN/m

Upper:	Timber	▼		▼
			(North/South Taupo)	
			=	38 kg/m ²
			=	0.37 kPa
	Height	=		m
	Load/m	=		kN/m

Other (Specify Wall Weight)				
	Weight	=		38 kg/m ²
		=		0.37 kPa
	Height	=		2.70 m
	Load	=		1 kN/m

SUSPENDED MID-FLOOR

	Unit/Floor	=	Timber	▼
	Topping	=	N/A	▼
		=		0.38 kPa
	Live Loading	=		1.50 kPa
	Super Imposed Dead	=		kPa
	Tributary Span	=		m
	Dead Load/m	=		kN/m
	Live Load/m	=		kN/m

ROOF

			Tributary Length = S	
	Light	▼	=	0.46 kPa
	Live Loading		=	0.25 kPa
	Tributary Span	=		4.07 m
	Dead Load/m	=		1.87 kN/m
	Live Load/m	=		1.02 kN/m

Loadings Summary

Walls	3.75	kN/m	Dead
Mid Floors		kN/m	Dead
		kN/m	Live
Slab*	4.15	kN/m	Dead+SDL
	0.90	kN/m	Live
Roof	1.87	kN/m	Dead
	1.02	kN/m	Live [^]
Extra Dead		kN/m	Dead
Extra Live		kN/m	Live

* Includes Edge Beam Weight, SDL = 0.5 kPa LL = 1.5 kPa

[^] Roof LL not added if midfloor exists else LL = 0.25 kPa

Date : 6/07/2019
 Designer : AAF
 Checker : NL
 Job Number : 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
 Description : EDGE BEAM

Working Loads

Dead	9.78	kN/m
Live	1.92	kN/m
Ultimate Loads (1.2G + 1.5Q)		
Dead	11.73	kN/m
Live	2.88	kN/m
Total Ultimate Load on Edge	w = 14.61	kN/m

Edge Beam Details

Wall Construction Type

Timber Clad Frame min beam width 200mm ▼

Beam Width = 400 mm
 Pod Depth = 220 mm
 Top slab Depth = 85 mm
 Self Weight = 2.93 kN/m
 Construction Type = Standard Raft ▼

OK!

Standard Raft Construction

Dependable bearing capacity: 100 kPa

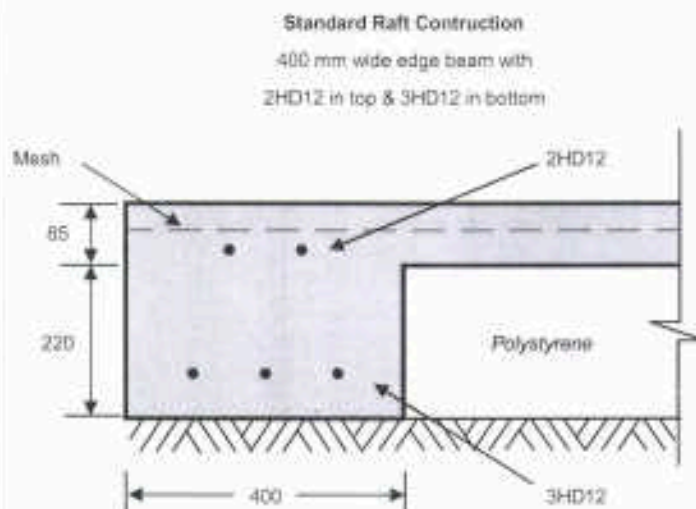
Bearing Check = OK!
 Working Pressure = 26 kPa

Steel Requirements - As Per Std Drg's

Top Steel: 2HD12
 Btm Steel: 3HD12

Prescribed Edge Beam Design

Location (ie: which wall):
 EDGE BEAM



Date : 6/07/2019
 Designer : AAF
 Checker : NL
 Job Number : 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 18 Oakland Place
 Description : STANDARD RIB

Loadings

WALLS

Lower

HOTBloc	▼	Solid	▼
		(North/South Taupo)	
Light	▼ =	400	kg/m ²
	=	3.92	kPa
Height	=		m
Load/m	=		kN/m

Upper

HOTBloc	▼	Solid	▼
		(North/South Taupo)	
Light	▼ =	400	kg/m ²
	=	3.92	kPa
Height	=		m
Load/m	=		kN/m

Other (Specify Wall Weight)

Weight	=	30	kg/m ²
	=	0.29	kPa
Height	=		m
Load	=		kN/m

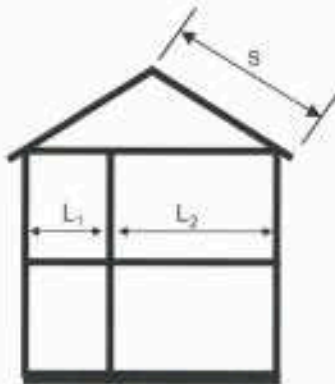
SUSPENDED MID-FLOOR

Tributary Length = $(L_1 + L_2)/2$

Unit/Floor	=	Timber	▼
Topping	=	N/A	▼
	=	0.38	kPa
Live Loading	=	1.50	kPa
Super Imposed Dead	=		kPa
Tributary Span	=		m
Dead Load/m	=		kN/m
Live Load/m	=		kN/m

ROOF

Tributary Length = S		(Check if Rafter or Truss)	
Light	▼ =	0.46	kPa
Live Loading		0.25	kPa
Tributary Span	=		m
Dead Load/m	=		kN/m
Live Load/m	=		kN/m



Tributary Roof and Floor Lengths

Loadings Summary

Walls		kN/m	Dead
Mid Floors		kN/m	Dead
		kN/m	Live
Slab*		kN/m	Dead+SDL
	1.80	kN/m	Live
Roof		kN/m	Dead
		kN/m	Live*
Extra Dead		kN/m	Dead
Extra Live		kN/m	Live

* Includes Internal Rib Weight, SDL = 0.5 kPa LL = 1.5 kPa

* Roof LL not added if midfloor exists else LL = 0.25 kPa

Date: 6/07/2019
 Designer: AAF
 Checker: NL
 Job Number: 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address: Lot 70, 16 Oakland Place
 Description: STANDARD RIB

Working Loads

	Dead		kN/m
	Live	1.80	kN/m
Ultimate Loads (1.2G + 1.5Q)	Dead		kN/m
	Live	2.70	kN/m
Total Ultimate Load on Internal	w =	2.70	kN/m

Internal Rib Details

Rib Width =	100	mm
Pod Depth =	220	mm
Top slab Depth =	85	mm
Self Weight =	0.53	kN/m
Construction Type	Standard Raft	

OK

Standard Raft Construction

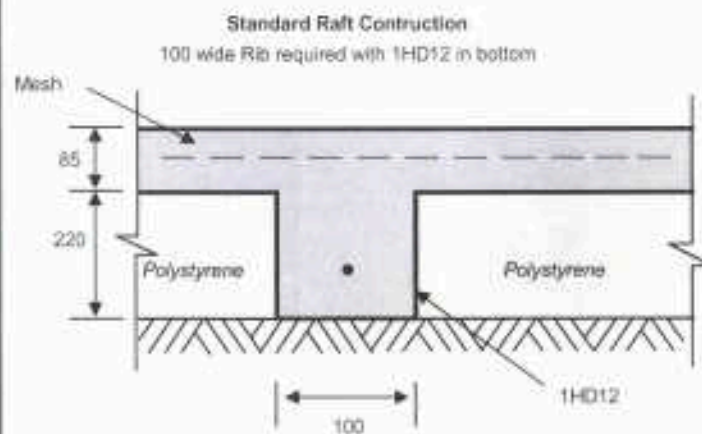
Dependable bearing capacity:	100	kPa
Bearing Check =	OK	
Working Pressure =	7	kPa

Steel Requirements - As Per Std Drg's

Botm Steel: 1HD12

Prescribed Internal Rib Design

Location (ie: which wall):
 STANDARD RIB



Date: 6/07/2019
Designer: AAF
Checker: NL
Job Number: 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address: Lot 70, 16 Oakland Place
Description: Summary

Brief:

Design a raftfloor to satisfy the criteria set-out by DBH document 'Guidance on house repairs and reconstruction following the Canterbury Earthquake'

House Type:

Walls:

Lower: 20 Series Solid Light = 400 kg/m²
Height: 0.7 m Load/m: = 2.75 kN/m

Upper: 20 Series Solid Light = 400 kg/m²
Height: m Load/m: = 0.00 kN/m

Other: Weight: = 38 kg/m²
Height: 2.7 m Load/m: = 1.01 kN/m

Mid-Floor:

Unit/Floor: Timber Topping: N/A = 0.38 kPa
Tributary span: m Load/m: = 0 kN/m

Roof:

Roof type: Light = 0.46 kPa
Tributary span: 4.07 m Load/m: = 1.8722 kN/m

Design Summary:

Mesh: 500E, 6.1 mm diameter @ 200 spacing on 40mm mesh chairs
concrete f_c = 20 MPa
Pods: 1100mm square, 220mm deep
Rib 1: 100mm wide rib, with 1 HD12 at top
Rib 2: 100mm wide rib, with 1 HD12 at top
HD10 to bottom of ribs
Generally: 400mm wide edgebeam with 2/ HD12 bars to top and 3/ HD12 bars to bottom
Additional:

Date : 6/07/2019
 Designer : AAF
 Checker : NL
 Job Number : 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
 Description : Edge Cantilever

A: Edge Cantilever



Section Parameters along Edge

Rib 1		Rib 2	
Rib 1 width:	100	Rib 2 width:	100
pod depth:	220	topping depth:	85
pod width:	1100		

Rib 1: Section Properties

$A =$	124000 mm ²	}	⇒	$I_x =$	571006938.2 mm ⁴
moment area =	8625000 mm ³			$I_{xx} =$	480885216.5 mm ⁴
centroid =	89.55645161 mm				

Rib 2: Section Properties

$A =$	124000 mm ²	}	⇒	$I_x =$	571006938.2 mm ⁴
moment area =	8625000 mm ³			$I_{xx} =$	480885216.5 mm ⁴
centroid =	69.55645161 mm				

Load combination to consider:

G, E_u, $\Psi_c Q$ ($\Psi_c = 0.3$)

Loads:

load at edge, G:	4.87 kN/m	slab live load:	2.5 kPa
edge beam:	2.93 kN/m	load at edge, 0.3Q:	0 kN/m
Rib 1, G:	3.46 kN/m	Rib 1, 0.3Q:	0.9 kN/m
Rib 2, G:	3.46 kN/m	Rib 2, 0.3Q:	0.9 kN/m

Design Forces at critical sections:

$M^*_{total} =$	48.65 kNm	$M^*_{Rib1} =$	23.33 kNm
		$M^*_{Rib2} =$	23.33 kNm
$V^*_{total} =$	30.73 kN	$V^*_{Rib1} =$	15.36 kN
		$V^*_{Rib2} =$	15.36 kN

From P-frame analysis:

Max. deflection $\Delta =$	2.63 mm	OK
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Date : 6/07/2019
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 Job Number : 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
 Description : Edge Cantilever

Section Design - Rib 1

Bending:

mesh:	6.1 mm	200 spacing	500 MPa	87.67 kN
top reinforcement:	1 of	12 diameter	500 MPa	56.55 kN
mesh chair:	40 mm	top reinforcement, tied under mesh		
therefore $d =$	257.1 mm			
try $f_c =$	20 MPa	$T =$	144.22 kN	
$a =$	84.84 mm	$c =$	99.81 mm	OK, less than 0.75cb
$\phi M_{Rib,1} =$	26.32 kNm	$M^*_{Rib,1} =$	23.33 kNm	OK

Shear:

$p_s =$	0.011218761	$v_s =$	0.803 MPa	
$\phi V_{Rib,1} =$	15.48 kN	$V^*_{Rib,1} =$	15.36 kN	OK, steel fibres not req.

If shear exceeded, try adding 10kg/m3 steel fibres (to section below topping concrete only):

$V_{sl} = 0.7 k_f k_1 k_2 b_w d$	$k_1 = 1.843025061$	$\rightarrow$	1.5
	$k_2 = 1.881973807$		
$f_{ck} =$	0.12 MPa	$f_{Rib,4} =$	1.0 MPa
$\phi V_{Rib,1,sl} =$	4.57 kN		
$\phi V_{Rib,1,sl,sl} =$	20.05 kN	$V^*_{Rib,1} =$	15.36 kN
			OK

Section Design - Rib 2

Bending:

mesh:	6.1 mm	200 spacing	500 MPa	87.67 kN
top reinforcement:	1 of	12 diameter	500 MPa	56.55 kN
mesh chair:	40 mm	top reinforcement, tied under mesh		
therefore $d =$	257.1 mm			
try $f_c =$	20 MPa	$T =$	144.22 kN	
$a =$	84.84 mm	$c =$	99.81 mm	OK, less than 0.75cb
$\phi M_{Rib,2} =$	26.32 kNm	$M^*_{Rib,2} =$	23.33 kNm	OK

Shear:

$p_s =$	0.011218761	$v_s =$	0.803 MPa	
$\phi V_{Rib,2} =$	15.48 kN	$V^*_{Rib,2} =$	15.36 kN	OK, steel fibres not req.

If shear exceeded, try adding 10kg/m3 steel fibres (to section below topping concrete only):

$V_{sl} = 0.7 k_f k_1 k_2 b_w d$	$k_1 = 1.843025061$	$\rightarrow$	1.5
	$k_2 = 1.881973807$		
$f_{ck} =$	0.12 MPa	$f_{Rib,4} =$	1.0 MPa
$\phi V_{Rib,2,sl} =$	4.57 kN		
$\phi V_{Rib,2,sl,sl} =$	20.05 kN	$V^*_{Rib,2} =$	15.36 kN
			OK

Date: 6/07/2019
 Designer: AAF
 Checker: NL
 Job Number: 76541 rev01

TC2 Raftfloor Design



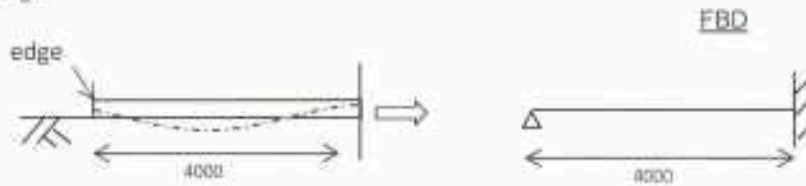
**WILTON
JOUBERT**

Consulting Engineers

Site Address: Lot 70, 16 Oakland Place
 Description: Floor

A: Loss of support (4.0m) under slab

Scenario 1 - near edge:



Scenario 2 - within slab:



Comment: Scenario 1 would yield higher forces & deflections compared to scenario 2

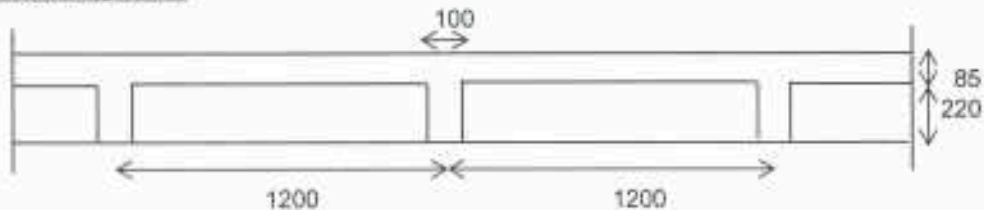
Loadings:

Self weight of raftslab: 3.460 kN/m, per rib
 Domestic live load: 3.0 kN/m, per rib

Load combination to consider:

G, Eu, ψQ ($\psi = 0.3$)

Section Parameters: Typical Rib



T-section per each rib:

A =	124000 mm ²	}	⇒	I _g =	571008938.2 mm ⁴
moment area =	8625000 mm ³				
centroid =	69.56645161 mm				
f _r =	2.68 MPa				
M _{cr+} =	6.51 kNm				
M _{cr-} =	22.03 kNm				

Date : 6/07/2019
 Designer : AAF
 Checker : NL
 Job Number : 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

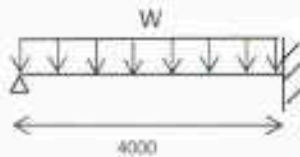
Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
 Description : Floor

Analysis:

Under loads given previous, UDL (w):

G = 3.46 kN/m
 $\frac{1}{2}G = 0.54 \text{ kN/m}$ (Npc=0.3)



From P-frame analysis:

$M^+ = 4.905 \text{ kNm}$ < $M_{cr+} = 6.51 \text{ kNm}$
 $M^- = 8.72 \text{ kNm}$ < $M_{cr-} = 22.03 \text{ kNm}$ } $I_e = I_g$

Max. deflection $\Delta = 0.49 \text{ mm}$ **OK!**

Check strength:

Positive strength - 10 mm diameter 500 MPa
 $T = 39.27 \text{ kN}$ $d = 250.00 \text{ mm}$
 $a = 3.25 \text{ mm}$
 $\Rightarrow a/Mn = 8.29 \text{ kNm}$ > $M^+ = \text{OK!}$

Negative strength - only mesh considered

$T = 87.67 \text{ kN}$ $d = 263.05 \text{ mm}$
 $a = 51.57 \text{ mm}$
 $\Rightarrow a/Mn = 17.68 \text{ kNm}$ > $M^- = \text{OK!}$

Shear:

$V_{max} = 10.9 \text{ kN}$ (from P-frame analysis)
 $V^* = 9.8 \text{ kN}$ (from P-frame analysis, 263.05mm from support)

$\rho_w = 0.00667$ $v_u = 0.811 \text{ Mpa}$
 $\Rightarrow a/Vc = 11.88 \text{ kN}$ > $v_u^* = 0.802 \text{ Mpa}$
 $V^* = \text{OK!}$

If shear exceeded, try adding 10kg/m³ steel fibres (to section below topping concrete only):

$V_{sd} = 0.7 k_f k_t k_{fs} b_w d$ $k_f = 1.823987635$ > 1.5
 $k_t = 1.871956559$
 $f_{ctd} = 0.12 \text{ MPa}$ $f_{ctd} = 1.0 \text{ MPa}$
 $\phi V_{sd(1.5)} = 4.65 \text{ kN}$
 $\phi V_{sd(1.5)} = 16.53 \text{ kN}$ $V_{sd(1.5)}^* = 9.75 \text{ kN}$ **OK**

Date : 8/07/2019
Designer : AAF
Checker : NL
Job Number : 76541 rev01

TC2 Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
Description : Edge Beam

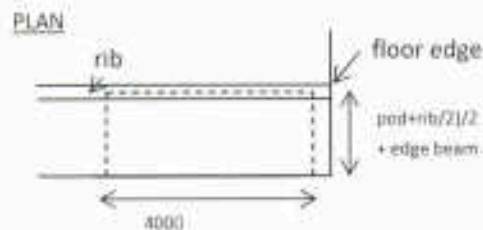
B: Loss of support (4.0m) under edge beam

As per case A, worst case is scenario 1 where happens near the edge.

Loadings:

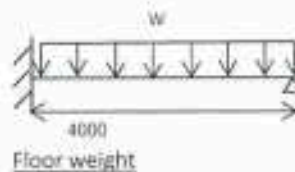
wall load:	3.00 kN/m	
roof load:	1.87 kN/m	
floor load:	0 kN/m	(G only)
Self weight of raftslab:	3.46 kPa	
live load:	1.5 kPa	

Consider failure of support as illustrated:



Hence, edge beam to support 1000mm of floor at worst point.

Edge beam: 400 mm wide



G= 1.90 kN/m
Q= 1.20 kN/m

Date : 6/07/2019
 Designer : AAF
 Checker : NL
 Job Number : 76541 rev01

TC2 Raftfloor Design

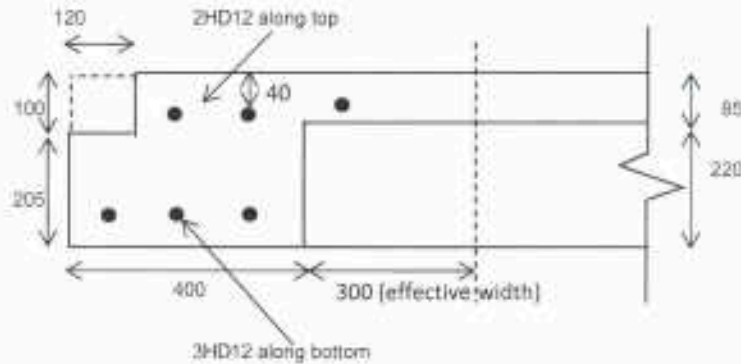


**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
 Description : Edge Beam

Section properties:



$A =$	135500 mm ²	}	$\Rightarrow$	$I_g =$	1115275096 mm ⁴
moment area =	19088750 mm ³				
centroid =	140.8763838 mm				
$f_r =$	2.68 Mpa				
$M_{cr+} =$	18.23 kNm				
$M_{cr-} =$	21.24 kNm				

Analysis:

From P-frame analysis:

$M^+ =$	11.3 kNm	<	$M_{cr+} =$	18.23 kNm	}	$I_e = I_g$
$M^- =$	20.1 kNm	<	$M_{cr-} =$	21.24 kNm		

Max. deflection $\Delta =$ 0.58 mm **OK!**

Check strength:

Negative strength

$T =$	113.10 kN	$T_{mesh} =$	36.72 kN
$a =$	22.33 mm	$d =$	254.82 mm
$\Rightarrow \phi M_n =$	31.44 kNm	>	M^- OK!

Positive strength

$T =$	169.65 kN	$d =$	249 mm
$a =$	24.95 mm		
$\Rightarrow \phi M_n =$	34.11 kNm	>	M^+ OK!

Shear:

$V_{max} =$	25.2 kN	(from P-frame analysis)
$V^* =$	22.6 kN	(from P-frame analysis, 254mm from support)

$\phi_w =$	0.00296	$v_d =$	0.446 Mpa
		$v_c =$	0.440 Mpa
$\Rightarrow \phi V_c =$	33.60 kN	>	V^* OK!

If shear exceeded, try adding 10kg/m³ steel fibres (to section below topping concrete only):

$V_{fs} = 0.7 k_f k_{fs} b_w d$	$k_f =$	1.10841055	$\Rightarrow$	1.10841055
	$k_{fs} =$	1.885930447		
$b_w =$	0.12 MPa	$f_{fs,s} =$	1.0 MPa	
$\phi V_{fs,1.0} =$	13.42 kN			
$\phi V_{fs,1.0} =$	47.03 kN	$V_{fs,1} =$	22.63 kN	OK

Date : 6/07/2019
 Designer : AAF
 Checker : NL
 Job Number : 76541 rev01

TC2 Raftfloor Design

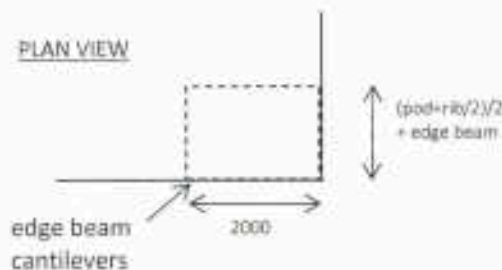


**WILTON
JOUBERT**

Consulting Engineers

Site Address : Lot 70, 16 Oakland Place
 Description : Edge Beam

C: Loss of support (2.0m) at extreme of floor (outer corners)



Loadings:

wall load:	3.00 kN/m	
roof load:	1.87 kN/m	
floor load:	0 kN/m	(G only)
Self weight of raftslab:	3.46 kPa	
live load:	1.5 kPa	

Model:



Section property as per previous

Analysis:

From P-frame analysis:

$M^* =$	20.1 kNm	<	$M_{cr} =$	21.24 kNm	$I_e = I_g$
Max. deflection $\Delta =$	0.74 mm	OK!			

Check strength:

Negative strength:

$T =$	113.10 kN	$T_{mesh} =$	38.72 kN
$a =$	22.33 mm	$d =$	254.82 mm
$\rho M n =$	31.44 kNm	$>$	$M^* =$ OK

Shear:

$V_{max} =$	17.7 kN	(from P-frame analysis)		
$V^* =$	20.14 kN	(from P-frame analysis, 254mm from support)		
$P_w =$	0.00298	$v_b =$	0.446 Mpa	
		$v_s =$	0.440 Mpa	
$\Rightarrow V_c =$	33.60 kN	$>$	V^*	OK!

If shear exceeded, try adding 10kg/m³ steel fibres (to section below topping concrete only).

$V_{ef} = 0.7 k_f k_i k_{tr} b_w d$	$k_i =$	1.10841055	$\rightarrow$	1.10841055
	$k_{tr} =$	1.880930447		
$f_{ct} =$	0.12 MPa	$f_{Rk,s} =$	1.0 MPa	
$\phi V_{Rk,s} =$	13.42 kN	$V^*_{Rk,s} =$	20.14 kN	OK
$\phi V_{Rk,s} =$	47.03 kN			

Date: 17/05/2018
 Designer: AAF
 Checker: NL
 Job Number: 76541

Earthquake Raftfloor Design



**WILTON
JOUBERT**

Consulting Engineers

Site Address: Lot 70, 16 Oakland Place
 Description: SLIDING RESISTANCE

Calculation of Shear Pile Requirements

Use AS1170 design philosophy of preventing damaging movement up to an SLS event, and thereafter accepting increasing levels of damage as the event increases.

Assumed Class C soil:

City/town: Rotorua

$C(t) = Ch(t) Z R N(T,D)$

$Ch(t)$ 2.36

Z 0.24

R_s (25 yr RPI) 0.25

R_u 500yr 1

$N(T,D)$ 1 SLS

$C(t)$ SLS 0.14

$C(t)$ ULS 0.57

Assume $T1 = 0.4$

$k_u = 1 + (u-1)T1/0.7$

$k_u = 1$

$C_d(T1) = C(t) Sp/k_u$

For base sliding $Sp = 1.0$

SLS $C_d(T1) = 0.14$

ULS $C_d(T1) = 0.50$

Note for Class D soil SLS $C_d(T1) = 0.18$

ULS $C_d(T1) = 0.63$

Testing by Dr McManus University of Canterbury (Geotechnical Society Symposium, 2003) found the friction co-efficient of slab on polythene on sand had peak friction co-efficients of 0.42 for an unloaded slab and 0.53 for a loaded slab. Residual friction coefficient were 0.38 and 0.49 respectively.

These values are some what lower than that published by other sources, normally 0.7 peak and 0.5 residual.

Even using the lower values there will be no relative movement between the slab and the ground at SLS level event on either Class C or D. At ULS level event there may be relative movement between the slab and the ground, this may break services to the house, but will also serve to reduce the forces transferred to the structure of the house. This is acceptable within the intent of NZS 1170.5 2004.

However as the foundation is founded on 2 layers of DPM, the above assumptions are no longer accurate as it does not reference the friction co-efficient of slab on polythene on polythene, therefore shear keys will be required to support the house in shear.

**WILTON
JOUBERT**

Consulting Engineers

SLIDING RESISTANCE<Job No.> 76541 rev01
<Job Title> Lot 70, 16 Oakland Place
<Description> Sliding ResistanceDate: 6/7/2019
Designer: AAF
Checker: NL**Horizontal Loadings**

$$V = C \cdot Wt \quad C = C_{d1}(T_s) \cdot Z \cdot R \cdot N(T,D) \cdot S_p / k_a$$

Limit state: per AS/NZS 1170

Subsoil Class: D

assumed subsoil category (b)

$$\begin{aligned} C_{d1}(T_s) &= 3 \\ Z &= 0.24 \\ R &= 0.25 \\ N(T,D) &= 1 \\ S_p &= 0.925 & \mu &= 1.25 \\ \text{assume } T_s &= 0.4 \\ \text{then } k_a &= 1.14 \\ C_d &= 0.146 & \text{then } C &= 0.146 \\ \text{or greater than} &= 0.008 \end{aligned}$$

Testing by Dr McManus University of Canterbury (Geotechnical Society Symposium, 2003):
found the friction co-efficient of slab on polythene on sand had peak friction co-efficients of 0.42
for an unloaded slab and 0.53 for a loaded slab. Residual friction coefficient
were 0.38 and 0.49 respectively.

Sliding resistance is given by:

$$R = 0 \quad Wt$$

not OK. $R < V$, provide shear keys**Building Weight**(only required if $R < V$)Building weight = 119 kN
(from Wall Loadings Sheet)Total floor slab area = 50 m²
slab perimeter = 27 medge beam width = 400 mm
topping thickness = 85 mm
pod depth = 220 mm
internal rib width = 100 mmpod dimension 1 = 1100 mm
pod dimension 2 = 1100 mmtotal volume = 15.3 m³
pod volume = 7.4 m³
net concrete volume = 7.9 m³
weight of slab = 193 kNlive load over slab, q_s = 1.5 kPa
 q_u = 0.6 kPa
 Q_u = 30 kNtotal weight, Wt = 342 kN
 C = 0.15
 V = 49.8 kNresistance provided, R = 0.0 kN
to be prov. by shear keys = 49.8 kNresistance from each shear key, F = 16.0 kN - see following page

number of shear keys required = 3

1. SHEAR CHECK (ULS)
Doc. Date: 9/3/1999

		SLIDING RESISTANCE	
<Job No.>: 76541 rev01 <Job Title>: Lot 70, 16 Oakland Place <Description>: Sliding Resistance		Date: 6/7/2019 Designer: AAF Checker: NL	
Horizontal Loadings	$V = C \cdot Wt$ $C = C_u(T_1)^Z \cdot R \cdot N(T,D)^{S_u} / k_u$		
assumed subsoil category (b)	Limit state: $\rightarrow$ ∇ $C_u(T_1) = 3$ Subsoil Class: D $Z = 0.24$ $R = 1$ $N(T,D) = 1$ $S_u = 0.925$ $\mu = 1.25$ assume $T_1 = 0.4$ then $k_u = 1.14$ $C_u = 0.583$ then $C = 0.583$ or greater than = 0.032		
Testing by Dr McManus University of Canterbury (Geotechnical Society Symposium, 2003) found the friction co-efficient of slab on polythene on sand had peak friction co-efficients of 0.42 for an unloaded slab and 0.53 for a loaded slab. Residual friction coefficient were 0.38 and 0.49 respectively.			
Polythene sheet should rip at design seismic loads as it is 0.2mm thin, and the sand will be acting as 'sandpaper'. Sliding resistance is given by:			
$R = 0.38 \cdot Wt$			
not OK. $R < V$, provide shear keys			
Building Weight	Building weight = 119 kN (from Wall Loadings Sheet)		
(only required if $R < V$)	Total floor slab area = 50 m ² slab perimeter = 27 m edge beam width = 400 mm topping thickness = 85 mm pod depth = 220 mm internal rib width = 100 mm pod dimension 1 = 1100 mm pod dimension 2 = 1100 mm total volume = 15.3 m ³ pod volume = 7.4 m ³ net concrete volume = 7.9 m ³ weight of slab = 193 kN live load over slab, $q_s = 1.5$ kPa $q_d = 0.6$ kPa $Q_d = 30$ kN total weight, $Wt = 342$ kN $C = 0.58$ $V = 199.3$ kN resistance provided, $R = 130.0$ kN to be prov. by shear keys = 69.4 kN resistance from each shear key, $F = 16.0$ kN - see following page number of shear keys required = 4		

		SHEAR PILE RESISTANCE	
<Job No.> <Job Title> <Description>	76541 rev01 Lot 70, 16 Oakland Place Shear Pile Resistance	Date: Designer: Checker:	6/7/2019 AAF NL
Pile strength	Pile diameter = 400 mm equivalent square = 283 mm reinforcement diameter = 12 mm (or 2HD12) reinforcement yield = 500 MPa $T = 56.5$ kN $p = 13.4$ mm $M_n = 7.6$ kNm say at $0.7 * M_n$, $M^* = 5.33$ kNm shear in concrete, $v_c = 0.35$ MPa $V_c = 28.16$ kN $0.7 * V_c = 19.71$ kN undrained soil strength, $c_u = 50$ kPa safety factor, $SF = 1.43$ $S_u = c_u / SF = 35.0$ kPa assuming $t_v = 17.5$ MPa		
Brom's method for analysis	resolve horizontally, $H_u = 9 S_u d f$ $f = H_u / 9 S_u d$ taking moments about lower hinge, and solving for H_u $H_u = S_u d^2 \{ 13.5 [\sqrt{1 + 16 M^* / 81.1 S_u d^3}] - 1 \}$ $H_u = 16.0$ kN $f = 0.13$ m <- this value to calculate depth of pile based on 'short pile' analysis		
'Short Pile' analysis	equivalent height, $e = 0.33$ m therefore $e' = e + 1.5d = 0.93$ m $\beta = H_u / 9 S_u d = 0.13$ m Taking moments about point O and simplifying gives: $L' = \beta [1 + \sqrt{2 (1 + (2 e' / \beta)) }]$ $= 0.84$ m Pile depth, $L = 1.30$ m Resistance provided by 400mm concrete shear key 1.3m into the ground: $F = 16.0$ kN		



WALL LOADINGS

<Job No.>: 76541 rev01
<Job Title>: Lot 70, 16 Oakland Place
<Description>: Loadings

Date: 6/7/2019
Designer: AAF
Checker: NL

Upper Floor

WALLS

Upper Floor Wall Height = m

Type 1

W1000C = 400 kg/m²
= 3.92 kPa
Length = m
Load = kN

Type 2

W1000C = 400 kg/m²
= 3.92 kPa
Length = m
Load = kN

Type 3

W1000C = 30 kg/m²
= 0.29 kPa
Length = m
Load = kN

Other (Specify Wall Weight)

Weight = kg/m²
= kPa
Length = m
Load = kN

FLOOR

Tributary Midfloor Area = m²

Floor Type
Topping depth

Dead Load = 0.38 kPa
Live Loading = kPa
Super Imposed Dead = kPa
Dead Load = kN
Live Load/m = kN

ROOF

Tributary Roof Area = m²

Light = 0.46 kPa

Live Loading = kPa
Dead Load = kN
Live Load = kN

Other Loads

Details

Dead Load = kN
Live Load = kN

																																																																																																	
WALL LOADINGS																																																																																																	
76541 rev01	Job Number 76541 rev01 Title: Lot 70, 16 Oakland Place																																																																																																
Ground Floor	Ground Floor Wall Height = 3.4 m <u>Type 1</u> <table style="width: 100%; font-size: x-small;"> <tr> <td>20 Series</td> <td>▼</td> <td>Light</td> <td>▼</td> </tr> <tr> <td>Load</td> <td>▼ =</td> <td>400</td> <td>kg/m²</td> </tr> <tr> <td></td> <td>=</td> <td>3.92</td> <td>kPa</td> </tr> <tr> <td>Length</td> <td>=</td> <td>6</td> <td>m</td> </tr> <tr> <td>Load</td> <td>=</td> <td>74</td> <td>kN</td> </tr> </table> <u>Type 2</u> <table style="width: 100%; font-size: x-small;"> <tr> <td>20 Series</td> <td>▼</td> <td>Light</td> <td>▼</td> </tr> <tr> <td>Load</td> <td>▼ =</td> <td>245</td> <td>kg/m²</td> </tr> <tr> <td></td> <td>=</td> <td>2.40</td> <td>kPa</td> </tr> <tr> <td>Length</td> <td>=</td> <td></td> <td>m</td> </tr> <tr> <td>Load</td> <td>=</td> <td></td> <td>kN</td> </tr> </table> <u>Type 3</u> <table style="width: 100%; font-size: x-small;"> <tr> <td>10 Series</td> <td>▼</td> <td></td> <td>▼</td> </tr> <tr> <td></td> <td>▼ =</td> <td>30</td> <td>kg/m²</td> </tr> <tr> <td></td> <td>=</td> <td>0.29</td> <td>kPa</td> </tr> <tr> <td>Length</td> <td>=</td> <td></td> <td>m</td> </tr> <tr> <td>Load</td> <td>=</td> <td></td> <td>kN</td> </tr> </table> <u>Other (Specify Wall Weight)</u> <table style="width: 100%; font-size: x-small;"> <tr> <td>Weight</td> <td>=</td> <td>38</td> <td>kg/m²</td> </tr> <tr> <td></td> <td>=</td> <td>0.37</td> <td>kPa</td> </tr> <tr> <td>Length</td> <td>=</td> <td>21</td> <td>m</td> </tr> <tr> <td>Load</td> <td>=</td> <td>27</td> <td>kN</td> </tr> </table> ROOF <table style="width: 100%; font-size: x-small;"> <tr> <td>Tributary Roof Area</td> <td>=</td> <td>50</td> <td>m²</td> </tr> <tr> <td>Load</td> <td>▼ =</td> <td>0.46</td> <td>kPa</td> </tr> <tr> <td>Live Loading</td> <td></td> <td></td> <td>kPa</td> </tr> <tr> <td>Dead Load</td> <td>=</td> <td>22.99</td> <td>kN</td> </tr> <tr> <td>Live Load</td> <td>=</td> <td></td> <td>kN</td> </tr> </table>	20 Series	▼	Light	▼	Load	▼ =	400	kg/m ²		=	3.92	kPa	Length	=	6	m	Load	=	74	kN	20 Series	▼	Light	▼	Load	▼ =	245	kg/m ²		=	2.40	kPa	Length	=		m	Load	=		kN	10 Series	▼		▼		▼ =	30	kg/m ²		=	0.29	kPa	Length	=		m	Load	=		kN	Weight	=	38	kg/m ²		=	0.37	kPa	Length	=	21	m	Load	=	27	kN	Tributary Roof Area	=	50	m ²	Load	▼ =	0.46	kPa	Live Loading			kPa	Dead Load	=	22.99	kN	Live Load	=		kN
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Wilton Joubert Ltd.

108 Lunn Ave
Auckland,

TC2 Raftfloor

GRAPHICAL RESULTS - Ld Comb 1 G & 0.3Q->Deflections
Engineer: Wilton Joubert Ltd



P-FRAME

Standard Version 9.02
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Wilton Joubert Ltd.

108 Lunn Ave
Auckland,

TC2 Raftfloor

GRAPHICAL RESULTS - Ld Comb 1 G & 0.3Q->Deflections

Engineer: Wilton Joubert Ltd



P-FRAME

Standard Version 9.02

© Copyright 1995-2009, CSC (UK) Ltd.

Wilton Joubert Ltd.

108 Lunn Ave
Auckland,

TC2 Raftfloor

GRAPHICAL RESULTS - Ld Comb 1 G & 0.3Q -> Shear Force (kN)
Engineer: Wilton Joubert Ltd



P-FRAME

Standard Version 9.02
© Copyright 1995-2009, CSC (UK) Ltd.

Wilton Joubert Ltd.

108 Lunn Ave
Auckland,

TC2 Raftfloor

GRAPHICAL RESULTS - Ld Comb 1 G & 0.3Q->Moment (kN-m)
Engineer: Wilton Joubert Ltd



P-FRAME

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Wilton Joubert Ltd.

108 Lunn Ave
Auckland,

TC2 Raftfloor

GRAPHICAL RESULTS - Ld Comb 1 G & 0.3Q->Deflections
Engineer: Wilton Joubert Ltd



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Wilton Joubert Ltd.

108 Lunn Ave
Auckland,

TC2 Raftfloor

GRAPHICAL RESULTS - Ld Comb 1 G & 0.3Q=>Shear Force (kN)
Engineer: Wilton Joubert Ltd



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108 Lunn Ave
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GRAPHICAL RESULTS - Ld Comb 1 G & 0.3Q-> Moment (kN-m)
Engineer: Wilton Joubert Ltd.



P-FRAME

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Consulting Engineers

Northland: 021 401386
Auckland: 09 5791114
Canterbury: 021 801554
Southern Lakes: 021 404586

www.wiltonjoubert.co.nz
email: jobs@wj.co.nz

Project Name: Lot 70, 16 Oakland Place

Job Number: 76541 rev01

Building height to apex:	6.0 m	Roof weight:	light
Roof height above eaves:	2.5 m	Cladding weights:	
Stud height:	2.4 m	single	light
		subfloor	light
Building length:	21.4 m		
Building width:	12.6 m		
Floor area:	180.0 m ²		
Roof pitch:	25.0 degrees		

Wind zone: High
Earthquake zone: 2

BU's required for Wind (From NZS3604:2011)

subfloor across	95 BU's/m
subfloor along	95 BU's/m

BU's required for EQ (From NZS3604:2011)

subfloor E =	12 BU's/m ²
--------------	------------------------

Total subfloor bracing demand - across :	2033 BU's
Total subfloor bracing demand - along :	1197 BU's
Total subfloor bracing demand - EQ:	2160 BU's

ACROSS

Design strength (kN):	6.0	Total
Number of SED piles:	18	
Bracing Capacity (BU):	2160.00	2160.00

ALONG

Design strength of Bracing Pile (kN):	6.0	
Number of SED Bracing piles:	18	
Total Bracing Capacity (BU):	2160.00	2160.00

GENERAL

1. Do not scale from drawings. These drawings are to be read in conjunction with the architectural drawings and all other related documents. Refer to architectural drawings for dimensions, details & finishes.
2. Contact the architect/engineer if any discrepancies are found.
3. Unless no circumstances shall polythene sheets be used. (Use recommended systems as per details provided)
4. OPM shall be in accordance with NZS-5624 (polythene sheet, max. 0.20mm). All penetrations through the OPM shall be sealed.
5. A layer of sand bedding or granular base (GAPTS) shall be placed, screeded and compacted over the building platform. The maximum thickness of this layer shall be no more than 50mm.
6. All service trenches shall be properly sealed and completed.
7. Where underfloor heating is retained, floor topping shall be increased to 110mm.
8. Concrete patching/repairing has not been allowed for in this design. Please advise Wilton Joubert Ltd if it is intended for the floor to be patch/repaired.
9. Polythene grade shall be 1100 x 1100 x 200mm.

CONCRETE

1. All concrete work and materials shall conform to NZS3109 and applicable building consent authority requirements.
2. No cuts shall be made to the floor other than those shown on the drawings.
3. Unless otherwise noted.

Concrete for slabs shall be:
20MPa minimum with Form K2211/1022 form mix or 25MPa minimum with Form K2211/1022 form mix (if in compliance zone D-1).

Concrete for footings shall be:
20MPa minimum or 25MPa minimum within compliance zone D (if in doubt, confirm with local BCA).

REINFORCEMENT

1. Unless otherwise specified, all reinforcement shall be Ductility Class E, in accordance with NZS-4671.
2. All joint diameters shall comply with NZS-3109. Re-bending of reinforcement is not permitted. Spot welding of reinforcement is not permitted.
3. All rebar reinforcement shall be Ductility Class E as per NZS-4671.
4. Unless otherwise specified by manufacturer provided specifications, rebar shall be supplied a minimum of 250mm or by a grid area 50mm whichever is greater.
5. Unless otherwise specified on plans, minimum covers are:
applied for earth: 25mm
exposed for subg: 50mm
protected by damp-proofing: 50mm
6. Unless otherwise specified, reinforcement type are:

Reinforcement Grade	Nomination	min. lap (whichever is greater)	concrete strength (MPa)
300	"6"	400 or min. 600mm	all blackfill, 20 and 25
500	"10"	700	all blackfill
500	"10"	560	20
500	"10"	500	25

SITE CONDITIONS

1. Design based on some representative:
By: Wilton Joubert Ltd
Ref: 1053 rev A
Drawn: April 2019

Typicality: Design based on all reasonably material removed and within scope above building platform with a minimal ultimate bearing capacity of 300 kPa, subject to engineer's confirmation. Design based on TC2 requirements as detailed in MSE Guidance Document December 2012.

INSPECTIONS

1. Check the BUILDING CONSENT CONDITIONS for any inspections that are required by the Building Consent Authority (BCA).
2. If BCA requires PM to be issued for inspections, a local engineer may be engaged to carry out such inspections and issue a PM accordingly.

NOTES

WILTON JOUBERT

Consulting Engineers

Northland: 09 845 4008
Auckland: 09 827 0206
Canterbury: 03 324 0663
Southern Lakes: 03 433 9709
www.wiltonjoubert.co.nz

PROJ
Proposed Residence
Lot 70
16 Oakland Place
Napier, Bay of Plenty

Rev 1.0
General Notes

APP	WJ
NT	AW
Job # 76541	50



- | Test flow (gallons per hour) | Flowback pressure (psi) |
|------------------------------|-------------------------|
| 20.2 | 170 |
| 14.2 | 200-210 |
| 9.5 | 187-190 |
| 4.75 | 175-180 |
| 2.38 | 170-175 |
| 0.95 | 165-170 |
| 0.4 | 160-162 |
| 0.2 | 157-161 |
| 0.12 | 155-160 |
| 0.055 | 155 |

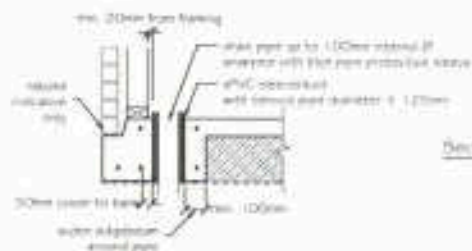


Tonkin & Taylor
Sustainable & Innovative Investment

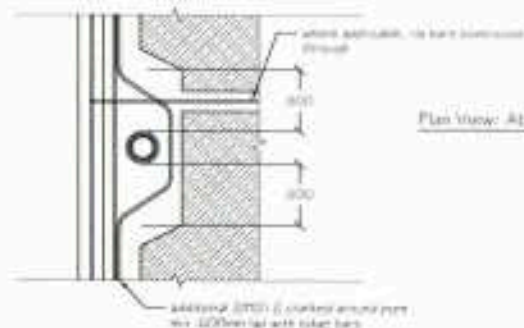
1. ☐ Australia 2. ☐ Europe 3. ☐ Asia Pacific
4. ☐ North America 5. ☐ Middle East 6. ☐ Africa

PIONEER PROPERTY TRUST
WESTERN ROAD, NGONGOTARA
STAGE THREE GEOTECHNICAL COMPLETION REPORT
Indicative Foundation Design

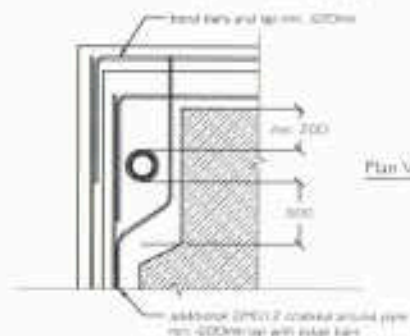
Figure 10



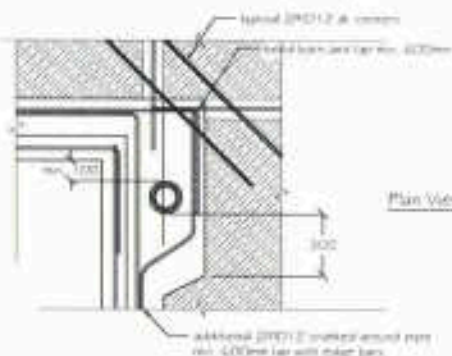
Section View: At Edge



Plan View: At Edge

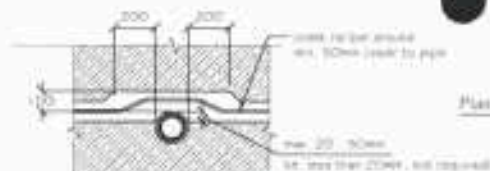


Plan View: At Open Corner

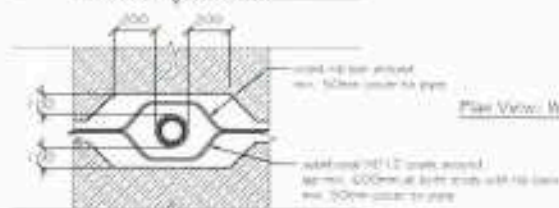


Plan View: At Closed Corner

Typical Detail Around Pipes
Raftfloor Edge Beam

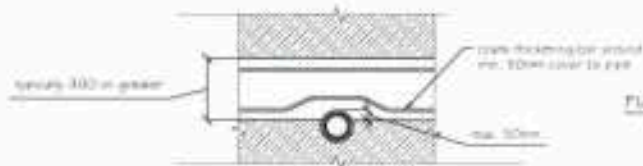


Plan View: At Rib Edge

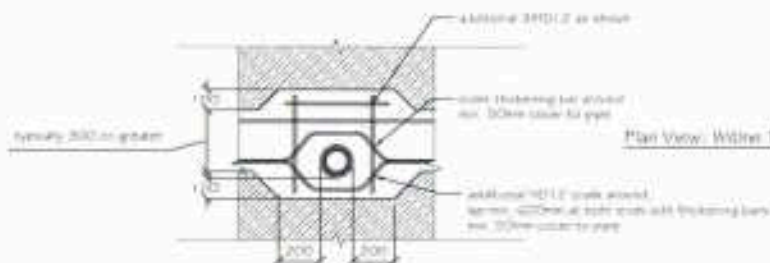


Plan View: Within Rib

Typical Detail Around Pipes
Raftfloor Internal Ribs



Plan View: At Thickening Edge



Plan View: Within Thickening

Typical Detail Around Pipes
Raftfloor Internal Thickenings

NOTES:

These details are applicable where plumbing/services are conveyed underground. Services are to be taken through polystyrene pods as much as possible. If this is unavoidable, it may be taken through ribs/thickenings, provided the details (or similar in principle) on this sheet are used.

All service trench backfill shall be properly compacted.

Member sizes and reinforcing shown are indicative only, details shown on raftslab plan & details shall take precedence over the details shown here.

1005

WILTON JOUBERT
Consulting Engineers

Northland 09 945 4188
Auckland-Southern 09 827 0199
Christchurch 03 624 063
Southern Islands 03 443 8300
www.wiltonjoubert.co.nz

Generic Raft Slab

Typical Pipe Details

D1



New Zealand
Institute of Architects
Incorporated



Building Code Clause(s) **B1**

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.engineeringnz.org)

ISSUED BY: Wilton Joubert Ltd.

(Design Firm)

TO: Mark Lam c/o Gourlay Homes

(Owner/Developer)

TO BE SUPPLIED TO: Rotorua District Council

(Building Consent Authority)

IN RESPECT OF: structural design services

(Description of Building Work)

AT: 16 Oakland Place

(Address)

Town/City: Ngongotaha

LOT 70

DP

SO

(Address)

We have been engaged by the owner/developer referred to above to provide:

Timber subfloor bracing and footings, TC2 Raftfloor design

(Extent of Engagement)

services in respect of the requirements of Clause(s) **B1** of the Building Code for:

☐ All or ☒ Part only (as specified in the attachment to this statement), 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 **B1/VM1, VM4** of
(verification method/acceptable solution)

☒ Alternative solution as per the attached schedule **MBIE Guidance Document December 2012**

The proposed building work covered by this producer statement is described on the drawings titled:

Lot 70 16 Oakland Place Ngongotaha, Bay of Plenty and numbered **S0-S1, D1, Figure 10**
together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:

- (i) Site verification of the following design assumptions as per Geotechnical Assessment by O'Brien Geotech. Ref: 583 Rev A Date: April 2019
(ii) 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 following level of construction monitoring/observation:

☐ CM1 ☒ CM2 ☐ CM3 ☐ CM4 ☐ CM5 (Engineering Categories) or ☐ as per agreement with owner/developer (Architectural)

I, **David Lau** am: ☒ CPEng **221906** # ☐ Reg Arch #
(Name of Design Professional)

I am a member of: ☒ Engineering New Zealand ☐ NZIA and hold the following qualifications: **BE(Hons), PhD, CPEng, CPEng, InfPE**

The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.

The Design Firm is a member of ACENZ: ☐

SIGNED BY: **David Lau**

(Name of Design Professional)

(Signature)

ON BEHALF OF: Wilton Joubert Ltd.

(Design Firm)

Date: **19/09/2019**

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.

THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, ENGINEERING NEW ZEALAND AND NZIA

To the BCA

Site address: 16 Oakland Place

Dear Sir / Madam,

B2 Compliance

You have requested a Producer Statement for Design – PS1 for Clause B2 of the Building Code – Structural Durability. Based on advice by the Institution of Professional Engineers New Zealand (IPENZ), we are not able to provide this because there is no effective verification method for B2 contained within the Building Code.

However, we can confirm that for the structural elements shown in our documentation:

Timber

Timber treatment has been selected in accordance with Table 1A of B2/AS1. In general this is already covered by the submitted architectural drawings.

Concrete & Masonry

Concrete covers have been selected in accordance with NZS3101, Part 1, Section 3. Masonry as per NZS4230, Table 4.1.

Steel

Typical steel fixings and connections for domestic type buildings to comply with NZS3404: 2011. Structural steel protection as specified in building consent documentation (by others) and to comply with SNZ TS 3404:2018.

We trust this provides the information that you are seeking.

Yours faithfully



David Lau, Wilton Joubert Ltd.

Dated: 19/09/2019

PRODUCER STATEMENTS – Advisory Note

Producer Statements shall be submitted to territorial authorities or building consent authority in order for Code of Compliance Certificates to be issued. The requirement for consultants to issue the related Producer Statements may appear as a condition under the building consent documents or as a separate letter from the territorial authority or building certifier. **It is the owner's (or consent applicant) responsibility to check the building consent documentation and notify Wilton Joubert Ltd. in relation to the requirement for construction inspections required (and the subsequent PS4: Producer Statement for Construction Review) as stated on the consent documents. Please note, we cannot issue PS4 if we did not carry out the inspection.**

In order to secure our inspection services, it is strongly recommended that Wilton Joubert Ltd. be given at least 48 hours notice prior to time of inspection. Our inspections are limited to items that have been designed and detailed by us. We are also unable to inspect non-consented or unauthorised work. Building consented, stamped plans with consent numbers (or legible copy of the same) including amendments where applicable shall be made available on site during inspections.

In some cases due to the distance of the job from our offices, it may be more practical and cost effective to contact a local professional engineer to carry out the inspection, who may contact us with any questions that may arise. The engineer who carried out the inspection would subsequently be responsible for the issue of the producer statement for construction review.

The costs associated with site inspections and issuing of Producer Statements are separate from any previous work that we have been engaged for, such as engineering design of works. The costs for carrying out the inspections and related work are based on time spent travelling to site, time on site and other associated costs. Please contact us for an estimate of costs. Our assumptions are that the person(s) who arranged the inspection is responsible for payment of the fees, unless otherwise stated at time of engagement.

Memorandum from licensed building practitioner: Certificate of design work

Section 45 and section 30C, Building Act 2004

Please fill in the form as fully and correctly as possible.

If there is insufficient room on the form for requested details, please continue on another sheet and attach the additional sheet(s) to this form.

THE BUILDING

Street address: 16 Oakland Place

Suburb:

Town/City: Ngongotaha

Postcode:

THE OWNER(S)

Name(s):

Mailing address:

Suburb:

PO Box/Private Bag:

Town/City:

Postcode:

Phone number:

Email address:

BASIS FOR PROVIDING THIS MEMORANDUM

I am providing this memorandum in my role as the: Please tick the option that applies ☒

- ☐ **sole** designer of all of the RBW design outlined in this memorandum – I carried out all of the RBW design work myself – no other person will be providing any additional memoranda for the project
- ☐ **lead** designer who carried out some of the RBW design myself but also supervised other designers – this memorandum covers their RBW design work as well as mine, and **no other** person will be providing any additional memoranda for the project
- ☐ **lead** designer for all but specific elements of RBW – this memorandum only covers the RBW design work that I carried out or supervised and the **other** designers will provide their own memorandum relating to their specific RBW design
- ☒ **specialist** designer who carried out specific elements of RBW design work as outlined in this memorandum – other designers will be providing a memorandum covering the remaining RBW design work

IDENTIFICATION OF DESIGN WORK THAT IS RESTRICTED BUILDING WORK (RBW)

I David Lau carried out / supervised the following design work that is restricted building work

PRIMARY STRUCTURE: B1

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ☒ if included. Cross ☐ if excluded	If appropriate, provide details of the RBW	Tick ☒ whether you carried out this design work or supervised someone else carrying out this design work	If appropriate, specify references
All RBW design work relating to B1	☒	☐ Carried out ☐ Supervised	
Foundations and subfloor framing	Timber subfloor bracing and footings, TC2 Raftfloor design (B1)	☐ Carried out ☒ Supervised	S0-S1, D1, Figure 10

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ☒ if included. Cross ☒ if excluded	If appropriate, provide details of the RBW	Tick ☒ whether you carried out this design work or supervised someone else carrying out this design work	If appropriate, specify references
Walls ☒		☐ Carried out ☐ Supervised	
Roof ☒		☐ Carried out ☐ Supervised	
Columns and beams ☒		☐ Carried out ☐ Supervised	
Bracing ☒		☐ Carried out ☐ Supervised	
Other ☒		☐ Carried out ☐ Supervised	

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ☒ if included. Cross ☒ if excluded.	If appropriate, provide details of the RBW	Tick ☒ whether you carried out this design work or supervised someone else carrying out this design work.	If appropriate, specify references
EXTERNAL MOISTURE MANAGEMENT SYSTEMS: E2			
All RBW design work relating to E2 ☒		☐ Carried out ☐ Supervised	
Damp proofing ☒		☐ Carried out ☐ Supervised	
Roof cladding or roof cladding system ☒		☐ Carried out ☐ Supervised	
Ventilation system (for example, subfloor or cavity) ☒		☐ Carried out ☐ Supervised	
Wall cladding or wall cladding system ☒		☐ Carried out ☐ Supervised	
Waterproofing ☒		☐ Carried out ☐ Supervised	
Other ☒		☐ Carried out ☐ Supervised	

Design work that is RBW	Description of RBW	Carried out or supervised	Reference to plans and specifications
Tick ☒ if included. Cross ☒ if excluded	If appropriate, provide details of the RBW	Tick ☒ whether you carried out this design work or supervised someone else carrying out this design work.	If appropriate, specify references
FIRE SAFETY SYSTEMS: C1 - C6			
Emergency warning systems Evacuation and fire service operation systems ☒ Suppression or control systems Other		☐ Carried out ☐ Supervised	
Note: The design of fire safety systems is only restricted building work when it involves small-to-medium apartment buildings as defined by the Building (Definition of Restricted Building Work) Order 2011.			
WAIVERS AND MODIFICATIONS			
Waivers or modifications of the Building Code are required. ☐ Yes ☒ No			
If Yes, provide details of the waivers or modifications below:			
Clause	Waiver/modification required		
List relevant clause numbers of building code	Specify nature of waiver or modification of building code required		

ISSUED BY

Name and contact details of the licensed building practitioner who is licensed to carry out or supervise design work that is restricted building work.

Name **David Lau**

LBP or Registration number: **221906**

The practitioner is a: ☐ Design LBP ☐ Registered architect ☒ Chartered professional engineer

Design Entity or Company (optional): **Wilton Joubert Ltd.**

Mailing address (if different from below): **PO Box 11381, Ellerslie, Auckland 1542**

Street address/Registered office: **108 Lunn Avenue**

Suburb: **Mt. Wellington**

Town/City: **Auckland**

PO Box/Private Bag:

Postcode:

Phone number: **09 527 0196**

Mobile:

After hours:

Fax:

Email address: **jobs@wjl.co.nz**

Website: **www.wiltonjoubert.co.nz**

DECLARATION

I, **David Lau** LBP, state that I have applied the skill and care reasonably required of a competent design professional in carrying out or supervising the Restricted Building Work (RBW) described in this form, and that based on this, I also state that the RBW:

- Complies with the building code, or
- ~~Complies with the building code subject to any waiver or modification of the building code recorded on this form~~

Signature: _____



Date: **19/09/2019**

Memorandum from licensed building practitioner: Certificate of design work

Section 45 and Section 30C, Building Act 2004

Please fill in the form as fully and correctly as possible.

If there is insufficient room on the form for requested details, please continue on another sheet and attach the additional sheet(s) to this form.

THE BUILDING

Street address: 16 Oaklands Place

Suburb: Ngongotaha

Town/City: Rotorua

Postcode: 3010

THE OWNER

Name(s): Mark Lam

Mailing address:

Suburb:

PO Box/Private Bag:

Town/City:

Postcode:

Phone number:

Email address:

BASIS FOR PROVIDING THIS MEMORANDUM

I am providing this memorandum in my role as the: Please tick the option that applies (✓)	
☐	sole designer of all of the RBW design outlined in this memorandum – I carried out all of the RBW design myself – no other person will be providing any additional memoranda for the project
☐	lead designer who carried out some of the RBW design myself but also supervised other designers – this memorandum covers their RBW design work as well as mine, and no other person will be providing any additional memoranda for the project
☒	lead designer for all but specific elements of RBW – this memorandum only covers the RBW design work that I carried out or supervised and the other designers will provide their own memoranda relating to their specific RBW design
☐	specialist designer who carried out specific elements of RBW design work as outlined in this memorandum – other designers will be providing a memorandum covering the remaining RBW design work

IDENTIFICATION OF DESIGN WORK THAT IS RESTRICTED BUILDING WORK (RBW)

I Mark Bishop of Mark Bishop Architecture Limited carried out / supervised the following design work that is restricted building work

PRIMARY STRUCTURE: B1

Design work that is restricted building work	Description	Carried out/ supervised	Reference to plans and specifications
Tick (✓) if included Cross (X) if excluded	[If appropriate, provide details of the restricted building work]	[Specify whether you carried out this design work or supervised someone else carrying]	[If appropriate, specify references]

		<i>out this design work]</i>	
--	--	------------------------------	--

Primary structure

All RBW Design work relating to B1	()		() Carried out () Supervised	
Foundations and subfloor framing	(✓)	<i>Subfloor framing</i>	() Carried out (✓) Supervised	07
Walls	(✓)	<i>NZS3604</i>	() Carried out (✓) Supervised	08, 13-16
Roof	(✓)	<i>NZS3604 MiTek SED</i>	() Carried out (✓) Supervised	10,
Columns and beams	()		() Carried out () Supervised	
Bracing	(✓)	<i>EzyBrace</i>	() Carried out (✓) Supervised	09, 28
Other	()		() Carried out () Supervised	

EXTERNAL MOISTURE MANAGEMENT SYSTEMS: E2

All RBW design work relating to E2	(✓)		() Carried out (✓) Supervised	
Damp proofing	(✓)	<i>DPC, DPM</i>	() Carried out (✓) Supervised	06, 13-16
Roof cladding or roof cladding system	(✓)	<i>Gerard Metal tile roofing</i>	() Carried out (✓) Supervised	04, 05, 13-16, 22
Ventilation system (for example, subfloor or cavity)	()	<i>Cladding cavity</i>	() Carried out (✓) Supervised	13-19
Wall cladding or wall cladding system	(✓)	<i>Timber weatherboard</i>	() Carried out (✓) Supervised	04, 05, 13-19
Waterproofing	()		() Carried out () Supervised	
Other	()		() Carried out () Supervised	

FIRE SAFETY SYSTEMS: C1 – C6

Emergency warning systems, evacuation and fire service operation systems, suppression or control systems, or	(✓)	<i>Smoke Alarms</i>	() Carried out (✓) Supervised	11
--	-----	---------------------	-----------------------------------	----

other			
-------	--	--	--

Note: The design of fire safety systems is only restricted building work when it involves small-to-medium apartment buildings as defined by the Building (Definition of Restricted Building Work) Order 2011.

Note: continue on another page if necessary.

WAIVERS AND MODIFICATIONS

Waivers or modifications of the building code are required () Yes (✓) No

If Yes, provide details of the waivers or modifications below:

Clause	Waiver/modification required
<i>[List relevant clause numbers of building code]</i>	<i>[Specify nature of waiver or modification of building code]</i>

Note: continue on another page if necessary.

ISSUED BY

Name: Mark Bishop	LBP or Registration number: 113995
The practitioner is a: (✓) Design LBP () Registered architect () Chartered professional engineer	
Design Entity or Company (optional): Mark Bishop Architecture Limited	
Mailing address (if different from below):	
Street address / Registered office: 1109 Pukuatua Street	
Suburb:	Town/City: Rotorua
PO Box/Private Bag: PO Box 908 ROTORUA	Postcode: 3010
Phone number: 07 9299807	Mobile: 021 244 0637
After Hours:	Fax:
Email address: mark@markbishop.co.nz	Website: www.markbishop.co.nz

DECLARATION

I Mark Bishop of Mark Bishop Architecture Ltd, LBP 113995,

state that I have applied the skill and care reasonably required of a competent design professional in carrying out or supervising the Restricted Building Work (RBW) described in this form, and that based on this, I also state that the RBW:

- Complies with the building code; or
- Complies with the building code subject to any waiver or modification of the building code recorded on this form.

Signature: 

Date: 11.10.2019



BRANZ Appraised

Appraisal No. 957 [2017]

HYDRATHANE INTERIOR WATERPROOFING MEMBRANE

Appraisal No. 957 [2017]

BRANZ Appraisals

Technical assessment of products
for building and construction



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Product

- 1.1 Hydrathane Interior Waterproofing Membrane is a liquid-applied waterproofing membrane for use under ceramic or stone tile finishes in internal wet areas.

Scope

- 2.1 Hydrathane Interior Waterproofing Membrane has been appraised for use as a waterproofing membrane for the internal wet areas of buildings, within the following scope:
- on floor substrates of concrete, plywood, compressed fibre cement sheet and fibre cement sheet tile underlay, and on wall substrates of concrete, concrete masonry, wet area fibre cement sheet lining systems and wet area plasterboard lining systems; and,
 - when protected from physical damage by ceramic or stone tile finishes; and,
 - where floors are designed and constructed such that deflections do not exceed 1/360" of the span.
- 2.2 The use of Hydrathane Interior Waterproofing Membrane on concrete slabs where hydrostatic or vapour pressure is present from below is outside the scope of this Appraisal.
- 2.3 Movement and control joints in the substrate must be carried through the membrane and tile finish. The design and construction of the substrate and movement and control joints is specific to each building, and is therefore the responsibility of the building designer and building contractor and is outside the scope of this Appraisal.
- 2.4 The ceramic or stone tile finishes are outside the scope of this Appraisal.
- 2.5 The membrane must be installed by trained installers approved by Construction Chemicals NZ Ltd.

Building Regulations

New Zealand Building Code (NZBC)

- 3.1 In the opinion of BRANZ, Hydrathane Interior Waterproofing Membrane, if designed, used, installed and maintained in accordance with the statements and conditions of this Appraisal, will meet the following provisions of the NZBC:
- Clause B2 DURABILITY:** Performance B2.3.1 (b) 15 years and B2.3.2 Hydrathane Interior Waterproofing Membrane meets these requirements. See Paragraph 9.1.
- Clause E3 INTERNAL MOISTURE:** Performance E3.3.6 Internal wet area floors and walls incorporating Hydrathane Interior Waterproofing Membrane meet this requirement. See Paragraphs 11.1-11.5.
- Clause F2 HAZARDOUS BUILDING MATERIALS:** Performance F2.3.1 Hydrathane Interior Waterproofing Membrane meets this requirement and will not present a health hazard to people.

Technical Specification

4.1 Materials supplied by Construction Chemicals NZ Ltd are as follows:

- **Hydrathane Interior Waterproofing Membrane** is a Class III, flexible, fast curing one part, waterbased polyurethane waterproofing membrane. It is supplied as a pink liquid in 4 and 15 litre containers.
- **Primebond** is a synthetic, acrylic based liquid, which is used for priming all internal porous surfaces. It is supplied in 1, 5 and 20 litre containers.
- **Primax** is a two pack, water resistant bonding primer for internal porous and low porosity substrates. It is supplied in a 5 lt/5 kg kit.
- **Bond Breaker Tape** is a fibre reinforced plastic tape installed to accommodate normal substrate differential movement. It is supplied in a roll 48 mm wide x 25 m long.
- **Reemat** is an alkali-resistant reinforcing fibre installed over the Bond Breaker Tape to increase strength and ensure correct membrane thickness. It is supplied in a roll 140 mm wide x 100 m long.

Handling and Storage

5.1 All materials must be stored inside, up off concrete floors, in dry conditions, out of direct sunlight and freezing conditions. The membrane products have a shelf life of 12 months from date of manufacture in the original unopened packaging. Once opened, the products must be used within 3 months.

Technical Literature

6.1 Refer to the Appraisals listing on the BRANZ website for details of the current Technical Literature for the Hydrathane Interior Waterproofing Membrane. The Technical Literature must be read in conjunction with this Appraisal. All aspects of design, use, installation and maintenance contained in the Technical Literature and within the scope of this Appraisal must be followed.

Design Information

General

- 7.1 Hydrathane Interior Waterproofing Membrane is for use in buildings where an impervious waterproof membrane is required to floors and walls to prevent damage to building elements and adjoining areas.
- 7.2 The membrane must be protected from physical damage by the application of ceramic or stone tile finishes.
- 7.3 Movement and control joints may be required depending on the shape and size of the building or room, and the tile finish specified. Design guidelines can be found in the BRANZ Good Practice Guide: Tiling.
- 7.4 Timber framing systems must comply with NZS 3604, or where specific engineering design is used, the framing shall be of at least equivalent stiffness to the framing provisions of NZS 3604, or comply with the serviceability criteria of AS/NZS 1170. In all cases, framing must be provided so that the maximum span of the substrate as specified by the substrate manufacturer is met and all sheet edges are fully supported. Timber framing systems supporting the substrates must be constructed such that deflections do not exceed $1/360^{th}$ of the span. Where NZS 3604 is used, the allowable joist spans given in Table 7.1 shall be reduced by 20%.

Substrates

Plywood

- B.1 Plywood must be a minimum of 17 mm thick complying with AS/NZS 2269, CD Grade Structural with the sanded C face upwards and treated to H3 (CCA treated). LDSP treated plywood must not be used.
- B.2 The plywood must be laid with the face grain at right angles to the floor joists. Joists must be at 400 mm centres maximum and the edges of the sheets must be supported with blocking or framing. The plywood must be fixed with 10 g x 50 mm stainless steel countersunk head screws at 150 mm centres along the sheet edges and 200 mm centres to all framing through the body of the sheets.

Fibre Cement Compressed Sheet/ Fibre Cement Sheet Tile Underlay

- B.3 Fibre cement compressed sheet and tile underlay must be manufactured to comply with the requirements of AS/NZS 2908.2 and must be specified by the manufacturer as being suitable for use as a wet area membrane substrate. Installation must be carried out in accordance with the instructions of the manufacturer.

Concrete and Concrete Masonry

- B.4 Concrete and concrete masonry substrates must be to a specific engineering design meeting the requirements of the NZBC, such as concrete construction to NZS 3101, concrete slab-on-ground to NZS 3604 or NZS 4229, and concrete masonry to NZS 4229 and NZS 4230.

Wet Area Wall Linings

- B.5 Plasterboard wall linings must be manufactured to comply with AS/NZS 2588 and be suitable for use in internal wet areas.
- B.6 Fibre cement sheet must be suitable for use in wet areas and comply with AS/NZS 2908.2.
- B.7 Installation of plasterboard or fibre cement wall linings must be carried out in accordance with the instructions of the manufacturer.

Durability

Serviceable Life

- D.1 Hydrathane Interior Waterproofing Membrane, when subjected to normal conditions of environment and use, is expected to have a serviceable life of at least 15 years and be compatible with ceramic or stone tile finishes with a design serviceable life of 15-25 years.

Maintenance

- M.1 No maintenance of the membrane will be required provided significant substrate movement does not occur and the tile finish remains intact. Regular checks must be made of the tiled areas to ensure they are sound and will not allow moisture to penetrate. Any cracks or damage must be repaired immediately by repairing the tiles, grout and sealant.
- M.2 In the event of damage to the membrane, the tiling must be removed and the membrane repaired by removing the damaged portion and applying a patch as for new work.
- M.3 Drainage outlets must be maintained to operate effectively, and tile finishes must be kept clean.

Internal Moisture

- 11.1 Hydrathane Interior Waterproofing Membrane is impervious to water, and when appropriately designed and installed will prevent water from penetrating behind linings or entering concealed spaces.
- 11.2 Surfaces must be finished with ceramic or stone tiles. A means of compliance with NZBC Clause E3.3.3 and E3.3.4 is given in NZBC Acceptable Solution E3/AS1 Paragraph 3.1.1 (b), 3.1.2 (b) and 3.3.1 (b).
- 11.3 Falls in showers and shower areas must be a minimum of 1 in 50. In unenclosed showers, falls must extend a minimum of 1500 mm out from the shower rose. Floor wastes and drainage flanges must be provided and the floor must fall to the outlet.
- 11.4 Hydrathane Interior Waterproofing Membrane is suitable for use to contain accidental overflow to meet NZBC Clause E3.3.2. A means of compliance for overflow is given in NZBC Acceptable Solution E3/AS1, Section 2.
- 11.5 The waterproofing membrane must completely cover shower bases, and for unenclosed showers it must extend a minimum of 1500 mm out from the shower rose. Further design guidance on waterproofing wet areas, including waterproofing walls and junctions can be obtained from AS 3740, BRANZ Good Practice Guide: Tiling, and the flooring and wall lining manufacturers.
- 11.6 Where water resistant wall finishes such as prefinished sheet materials are used, they must overlap the membrane a minimum of 30 mm.

Installation Information

Installation Skill Level Requirement

- 12.1 Installation of the membrane must be completed by trained installers, approved by Construction Chemicals NZ Ltd.
- 12.2 Installation of substrates must be completed by, or under the supervision of, licensed Building Practitioners with the relevant Licence Class, in accordance with instructions given within the Construction Chemicals NZ Ltd Technical Literature and this Appraisal.

Preparation of Substrates

- 13.1 Substrates must be dry, clean and stable before installation commences. Surfaces must be even and free from ribs, sharp edges, dust, dirt or other materials such as oil, grease or concrete formwork release agents.
- 13.2 The relative humidity of concrete substrates must be 75% or less before membrane application. The concrete can be checked for dryness by using a hygrometer as set out in BRANZ Bulletin No. 585.
- 13.3 All voids, cracks, holes, joints and excessively rough areas must be filled to achieve an even and uniform surface. Junctions of substrate abutments, such as at wall/floor and wall/wall junctions must have reinforcements installed as set out in the Technical Literature.
- 13.4 Substrates must be primed with a primer as specified by Construction Chemicals NZ Ltd and allowed to dry fully before the membrane is installed.

Membrane Installation

- 14.1 Installation must not be undertaken where the substrate surface temperature is below 5°C or above 35°C.
- 14.2 Hydrathane Interior Waterproofing Membrane must be thoroughly stirred before application.
- 14.3 The membrane must be applied in a minimum of two coats at the rates set out in the Technical Literature. Subsequent coats must be applied in a different direction to the previous coat. The total finished thickness of the membrane must be 2.0 mm minimum.
- 14.4 Membrane application can be completed by roller [medium/long nap] or brush [long bristle].
- 14.5 The installation and use of any reinforcing must comply with the instructions in the Technical Literature.
- 14.6 Clean up may be undertaken with water.

Tiling

- 15.1 The membrane must be fully cured before tiling. The cured membrane must be protected at all times to prevent mechanical damage, so may require temporary covers until the finishing is completed.
- 15.2 Tiling must be undertaken in accordance with AS 3958.1 and the BRANZ Good Practice Guide: Tiling. The compatibility of the tile adhesive must be confirmed with the adhesive manufacturer or Construction Chemicals NZ Ltd.

Inspections

- 16.1 Critical areas of inspection are:
 - Construction of substrates, including crack control and installation of bond breakers and movement control joints.
 - Moisture content of the substrate prior to the application of the membrane.
 - Acceptance of the substrate by the membrane installer prior to application of the membrane.
 - Installation of the membrane to the supplier's instructions, particularly installation to the correct thickness and use of reinforcement.
 - Membrane curing and integrity prior to the installation of tiles including protection from mechanical damage during curing and prior to tile installation.

Health and Safety

- 17.1 Safe use and handling procedures for the membrane are provided in the Technical Literature. The materials must be used in conjunction with the relevant Material Safety Data Sheet.

Basis of Appraisal

The following is a summary of the technical investigations carried out:

Tests

- 18.1 The following testing of Hydrathane Interior Waterproofing Membrane has been undertaken by the following organisations:
 - CSIRO, Australia – Testing to the requirements of AS/NZS 4858: 2004 including Appendix A the effect of heat ageing, bleach, detergent and water on tensile and elongation, Water Vapour Transmission to ASTM E96-92, Appendix B, resistance of waterproofing membranes to cyclic movement, and water absorption.
 - BRANZ – adhesion to various substrates and low temperature flexibility.
- 18.2 The above test methods and results have been reviewed by BRANZ and found to be satisfactory.

Other Investigations

- 19.1 An assessment was made of the durability of Hydrathane Interior Waterproofing Membrane by BRANZ technical experts.
- 19.2 Site inspections were carried out by BRANZ to examine the practicability of installation.
- 19.3 The Technical Literature has been examined by BRANZ and found to be satisfactory.

Quality

- 20.1 The manufacture of the membrane has been examined by BRANZ and details regarding the quality and composition of the materials used were obtained by BRANZ and found to be satisfactory.
- 20.2 The quality of supply to the market is the responsibility of Construction Chemicals NZ Ltd.
- 20.3 Designers are responsible for the building design, and building contractors are responsible for the quality of installation of the framing systems and substrate.
- 20.4 Quality on site is the responsibility of the trained installers, approved by Construction Chemicals NZ Ltd.
- 20.5 Building owners are responsible for the maintenance of the ceramic tiles in accordance with the instructions of Construction Chemicals NZ Ltd.

Sources of Information

- AS 3740 - 2010 Waterproofing of wet areas within residential buildings.
- AS 3958.1: 2007 Ceramic Tiles - Guide to the installation of ceramic tiles.
- AS/NZS 1170: 2002 Structural design actions
- AS/NZS 2908.2: 2000 Cellulose-cement products - Flat sheet.
- AS/NZS 4858 - 2004 Wet area membranes.
- AS/NZS 2269: 2012 Plywood - Structural.
- Good Practice Guide: Tiling, BRANZ, April 2015.
- NZS 3101: 2006 Concrete Structures Standard.
- NZS 3602: 2003 Timber and wood-based products for use in buildings.
- NZS 3604: 2011 Timber framed buildings.
- NZS 4229: 2013 Concrete masonry buildings not requiring specific engineering design.
- NZS 4230: 2004 Code of practice for the design of masonry structures.
- Ministry of Business, Innovation and Employment Record of amendments - Acceptable Solutions, Verification Methods and handbooks.
- The Building Regulations 1992.

In the opinion of BRANZ, **Hydrathane Interior Waterproofing Membrane** is fit for purpose and will comply with the Building Code to the extent specified in this Appraisal provided it is used, designed, installed and maintained as set out in this Appraisal.

The Appraisal is issued only to **Construction Chemicals NZ Ltd**, and is valid until further notice, subject to the Conditions of Appraisal.

Conditions of Appraisal

1. This Appraisal:
 - a) relates only to the product as described herein;
 - b) must be read, considered and used in full together with the Technical Literature;
 - c) does not address any Legislation, Regulations, Codes or Standards, not specifically named herein;
 - d) is copyright of BRANZ.
2. **Construction Chemicals NZ Ltd:**
 - a) continues to have the product reviewed by BRANZ;
 - b) shall notify BRANZ of any changes in product specification or quality assurance measures prior to the product being marketed;
 - c) abides by the BRANZ Appraisals Services Terms and Conditions;
 - d) warrants that the product and the manufacturing process for the product are maintained at or above the standards, levels and quality assessed and found satisfactory by BRANZ pursuant to BRANZ's Appraisal of the product.
3. BRANZ makes no representation or warranty as to:
 - a) the nature of individual examples of, batches of, or individual installations of the product, including methods and workmanship;
 - b) the presence or absence of any patent or similar rights subsisting in the product or any other product;
 - c) any guarantee or warranty offered by **Construction Chemicals NZ Ltd**.
4. Any reference in this Appraisal to any other publication shall be read as a reference to the version of the publication specified in this Appraisal.
5. BRANZ provides no certification, guarantee, indemnity or warranty, to **Construction Chemicals NZ Ltd** or any third party.

For BRANZ



Chelydra Percy
Chief Executive
Date of Issue:
10 July 2017

Hydrathane

Water-based polyurethane waterproofing membrane

Packaging



Mixing



Application



Uses



Substrates

Concrete,
Building boards,
Brick, Block,
Render,
Cement sheet,
Flooring

Description

A one-part water-based polyurethane waterproofing membrane which is flexible, tough and fast curing (capable of drying in 6-12 hours @ 23°C @ 50% relative humidity). The cured membrane will remain tough, elastic and can bridge and seal hairline cracks.

Uses

A waterproofing membrane for internal wet areas e.g. bathrooms, showers, laundries, tiled or screeded roof tops, balconies and below ground applications e.g. retaining walls and planter boxes (subject to protection from damage and adequately drained) on concrete, render, screeds and approved wet area floor and wall building boards. I.e. compressed cement sheet, fibre cement sheeting and wet area plasterboard.

Features

- Waterproof and tile in the same day
- A tough elastic membrane
- UV stable
- Suitable for maintenance foot traffic
- Compatible with **Construction Chemicals** ceramic tile adhesives
- Does not stain tile grout or marble
- Fast drying - trafficable after 6-12 hours

Coverage (Approximate)

Floors – Apply two wet coats 0.8mm (800µm) to the floor and 100mm up the surrounding walls to obtain a 1mm (1000µm) dry film thickness. A 15 litre pail covers 10m².

Walls – Apply two wet coats 0.5mm (500µm) to obtain a 0.6mm (600µm) dry film thickness. A 15 litre pail covers 15m².

Performance Data

Conforms to AS/NZS 4858 Class 3 membrane

Tensile Strength (AS/NZS 4858) 2.20MPa

Elongation 468%

Modified CSIRO Moving Joint Test pass

Specification

The waterproofing membrane shall be a one-part water-based polyurethane compound with a tensile strength of 2.2MPa and 468% elongation such as **Hydrathane**, manufactured by **Construction Chemicals** and shall be applied in accordance with AS3740 and AS4654.2, local building codes, the manufacturer's instruction and good trade practice.

Surface Preparation

The surface to be waterproofed must be structurally sound and free from dirt, dust, grease, paint, wax, laitance and all other contaminants. Protrusions that can puncture the membrane must be ground flat. Holes and voids shall be filled with **Patch & Anchor**. Building boards must be installed in accordance with the manufacturer's instructions and local building codes. Cracks and junctions in building surfaces shall have a bond breaker tape or silicone applied evenly over the junction or crack prior to the membrane application (to accommodate extremes of movement). New concrete should be wood float finished and allowed to cure for 28 days. Steel float finished concrete, renders and screeds, must be mechanically abraded to remove laitance. Old concrete must be cleaned with a strong detergent/degreaser to remove contaminants then thoroughly washed and allowed to dry. All porous substrates, cement sheet and gypsum board must be primed with **Primebond** to prevent excessive moisture draw from the membrane. Metal surfaces, nail and screw heads, must be free of rust and primed with a rust inhibiting primer. All waterproofed floors, roofs and balconies shall be sloped to a drain outlet in conformity with AS3740 and external AS4654.2 and relevant local building codes. As a guide a 1:60 fall for wet areas and 1:100 fall for roofs and balconies.

Bond Breaker and Reomat

At the junction/joints in building surfaces i.e., floors/walls/walls, wastes etc., apply centrally over the junction, bond breaker tape or a 13mm bead of neutral cure silicone (allow to become touch dry). Apply a 150mm wide thick coat of waterproofing membrane centrally over areas where the bond breaker is applied.

Option 1: Reinforce the wet membrane with 140mm **Reomat** to guarantee its thickness and performance.

Option 2: Reinforcing is not required if the thickness is checked during application and the final dry film thickness is 1.5mm.

Membrane Application

Apply the membrane in accordance with AS3740 and AS4654.2 and local building codes and good trade practice. Prime concrete and building boards with **Primebond**. Apply two coats of **Hydrathane** with a brush or roller. Apply thickly allowing it to flow rather than brush to achieved required thickness. Apply the second coat at 90°

to the first (recoat time is approximately 2 hours @ 23°C @ 50% relative humidity) on floors and 100mm up surrounding walls apply two wet coats 0.8mm thick and on walls two wet coats 0.6mm thick. Apply the membrane down the front edge of balconies to the drip mould and down into drains and outlets and remove excess material. Apply a third coat if necessary to obtain the required thickness in critical areas i.e. over the bond breaking tape, cracks and building junctions.

Curing

1 day @ 23°C @ 50% relative humidity.
Colder temperatures will increase cure time.

Pond Test

If a ponding test is required, ensure the membrane is allowed to cure for a minimum of 1 day before pond testing.

Tiling

Apply tiling directly to the cured membrane with **Monoflex**, **Griplex** or **Kemflex 2:1**. Tiling can commence after 4-6 hours @ 23°C @ 50% relative humidity, longer in cooler conditions.

Precautions

- **Hydrathane** is UV resistant and will withstand maintenance foot traffic. It is advisable to screed, tile or protect with **Deckgrip** when traffic is more regular
- Do not apply if temperature exceeds 35°C or less than 5°C
- At above 30°C temperatures the membrane exhibits thermoplastic characteristics
- Do not apply if rain is expected within 1 day
- Do not thin liquid
- Do not use in permanently immersed applications (swimming pools etc)
- Do not use on surfaces subject to rising damp or negative hydrostatic pressure
- Seal damp substrates with one coat of **Epecrete**
- Waterproofed areas must be sloped to a drain and water must not pond

Shelf Life

12 months in an unopened can, stored in a dry place at 22°C.



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The information contained in this technical publication is based on our current knowledge and experience and is provided as a guide only. In view of the many factors that may affect application it is the user's sole responsibility to ensure suitability for a specific purpose.

March 17

THERMATHENE BLACK

250 MICRON
CONCRETE UNDERLAY

APPLICATION AND INSTALLATION

Product Description	THERMATHENE BLACK 250 Micron Concrete Underlay is a tear resistant Polyethylene film.
Product Advantage	THERMATHENE BLACK is used as a concrete underlay and a moisture vapour barrier in areas where protection is required. Thermathene Black is 250 micron, and coloured black for ultra violet resistance.
Installation	THERMATHENE BLACK must be installed to E2/AS1 10.3.3. Damp Proof Membranes, and must be laid on a properly prepared base as required by NZS3604: 2011.7.5.4. THERMATHENE BLACK may be used to cover ground areas under suspended timber floors to prevent the rise of dampness. Ensure that the site is clear of rubbish, sharp edges such as rocks or bricks. Slit and patch around jack studs or pipe work. All joints must be taped with Thermakraft 66mm White General Purpose Acrylic tape. THERMATHENE BLACK must be inspected for tears and penetrations. Repair with Thermakraft 66mm White General Purpose Acrylic tape to ensure integrity of THERMATHENE BLACK as a moisture barrier. Thermakraft recommends a lap of 150mm at all joints
Roll Dimensions	250micron x 4000mm x 25m = 100m² (gusseted rolls) Other sizes and thickness available (check for availability)

THERMATHENE BLACK

250 MICRON
CONCRETE UNDERLAY

TECHNICAL SPECIFICATIONS

Durability

THERMATHENE BLACK 250 Micron Concrete Underlay to meet the performance requirements of NZBC Clauses B2, Durability B2.3.1[a] 50 years and B2.3.1(b) 15 years, E2 External Moisture.

THERMATHENE BLACK:

- Must be installed in accordance to the "APPLICATION and INSTALLATION GUIDELINES" as outlined in E2/AS1 10.3.3, Damp Proof Membranes, and must be laid on a properly prepared base as required by NZS3604:2011.7.5.4
- is not left exposed for more than 28 days,
- installed by a licensed building practitioner,
- Free of tears and penetrations.

Physical Properties

THERMATHENE BLACK

- Exceeds the minimum impact resistant film test AS1326:1972 (IR3)
- Complies with (A) AS2870:1995, 5.3.3 vapour barrier for concrete underlays
- Resistance to Water Vapour Transmission Not less than 90 MN.s/g



i. THERMATHENE BLACK is used as a concrete underlay and a moisture vapour barrier.

The recommendations contained in Thermakraft's literature are based on good building practice, but are not an exhaustive statement of all relevant information and are subject to any conditions contained in the Warranty. All product dimensions and performance claims are subject to any variation caused by normal manufacturing process and tolerances. Furthermore, as the successful performance of the relevant system depends on numerous factors outside the control of Thermakraft (for example quality of workmanship and design), Thermakraft shall not be liable for the recommendations in that literature and the performance of the Product, including its suitability for any purpose or ability to satisfy the relevant provisions of the Building Code, regulations and standards.



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