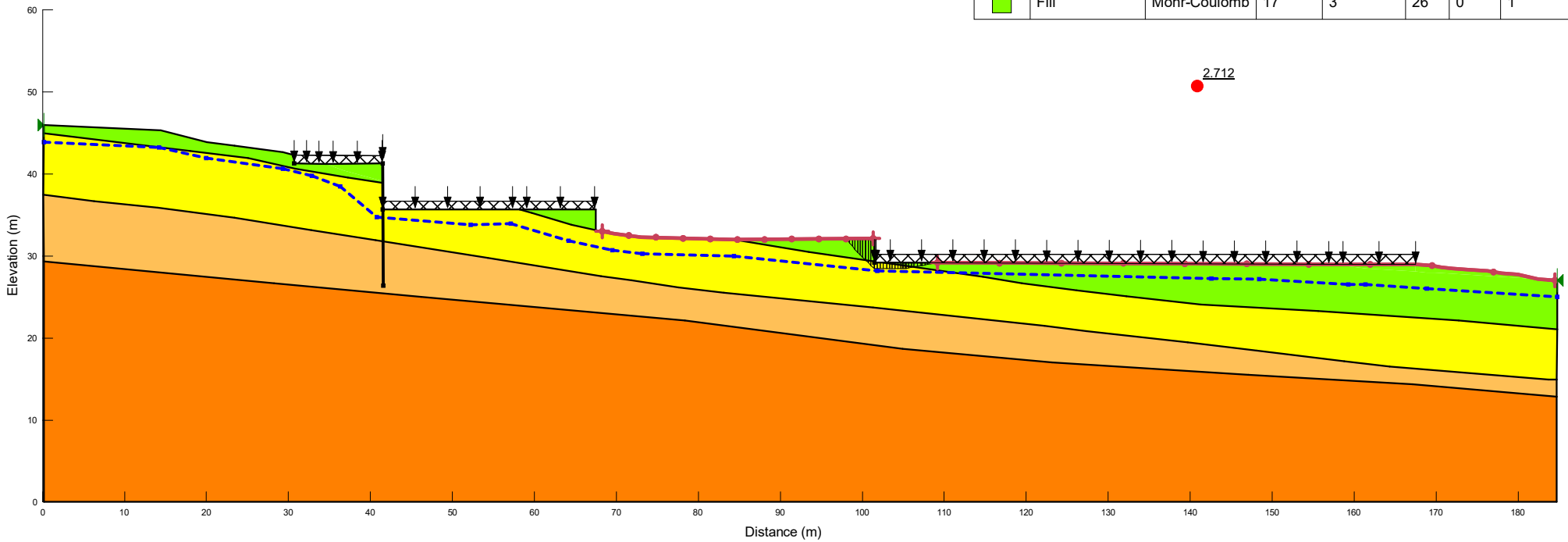


Color	Name	Model	Unit Weight (kN/m <sup>3</sup> )	Cohesion' (kPa)	Phi' (°)	Phi-B (°)	Piezometric Line
Yellow	ECBF Residual	Mohr-Coulomb	20	5	30	0	1
Orange	ECBF Unweathered Rock	Mohr-Coulomb	22	20	35	0	1
Light Orange	ECBF Weathered	Mohr-Coulomb	20	10	32	0	1
Green	Fill	Mohr-Coulomb	17	3	26	0	1



Title: SlopeW Template A-A\_Lower Slope\_Basements.gsz

Job Number: 30314

Analysis: Section A-A (Static)

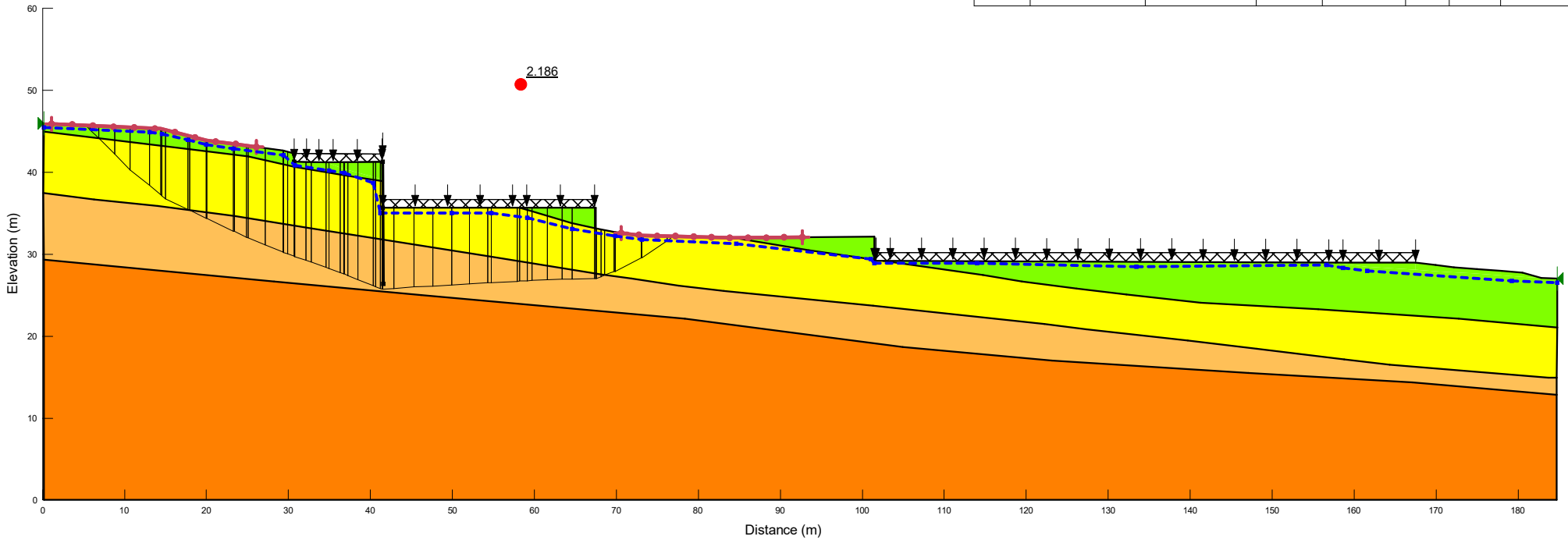
Analysed by: GUSI

Comments:

Scale: 1:720 @ A4

Checked by: CCHE

Color	Name	Model	Unit Weight (kN/m <sup>3</sup> )	Cohesion' (kPa)	Phi' (°)	Phi-B (°)	Piezometric Line
Yellow	ECBF Residual	Mohr-Coulomb	20	5	30	0	1
Orange	ECBF Unweathered Rock	Mohr-Coulomb	22	20	35	0	1
Light Orange	ECBF Weathered	Mohr-Coulomb	20	10	32	0	1
Green	Fill	Mohr-Coulomb	17	3	26	0	1



Title: SlopeW Template A-A\_Upper Slope\_Basements.gsz

Job Number: 30314

Analysis: Section A-A (Max Groundwater)

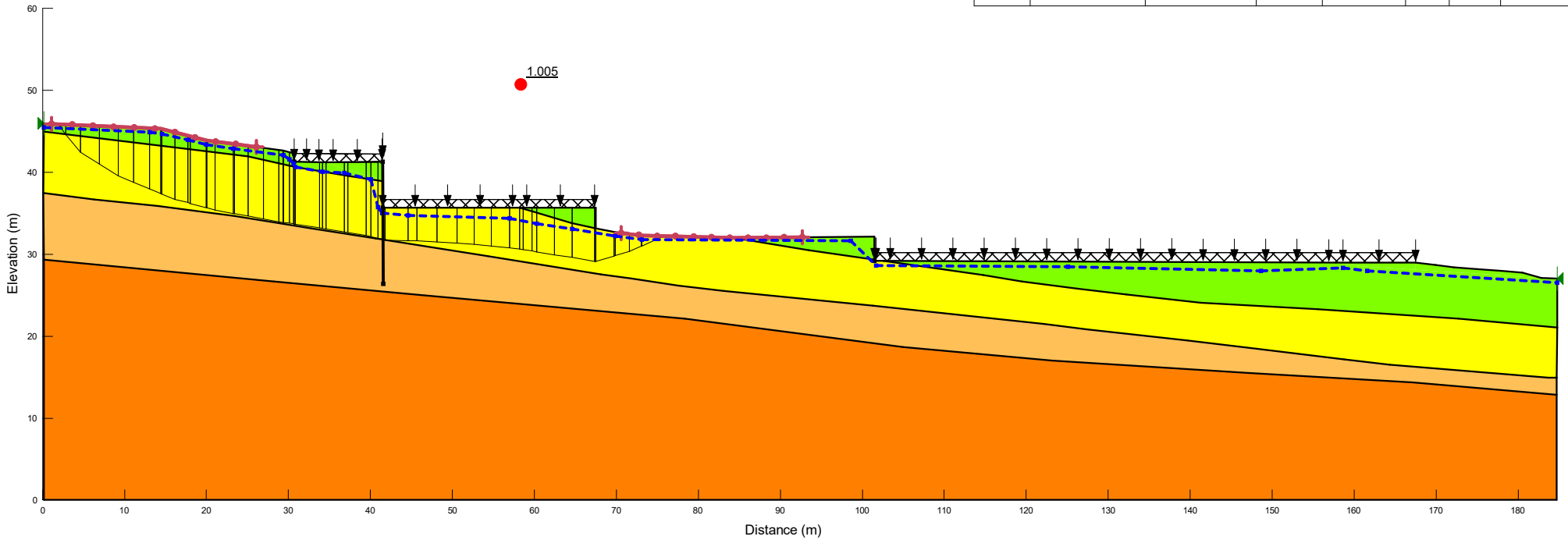
Analysed by: GUSI

Comments:

Scale: 1:720 @ A4

Checked by: CCHE

Color	Name	Model	Unit Weight (kN/m <sup>3</sup> )	Cohesion' (kPa)	Phi' (°)	Phi-B (°)	Piezometric Line
Yellow	ECBF Residual	Mohr-Coulomb	20	5	30	0	1
Orange	ECBF Unweathered Rock	Mohr-Coulomb	22	20	35	0	1
Light Orange	ECBF Weathered	Mohr-Coulomb	20	10	32	0	1
Green	Fill	Mohr-Coulomb	17	3	26	0	1



Title: SlopeW Template A-A\_Upper Slope\_Basements.gsz

Job Number: 30314

Analysis: Section A-A (Seismic)

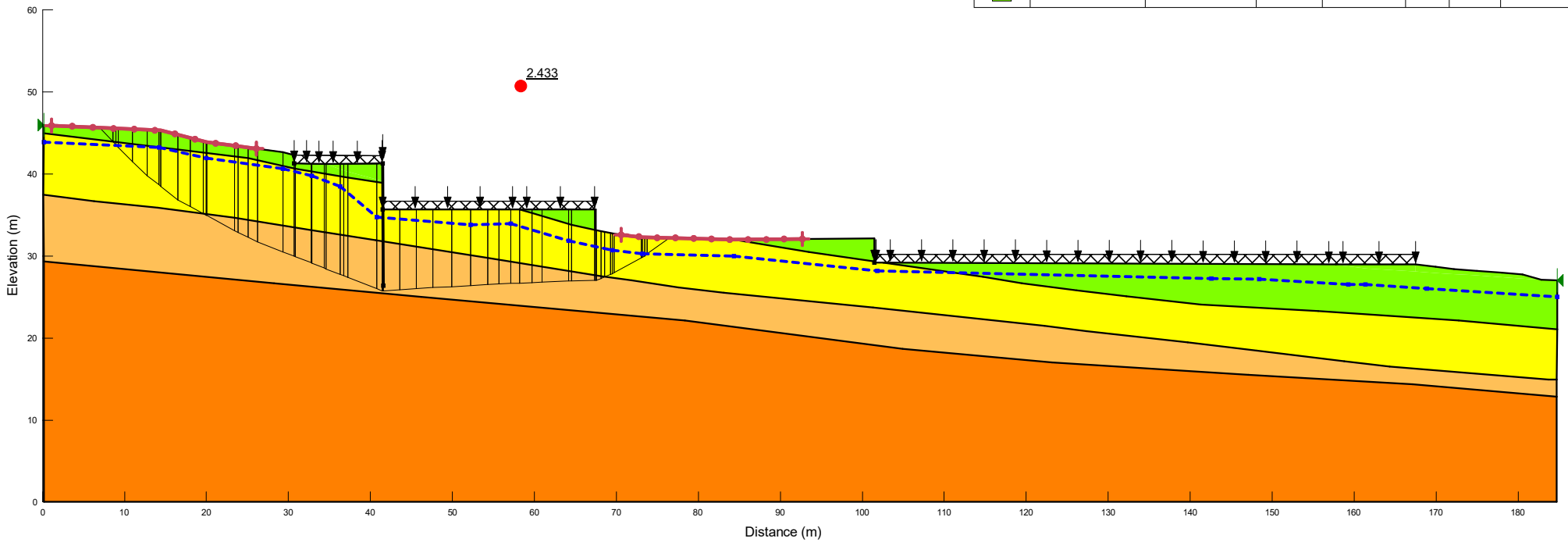
Analysed by: GUSI

Comments:

Scale: 1:720 @ A4

Checked by: CCHE

Color	Name	Model	Unit Weight (kN/m <sup>3</sup> )	Cohesion' (kPa)	Phi' (°)	Phi-B (°)	Piezometric Line
Yellow	ECBF Residual	Mohr-Coulomb	20	5	30	0	1
Orange	ECBF Unweathered Rock	Mohr-Coulomb	22	20	35	0	1
Light Orange	ECBF Weathered	Mohr-Coulomb	20	10	32	0	1
Green	Fill	Mohr-Coulomb	17	3	26	0	1



Title: SlopeW Template A-A\_Upper Slope\_Basements.gsz

Job Number: 30314

Analysis: Section A-A (Static)

Analysed by: GUSI

Comments:

Scale: 1:720 @ A4

Checked by: CCHE

## **Appendix F: Groundwater Drawdown Assessment**

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## F1 General

We have reviewed the geotechnical aspects of the Auckland Unitary Plan (AUP) rules for groundwater take & diversion<sup>11</sup> and expect that a Resource Consent will be required, given part of the development will be below groundwater level.

Groundwater level monitoring indicates up to 2 m of groundwater drawdown past summer low levels is expected as a result of excavation of the terraced basements at the northeastern corner of Building B01 Level 2 and Level 0. The groundwater drawdown level assessment is based on the lowest seasonal groundwater measured at the site (shown on Figure F8 at the end of this appendix as groundwater contours). We have assessed the effects considering a drained basement situation (i.e. groundwater is diverted into drains). Given the basement excavation will likely intercept the groundwater level, the effects are likely to be:

- Seepage through the basement retaining wall during excavation. Wall drainage will be required to control the build-up of groundwater pressure behind the wall and beneath the slabs; and
- Potential ground settlement due to lowering of the groundwater level by a maximum of 2 m (during construction and operation).

## F2 Extent of Groundwater Drawdown

The extent of groundwater drawdown away from the Site has been estimated using the CIRIA empirical method of drawdown into an open excavation<sup>12</sup>. The analyses, using a coefficient of permeability (k) of the residual ECBF material of  $8.5 \times 10^{-7}$  m/s, suggest a radius of drawdown of 4 metres. The coefficients of permeability is based on the permeability test results from Appendix D5.3 and are generally consistent with those adopted for residual ECBF in major projects in Auckland (e.g. Britomart, Victoria Park Tunnel, Central Rail Link).

Based on this result, the groundwater drawdown is not expected to have any measurable effect on the neighbouring properties as a result of the excavation works, given the excavation is at least 10 m away from the boundary.

### F2.1 Groundwater Inflows

The basements are to be designed as a fully drained structure during construction. The estimated inflow is between 2 and 15 m<sup>3</sup>/day, with the lower bound value based on summer measurements and the upper bound based on winter groundwater measurements.

---

<sup>11</sup> Auckland Council (15 April 2019). Plan. *Auckland Unitary Plan Operative in part. Chapter E – Auckland-wide, E2.*

<sup>12</sup> CIRIA (1986). *Control of groundwater for temporary works.* Report 113.



**LEGEND**

- - - - - SITE BOUNDARY
- PROPERTY BOUNDARIES
- PROPOSED RETAINING WALL
- 30 LOWEST RECORDED GROUND WATER CONTOURS (0.5m INTERVAL)



**NOTES:**

1. AERIAL PHOTOGRAPH AND PARCEL BOUNDARIES SOURCED FROM AUCKLAND COUNCIL GEOMAPS SERVICE UNDER CC BY 3.0-NZ LICENCE.
2. BASEPLAN SUPPLIED BY BECA. REF " 3124460-221-Architect layout.dwg" DATED AUG 08 2019.
3. EXISTING CONTOUR SUPPLIED BY BECA. REF " 3124460-221-EX Topo.dwg" DATED AUG 08 2019.
4. PROPOSED CONTOUR SUPPLIED BY BECA. REF " 33124460-221-PR Contours.dwg" DATED AUG 08 2019.

<b>PROJECT No.</b> 30314.0001		
<b>DESIGNED</b>	CBM	Aug.19
<b>DRAWN</b>	JC	Aug.19
<b>CHECKED</b>		
<b>APPROVED</b>		<b>DATE</b>

<b>CLIENT</b>	<b>RYMAN HEALTHCARE LIMITED</b>
<b>PROJECT</b>	<b>RYMAN SITE 3 - GEOTECHNICAL INVESTIGATION</b>
<b>TITLE</b>	<b>223 KOHIMARAMA ROAD AND 7 JOHN RYDER PLACE GROUNDWATER CONTOUR PLAN (LOWEST RECORD)</b>
<b>SCALE (A3)</b>	1:1000
<b>FIG No.</b>	30314.0001-F8
<b>REV</b>	1



## **Appendix G: Retaining wall concept design**

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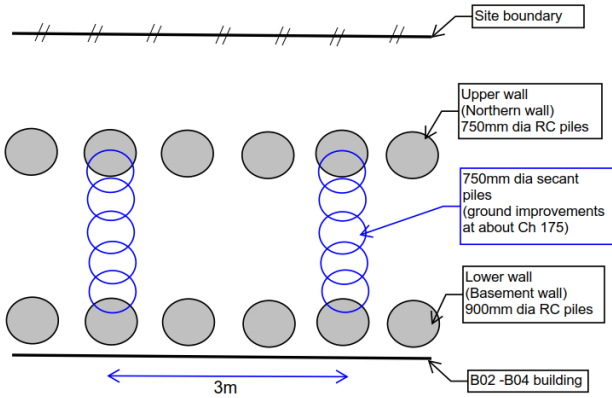


## G1 General

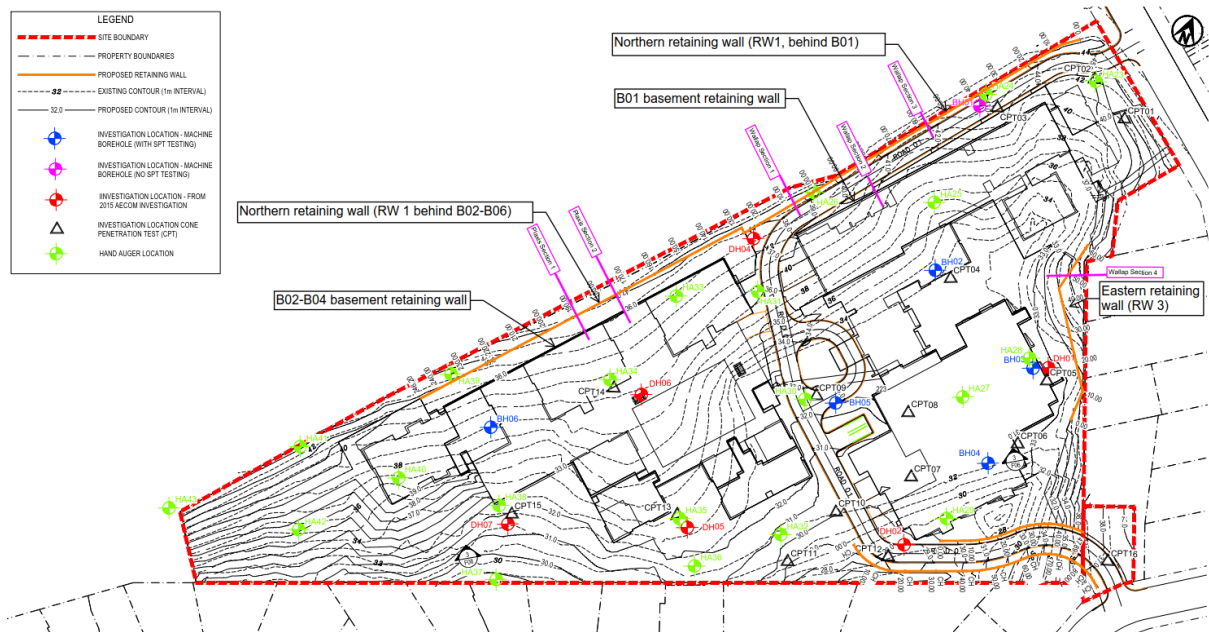
Permanent retaining walls are required to retain the excavations for the basements and driveways and landscaping at the Site. All proposed walls are cantilevered, and typically reinforced concrete (RC) bored piles, with ground improvements where lower settlement effects are necessary near existing structures on neighbouring properties. During detailed design, the structural system for the walls will be finalised, and any alternative systems considered will be designed to comply with at least equivalent to or less than the proposed deflection and settlement limits stated in the Construction Monitoring and Contingency Plan in Appendix H. We have assumed appropriate drainage measures will be installed for all walls so that they are fully drained.

The significant retaining walls that have been assessed for effects to the neighbouring properties are presented in Appendix Table L and Appendix Figure G in Appendix G. There are other retaining walls proposed at the site however, these walls are considered to be offset sufficiently that will unlikely have an impact on the neighbouring properties.

**Appendix Table L: Concept design retaining wall geometry**

Location	Description	Permanent retaining height of walls
<p>Northern retaining wall near the Selwyn College boundary (RTW01)</p>	<p>The wall can be divided into two sections:</p> <p><u>1 -The northern wall behind B02, B04 &amp; B06 (Ch 0 to 125)</u></p> <p>Comprises 750 mm dia reinforced concrete piles (RC) at 1.5 m c.c to support the excavation upslope of the garden walkway behind B02, B04 &amp; B06</p> <p>At about Ch175, a row of 750mm dia secant piles will be installed in between the upper and lower RC walls at 3 m centres. This will be completely below ground, and will stiffen the ground to reduce deflections and settlement in front of the light weight storage garage in Selwyn College land.</p>  <p><i>Appendix Figure F - Plan view showing ground improvement arrangements at Ch 175</i></p>	<p>Up to 4 m high but typically less than 3 m.</p>
	<p><u>2 -The northern wall behind B02, B04 &amp; B06 (Ch125+)</u></p> <p>This wall is located upslope of the accessway behind B01 and comprises:</p> <ul style="list-style-type: none"> <li>900 mm cantilevered RC piles at 1 m c.c where retaining heights are between 4 and 6.2 m.</li> </ul>	<p>Up to 6.2 m high but typically less than 3 m</p>

	Where retention is less than 4 m high, the wall diameter will drop to 450 mm diameter cantilevered timber pole wall at 1 m c.c.	
B02 and B04 basement wall, near the Selwyn College boundary	Comprises 900 mm dia reinforced concrete piles at 1.5 m c.c to support the two-level basement excavation. The basement wall will be at least 6 m away from the Northern retaining wall	Up to 6 m high.
B01 basement wall, near the Selwyn College boundary	Partial retention of the basement at the northern side of Building B01. The wall comprises 900 mm dia cantilevered RC piles at 1 m c.c. This wall is at least 10 m away from the northern retaining wall.	Between 3 to 5.5 m high
Eastern retaining wall located at the boundary to (RWT03): - 3A John Rymer Place, - 249A Kohimarama Rd - 297A Kohimarama Rd	The wall comprises 450 mm dia cantilevered timber piles at 1.2 m c.c. This wall is between 0 and 2 m away from the boundary.	Up to 2.5 m high



Appendix Figure G: Location of retaining walls

The following sections present the results of the geotechnical analysis undertaken for these retaining walls systems, and the anticipated effects outside the site boundary. The geotechnical design parameters adopted are based on the soil parameters outlined in Section D4 in Appendix D. The relevant geotechnical design and construction considerations are also documented in the Appendix.

Concept design analysis have been undertaken to assess maximum bending moments, shear forces, and deflections for the embedded retaining walls.

## G2 Design criteria

The retaining walls will generally be detailed and constructed to limit vertical settlements of the ground outside the property boundary.

The eastern wall, the northern retaining wall and basement retaining wall behind B01 were modelled using WALLAP software. Given there are wall interactions between the northern wall and basement wall behind B02-B06, we have undertaken a Plaxis analysis of the two-tiered retaining wall along two critical sections.

The geotechnical analysis of both Plaxis and Wallap retaining walls has been undertaken using pseudo non-linear finite element software<sup>13</sup> with the following initial design assumptions for concept design analysis:

- Factor of Safety (Strength Reduction Factor Method) for overall wall stability  $\geq 1.5$  (long term stability),  $\geq 1.2$  (temporary) and  $\geq 1.2$  (Seismic)

The WALLAP and Plaxis wall sections that have been analysed are shown on Appendix Figure G.

## G3 Surcharge loads

Surcharge loads behind the retaining walls varies and are presented in Appendix Table M. Existing ground profiles, including proposed backslope batters behind retaining walls have been accounted for as vertical surcharge pressures. A unit weight of  $18\text{ kN/m}^3$  has been assumed for backslope soils.

**Appendix Table M: Surcharge loads behind retaining walls**

Wall Section	Surcharge Description
Wallap Section 1	Surcharge batter slope at 3H: 0.5V and up to 0.5 high. 10 kPa traffic surcharge
Wallap Section 2	Surcharge at 10 m away from the wall to represent upper retaining wall load
Wallap Section 3	Surcharge batter slope at 3H: 0.5V and up to 1.5 high. 10 kPa traffic surcharge
Wallap Section 4	Surcharge batter slope at 1H: 2V and up to 1.0 high.
Plaxis Section 1	5 kPa traffic surcharge where there is an accessway upslope
Plaxis Section 2	5 kPa traffic surcharge where there is an accessway upslope. 10 kPa for the lightweight garage.

---

<sup>13</sup> CIRIA C760 (2017) Guidance on embedded retaining wall design



## G4 Retaining wall pile design parameters

The wall parameters for each wall sections are presented in Appendix Table N.

**Appendix Table N – Pile wall parameters**

Wall Section	Soldier pile arrangement	Max Retained height (m)	Second moment of inertia (m <sup>4</sup> /m)		
			100%lgross	Construction (75%lgross)	Long-term static (50%lgross)
Wallap Section 1	900 dia RC piles at 1 m c.c	5.95	0.0322	0.0241	0.016
Wallap Section 2	900 dia RC piles at 1 m c.c	6.2	0.0322	0.0241	0.016
Wallap Section 3	450 dia high density timber poles at 1 m c.c	2.2	0.0020	0.0015	0.001
Wallap Section 4	400 dia timber piles at 1.2 m c.c	2.5	0.0015	0.0007	0.0005
Plaxis section 1	Upper wall: 750 mm RC piles at 1.5 m c.c	3.24	0.01035	0.00777	0.00518
	Lower wall: 900 mm RC piles @ 1.5 m c.c	6.12	0.02147	0.01610	0.01074
Plaxis section 2	Upper wall: 750 mm RC piles at 1.5 m c.c	3.24	0.01035	0.00777	0.00518
	Lower wall: 900 mm RC piles @ 1.5 m c.c	6.12	0.02147	0.01610	0.01074

NB: Section 4 for checking interaction of RW01 (northern boundary wall) and RW03 (Basement B01) using Plaxis.

## G5 Seismic design

The PGA described in Appendix E.5.3 have been applied to the retaining wall design. Seismic design loads have been calculated in accordance with guidance presented in NZGS Module 6: Earthquake-resistant Retaining Wall Design, May 2017. The seismic design loads for cantilevered (Flexible) walls have been calculated using Mononobe-Okabe (M-O) equations.

With the exception of the basement retaining walls for Building B01, the walls have been designed with a PGA importance level of IL2. The basement retaining walls for Building B01 have been designed with a PGA IL3, on the basis that a hospital facilities will be provided in the building.

## G6 Groundwater level

All walls are assumed to be drained so the groundwater level will generally be at the base of the wall. A water pressure of 1/3 of the retained height is assumed for long term condition to check the sensitivity of the wall to transient elevated groundwater conditions, despite the inclusion of wall drainage systems.

## G7 Piled retaining wall analysis results

Summary results of the detailed wall analysis are summarised in Appendix Table O. A copy of the Wallap outputs, Plaxis model and a sketch of the retaining walls are presented at the end of the appendix.

We have assumed the retaining walls are expected to be constructed using a top-down construction methodology as follow:

1. Construct secant piles ground improvement where required
2. Construct piles to target depth
3. Excavate piles to subgrade level, install appropriate drainage measures and planks/shotcrete between the walls as excavation progresses in stages.
4. Backfill to underside of basement slab or pavement level
5. Construct basement slab and pavement level

**Appendix Table O: Wallap Summary**

Sections	Units	Wallap Section 1	Wallap Section 2	Wallap Section 3	Wallap Section 4	Plaxis Section 1	Plaxis Section 2
Description		Northern boundary wall at higher retained height (<6 m)	Building B01-B06 basement northern retaining wall	Northern boundary wall at lower retained height (<3.5 m)	Eastern boundary (<2.5 m)	Two-tiered northern wall above B02 and B04 (General)	Two-tiered northern wall with ground improvements above B02 and B04 (at Garage)
RTW Pile details		900 mm RC at 1 m c.c	900 mm RC at 1 m c.c	450 mm timber pole at 1 m c.c	450 mm timber pole at 1.2 m c.c	Upper wall (U): 750 mm RC @ 1.5 m c.c.  Lower wall (L): 900 mm RC @1.5 m c.c	Upper wall (U): 750 mm RC @ 1.5 m c.c.  Lower wall (L): 900 mm RC @1.5 m c.c  GI: Secant piles 750 mm dia 3 MPa between Upper & Lower walls at 3.0 m spacing
Location within Site boundary	m	4	>10	0	2.0	4	4
Top of wall	mRL	44	41	44	37.6	45.24	45.24
Wall heights:	m						
- Permanent	m	5.7	4.37	3.5	2.5	U: 3.24 L:6.12	U:3.24 L: 6.12
- Construction <sup>(1)</sup>	m	6.2	5.37	4.0	3.0	U:3.74 L: 6.62	U:3.74 L: 6.62
Max Deflections:							
- Static (temporary)	mm	71	37	46	16	U: 48 L: 43	U: 24 L: 20
- Static (Permanent)	mm	71	40	46	18	U: 64 L: 58	U:24 L:19

(1) Include over-excavation of 0.5m for the driveway walls and 1.0 for the basement walls





## G8 Settlement due to retaining wall deflections

The surface settlement due to deflection of the retaining wall is estimated based on CIRIA guidelines<sup>14</sup> and outputs from the Plaxis model. The estimated settlement at the northern site boundary is presented in Appendix Table P. On this basis, we assess less than 40 mm of settlement outside the boundary, which reduces to less than 7 mm at a 10 m setback from the boundary.

**Appendix Table P: Estimated maximum settlement at the northern boundary due to wall deflections**

Section	Estimated maximum settlement at boundary (mm)	Estimated distance of wall to the site boundary (m)
Wallap Section 1	40	0
Wallap Section 2	30	10
Wallap Section 3	25	4
Wallap Section 4	8	2
Plaxis Section 1	40	4
Plaxis Section 2	15	4

The effects of settlement due to retaining wall deflections are considered at:

- Selwyn College adjacent to the northern boundary of the Site.
- Property at Lot 2 DP31859 400 (3A John Rymer Place) adjacent to the eastern boundary of the Site.

### G8.1.1 Effects on adjacent land and structures at Selwyn College

The effects of the wall deflection within the Selwyn College property is outlined as follow:

- The majority of the buildings at Selwyn College property are at least 10 m away from the boundary with the exception of the lightweight garage at about Chainage (Ch) 172 to 178. Settlements at the Selwyn buildings are expected to be less than 5-10 mm, with differential settlements of less than 1 in 1000. This magnitude of movement is typically within the tolerance of buildings of similar construction and within the range of seasonal shrink/swell magnitudes. On this basis, we assess the risk of consequential effects to the buildings to be very low.
- The retained height near the lightweight garage (Ch 172 to 178) is about 3.4 m high at about 4 m from the boundary. Our assessment indicate that any deformation that occurs is likely to be significantly less than deformation associated with seasonal shrink/swell effects (i.e. less than 5 – 10 mm of movements). Given the nature of the structure (being a lightweight storage garage with metal cladding), we assess the risk of consequential effects to the building to be very low.
- The accessway could experience total and differential settlements of up to 30 mm and 1 in 400 respectively. The access road, with may experience settlements typically of less than 30 mm, and with 1 in 400 differential settlement expected. There is therefore a risk of some lateral and vertical deformation of the driveway surface. This could lead to new cracks or degradation from the existing condition. If they manifest, the cracks are likely be observed running parallel to the boundary and could reduce the service life of the driveway.

<sup>14</sup> CIRIA C760 (2017) Guidance on embedded retaining wall design

Any cracks that occur during construction of the retaining wall can be resealed. We are not aware of any services in the driveway that could be affected.

We assess less than 40 mm of settlement at the boundary, grass verges and fields at Selwyn College. The grass verge is located at the boundary while the fields are at 7 m away from the boundary. The wire fence on the boundary may deform sideways, and potentially tilt during construction of the northern wall. Ryman and Selwyn should agree if any fence repair or replacement is required following the construction.

### **G8.1.2 Effects on adjacent land and structures at Lot 2 DP31859 (3A John Rymer Place)**

Retaining walls up to a single basement level (typically 2.5 m high) are proposed at the eastern boundary. The walls will mainly affect three adjoining properties:

- Lot 2 DP31859 (3A John Rymer Place) – The property boundary fence consists of plastic garden netting. The dwelling is set back from the property boundary by 5 m, with garden landscaping between. The proposed eastern wall is located at or about 4 m away from the boundary and is up to 2.5m high. We assess the wall as likely to induce less than 20 mm deformation, with no credible risk of affecting the dwelling.
- Lot 2 DP1459 (249A Kohimarama Road) – The property boundary fence consists of a 200 – 300 mm high timber fence. The structure is set back from the property boundary by 8 m, with a timber pole retaining wall on their property approximately 3 m from the property boundary.

The proposed eastern wall typically between 2 to 6 m inside the Ryman site boundary and is less than 1.4 m high. We assess the wall as likely to be negligible, with no credible risk of affecting the dwelling.

- Lot 1 DP41674 (247A Kohimarama Road) – The property boundary fence consists of timber fencing and decking poles supporting an elevated deck and adjacent pool structure. The deck structure lies directly on the property boundary, while the pool is offset about 2 m away from the boundary.

The proposed eastern wall is set back at least 3 m inside the Ryman site boundary and is up to 1.7 m high. The potential settlement at the boundary is assessed to be less than 10 mm, reducing to less than 5 mm at the pool. We consider these settlements are typically minor and are unlikely to affect the structures within this property.

## **G9 Monitoring**

We recommend monitoring of the excavation works and surroundings be undertaken to check that the groundwater conditions and retaining wall deflections are consistent with the design analyses and that the response of the structures are within design tolerances included in the groundwater take and diversion consent conditions.

Provided Selwyn College agrees the retaining wall deflection deformation and settlement effects assessment in this report, no contingency plans (ground and building settlement monitoring) is required under the Resource Consent. If it is not agreed, monitoring points should be installed at the northern boundaries. The proposed monitoring pins are presented in Figure R10 in Appendix H. Should any of the monitoring pins be damaged and become inoperable, then a new monitoring bore or pin may be required to be installed at a nearby location as agreed in consultation with the Team Leader.



## G9.1 Retaining Wall Deflections Limits

The following deflection limits are proposed:

**Appendix Table Q: Trigger level for retaining wall lateral movement**

Monitoring point	Alert trigger level (mm)	Alarm trigger level (mm)
RTW 1-RWT4, RTW6, RW7	45	65
RW5	15	20
RTW8 to RTW10	55	75
RTW11 to RTW13	30	45
RTW15 To RTW17, RTW19-RTW 20	40	60
RTW18	15	20
RTW21 to RTW26	30	40

## G9.2 Ground and Building Settlement Alert and Alarm Levels

Monitoring data are to be compared with the design assumptions and baseline readings. Alert and Alarm Levels shall be set in Appendix Table R. If the alert and alarm levels are reached, the actions outlined in Section G9.3 shall be undertaken.

**Appendix Table R: Ground and building deformation mark trigger levels**

Mark ID	Comment	Settlement Alert Level (mm)	Settlement Alarm Level (mm)	Differential Settlement Alert Level	Differential Settlement Alarm Level
<b>Ground Settlement Pins</b>					
GS 1 to GS 13	Northern boundary	20	30	1:750	1:400
<b>Building Survey Pins</b>					
BS1, BH3, BH5	Selwyn College (>10 m from boundary)	3	5	1:750	1:1000
BS2 and BS4, BS6 to BS11	Selwyn College (<5 m from boundary)	7	10	1:750	1:1000

### **G9.3 Contingency measures**

If the retaining wall deflections exceed the monitoring Trigger Levels, a review of the retaining design model will be carried out to assess the increased load in the piles and existing props. If required the following actions may be taken:

1. Install additional props;
2. Place a berm of soil in front of the wall; and
3. Remove any surcharge close to the wall.

Should settlement exceeding the alert and alarm levels occur adjacent to the Site, one or more of the following actions will be carried out:

1. Discussions on the situation with the property/services owner that may be affected;
2. Monitor the rate of settlement (assuming that other steps (as per above) have been undertaken to address the cause); and
3. Check public safety is maintained.

Description:

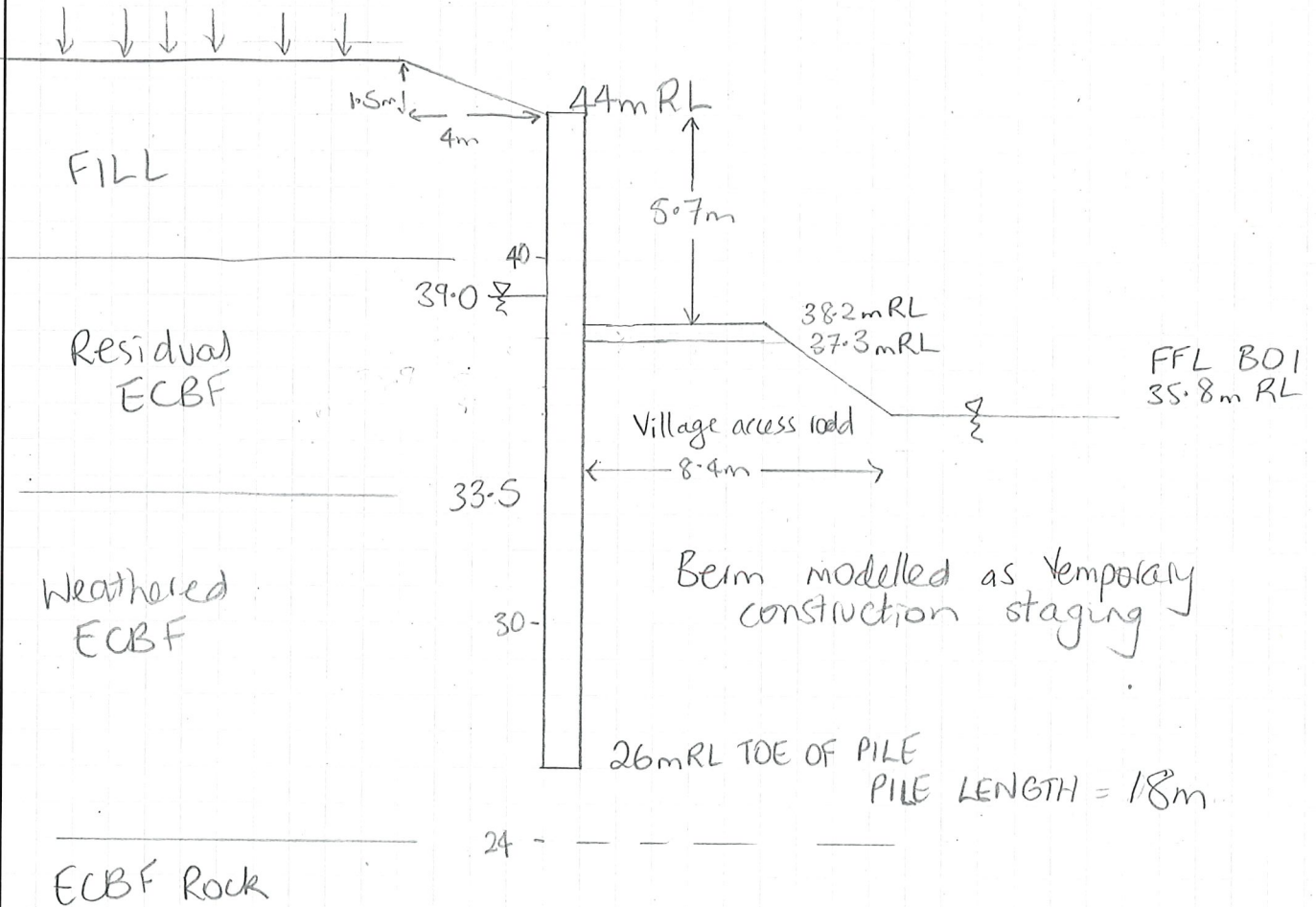
Walap File: RWT\_Section3\_B01\_DrivewayLongterm(Final)  
 RWT\_Section3\_B01\_DrivewayShortterm(Final)

Concept Design RTW

Section 1 B01 Driveway IL2

Retained Height 6.2m includes construction  
 Final Wall Height 5.7m

Existing Adjacent School Driveway  
 10 kPa Traffic surcharge







Lower rigid boundary at elevation 0.00 - Rough  
 Rigid boundary on Left side - Rough  
 Rigid boundary on Right side - Rough  
 Wall / soil interface - Smooth

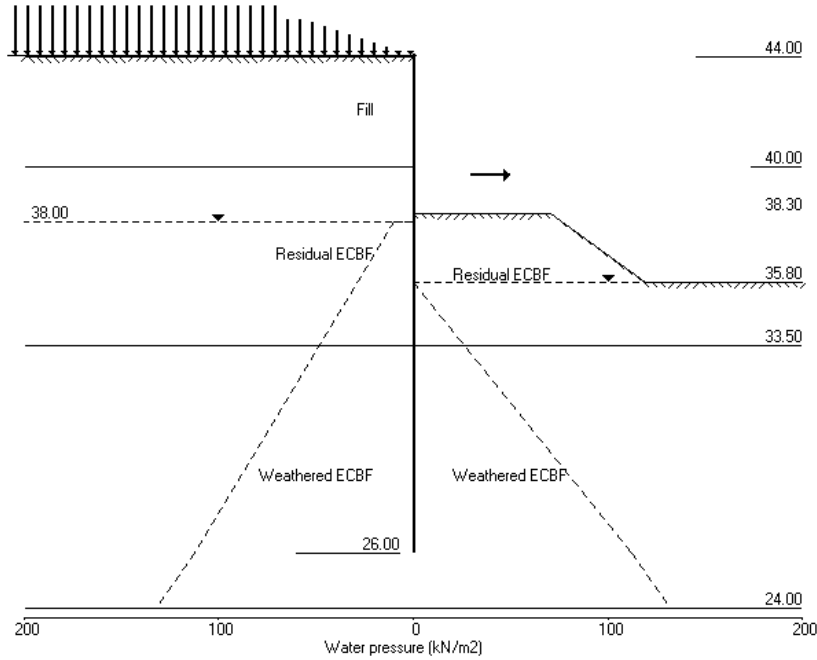
**OUTPUT OPTIONS**

Stage no.	Stage description	Output options		
		Displacement	Active,	Graph.
		Bending mom.	Passive	output
		Shear force	pressures	
1	Apply surcharge no.1 at elev. 44.00	No	No	No
2	Apply surcharge no.2 at elev. 44.00	Yes	Yes	No
3	Change EI of wall to 450887kN.m2/m run	Yes	Yes	Yes
4	Apply water pressure profile no.1	Yes	Yes	Yes
5	Excav. to elev. 38.30 on RIGHT side	Yes	Yes	Yes
6	Apply surcharge no.3 at elev. 44.00	Yes	Yes	Yes
7	Change EI of wall to 450887kN.m2/m run	Yes	Yes	Yes
8	Apply load no.1 at elev. 39.70	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2017 by DL Borin, distributed by GEOSOLVE  
 150 St. Alphonsus Road, London SW4 7BW, UK [www.geosolve.co.uk](http://www.geosolve.co.uk)

Units: kN,m

Stage No.8 Apply load no.1 at elev. 39.70



Units: kN,m

Stage No. 8 Apply load no.1 at elevation 39.70

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**  
 Factor of safety on soil strength

Stage No.	Ground level Act.	Pass.	Prop Elev.	FOS for toe elev. =	Moment of equil. at elev.	Toe elev. for FOS =	Wall Penetr-ation	Direction of failure
8	44.00	38.30	Cant.	1.456	26.94	26.00	1.500	L to R

Legend: \*\*\* Result not found

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**  
 Analysis options

Length of wall perpendicular to section = 5.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No  
 All soil moduli were factored to take account of  
 3-D effects due to the finite length of wall:  
 Modulus factors - Left side = 1.84  
 Right side = 1.72

Rigid boundaries: Left side 50.00 from wall Rough boundary  
 Right side 50.00 from wall Rough boundary  
 Lower rigid boundary at elevation 0.00 Rough boundary

\*\*\* Wall displacements reset to zero at stage 7

Node no.	Y coord	Nett pressure kN/m <sup>2</sup>	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m <sup>2</sup> /m
1	44.00	0.00	0.031	2.88E-03	0.0	0.0		450887
2	43.00	0.07	0.028	2.88E-03	0.0	2.0		450887
3	42.00	6.53	0.026	2.88E-03	3.3	4.1		450887
4	41.00	12.85	0.023	2.88E-03	13.0	12.6		450887
5	40.00	18.99	0.020	2.88E-03	28.9	34.0		450887
6	39.70	21.08	0.019	2.88E-03	35.0	43.6	43.4	450887
7	39.00	21.08	0.019	2.88E-03	78.4	43.6		450887
8	38.30	25.90	0.017	2.86E-03	94.8	104.3		450887
9	38.00	30.64	0.015	2.79E-03	114.6	177.8		450887
10	37.00	3.67	0.015	2.79E-03	114.6	177.8		450887
11	36.40	-17.53	0.014	2.74E-03	112.5	212.3		450887
12	35.80	-10.62	0.014	2.74E-03	112.5	212.3		450887
13	35.23	-75.47	0.011	2.53E-03	69.5	321.0		450887
14	34.65	-39.02	0.011	2.53E-03	69.5	321.0		450887
15	34.08	-64.72	0.010	2.36E-03	38.3	355.8		450887
16	33.50	-21.44	0.010	2.36E-03	38.3	355.8		450887
17	32.75	-35.63	0.009	2.17E-03	21.2	375.1		450887
18	32.00	-14.47	0.009	2.17E-03	21.2	375.1		450887
19	31.23	-15.25	0.007	1.96E-03	12.7	384.8		450887
20	30.48	-26.78	0.007	1.96E-03	12.7	384.8		450887
21	29.73	-11.12	0.006	1.74E-03	1.8	387.6		450887
22	29.00	9.10	0.005	1.51E-03	1.2	386.7		450887
23	28.25	4.80	0.005	1.29E-03	5.2	389.0		450887
24	27.50	-103.27	0.005	1.29E-03	5.2	389.0		450887
25	26.75	-55.09	0.004	1.02E-03	-54.2	363.7		450887

(continued)

(continued)

Stage No.8 Apply load no.1 at elevation 39.70

Stage No.8 Apply load no.1 at elevation 39.70

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
18	32.00	-9.59	0.003	7.92E-04	-78.5	307.4		450887
19	31.00	10.58	0.002	5.53E-04	-78.0	223.9		450887
20	30.00	16.26	0.002	3.89E-04	-64.5	150.9		450887
21	29.00	14.34	0.002	2.83E-04	-49.2	94.2		450887
22	28.00	10.84	0.001	2.20E-04	-36.7	51.8		450887
23	27.00	11.28	0.001	1.89E-04	-25.6	20.3		450887
24	26.00	31.92	0.001	1.80E-04	-4.0	0.0		0
25	25.75	0.14	0.001	0	0.0	0.0		0
26	24.00	21.50	0.001	0	19.0	0.0		0
		-9.04	0.001	0	19.0	0.0		0
27	20.00	0.02	0.000	0	0.9	0.0		0
28	16.00	0.01	0.000	0	1.0	0.0		0
29	12.00	0.01	0.000	0	1.0	0.0		0
30	8.00	0.00	0.000	0	1.0	0.0		0
31	4.00	-0.00	0.000	0	1.0	0.0		0
32	0.00	-0.52	0.000	0	0.0	0.0		---

LEFT side								
Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Adjusted soil modulus kN/m2
1	44.00	0.00	0.00	0.00	26.97	0.00	0.00a	36898
2	43.00	0.00	21.24	0.07	109.14	0.07	0.07a	36898
3	42.00	0.00	42.17	6.53	190.10	6.53	6.53a	36898
4	41.00	0.00	62.60	12.85	269.15	12.85	12.85a	36898
5	40.00	0.00	82.48	18.99	346.05	18.99	18.99a	36898
6	39.70	0.00	89.24	21.08	372.19	21.08	21.08a	36898
7	39.00	0.00	104.83	25.90	432.49	25.90	25.90a	36898
8	38.30	0.00	120.18	30.64	491.86	30.64	30.64a	36898
9	38.00	0.00	126.69	32.65	517.05	32.65	32.65a	36898
		10.00	116.69	29.56	478.37	29.56	39.56a	36898
10	37.00	18.53	129.60	33.55	528.30	33.55	52.08a	36898
11	36.40	23.65	137.16	35.89	557.57	35.89	59.54a	36898
12	35.80	28.77	144.61	38.19	586.39	38.19	66.96a	36898
13	35.23	33.68	151.65	40.37	613.63	46.12	79.79	36898
14	34.65	38.58	158.61	42.51	640.52	59.68	98.26	36898
15	34.08	43.49	165.48	44.64	667.11	72.58	116.06	36898
16	33.50	48.39	172.28	46.74	693.42	69.68	118.07	36898
		48.39	172.28	32.85	918.57	22.81	71.21A	92245
17	32.75	54.79	181.06	35.13	962.12	45.76	100.55	92245
18	32.00	61.19	189.73	37.38	1005.20	70.78	131.97	92245
19	31.00	69.72	201.18	40.35	1062.01	84.91	154.63	92245
20	30.00	78.26	212.50	43.29	1118.21	92.05	170.31	92245
21	29.00	86.79	223.72	46.20	1173.92	95.87	182.65	92245
22	28.00	95.32	234.87	49.09	1229.22	99.32	194.64	92245
23	27.00	103.85	245.95	51.97	1284.21	105.18	209.03	92245
24	26.00	112.39	256.97	54.83	1338.95	121.86	234.24	92245
25	25.75	114.89	259.36	55.45	1350.78	106.39	221.28	92245
26	24.00	132.39	275.99	59.77	1433.34	123.27	255.66	92245
		132.39	275.99	40.51	1824.38	93.19	225.58	184489
27	20.00	172.39	321.83	50.90	2103.28	115.32	287.71	184489
28	16.00	212.39	367.69	61.30	2382.28	134.43	346.82	184489
29	12.00	252.39	413.72	71.74	2662.33	154.53	406.92	184489
30	8.00	292.39	459.98	82.23	2943.78	175.23	467.62	184489
31	4.00	332.39	506.47	92.78	3226.63	196.39	528.78	184489
32	0.00	372.39	553.17	103.37	3510.79	216.05	588.44	184489

RIGHT side								
Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Adjusted soil modulus kN/m2
1	44.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	41.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	39.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	39.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	38.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	26.97	26.97	26.97p	34499
9	38.00	0.00	6.00	0.00	50.18	50.18	50.18p	34499
10	37.00	0.00	26.00	1.54	127.55	127.55	127.55p	34499
		0.00	26.00	1.54	91.10p	91.10	91.10p	34499
11	36.40	0.00	38.00	5.25	124.26b	124.26	124.26p	34499
		0.00	38.00	5.25	80.98b	80.98	80.98p	34499
12	35.80	0.00	50.01	8.95	102.60b	102.60	102.60p	34499
		0.00	50.01	8.95	81.44b	81.44	81.44p	34499
13	35.23	6.59	54.92	10.47	88.45b	88.45	95.05p	34499
		6.59	54.92	10.47	99.98b	99.98	106.57p	34499
14	34.65	13.19	59.83	11.99	107.91b	96.20	109.39	34499
		13.19	59.83	11.99	118.59b	96.20	109.39	34499
15	34.08	19.78	64.74	13.51	127.32b	87.18	106.96	34499
		19.78	64.74	13.51	137.27b	87.18	106.96	34499
16	33.50	26.38	69.66	15.03	146.68b	86.89	113.27	34499
		26.38	69.66	6.23	344.15b	148.10	174.48	86249
17	32.75	34.98	76.08	7.89	370.95b	120.67	155.64	86249
		34.98	76.08	7.89	256.50b	120.67	155.64	86249
18	32.00	43.58	82.51	9.56	275.05b	97.98	141.56	86249
		43.58	82.51	9.56	289.96b	97.98	141.56	86249
19	31.00	55.05	91.09	11.78	316.07b	89.01	144.05	86249
		55.05	91.09	11.78	331.90b	89.01	144.05	86249
20	30.00	66.51	99.68	14.01	359.36b	87.53	154.04	86249
		66.51	99.68	14.01	374.00b	87.53	154.04	86249
21	29.00	77.98	108.29	16.25	402.63b	90.33	168.31	86249
		77.98	108.29	16.25	416.26b	90.33	168.31	86249
22	28.00	89.45	116.91	18.49	445.91b	94.35	183.80	86249
		89.45	116.91	18.49	458.66b	94.35	183.80	86249
23	27.00	100.92	125.55	20.73	489.22b	96.83	197.75	86249
		100.92	125.55	20.73	501.19b	96.83	197.75	86249
24	26.00	112.39	134.22	22.98	532.58b	89.93	202.32	86249
		112.39	134.22	22.98	546.11b	89.93	202.32	86249
25	25.75	114.89	136.75	23.63	555.53b	106.25	221.13	86249
		114.89	136.75	23.63	567.50b	106.25	221.13	86249
26	24.00	132.39	154.54	28.25	635.00b	101.77	234.15	86249
		132.39	154.54	12.96	932.57b	102.23	234.62	172497
27	20.00	172.39	203.44	24.05	1188.20b	115.30	287.69	172497
		172.39	203.44	24.05	1182.89b	115.30	287.69	172497
28	16.00	212.39	252.70	35.22	1439.24b	134.42	346.80	172497
		212.39	252.70	35.22	1479.17b	134.42	346.80	172497
29	12.00	252.39	302.30	46.47	1744.47b	154.53	406.91	172497
		252.39	302.30	46.47	1778.48b	154.53	406.91	172497
30	8.00	292.39	352.21	57.79	2050.60b	175.23	467.62	172497
		292.39	352.21	57.79	2080.22b	175.23	467.62	172497
31	4.00	332.39	402.37	69.17	2357.65b	196.39	528.78	172497
		332.39	402.37	69.17	2383.88b	196.39	528.78	172497
32	0.00	372.39	452.71	80.59	2665.46b	216.57	588.96	172497

Run ID: RTW\_Section3\_B01\_DrivewayLongterm(Final)  
 Kohimarama Retirement Village  
 Concept B02\_6.4m RTH\_900mmdia 1m cc

Sheet No.  
 Date:12-08-2019  
 Checked :

TONKIN and TAYLOR GROUP LTD.  
 Program: WALLAP Version 6.06 Revision A52.B71.R55  
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Sheet No.  
 Job No. 30314.1  
 Made by : DNT

Data filename/Run ID: RTW\_Section3\_B01\_DrivewayLongterm(Final)  
 Kohimarama Retirement Village  
 Concept B02\_6.4m RTH\_900mmdia 1m cc

Date:12-08-2019  
 Checked :

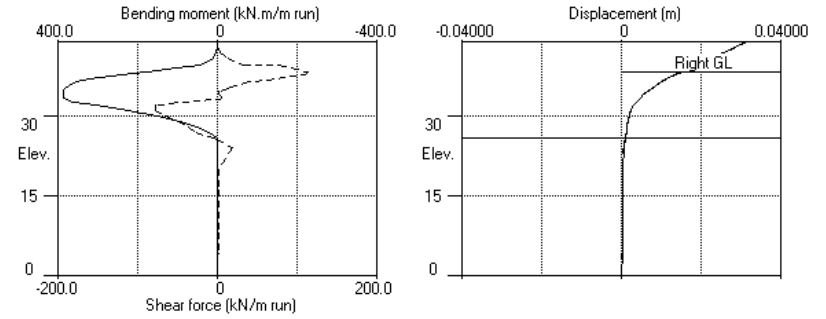
Stage No.8 Apply load no.1 at elevation 39.70

(continued)

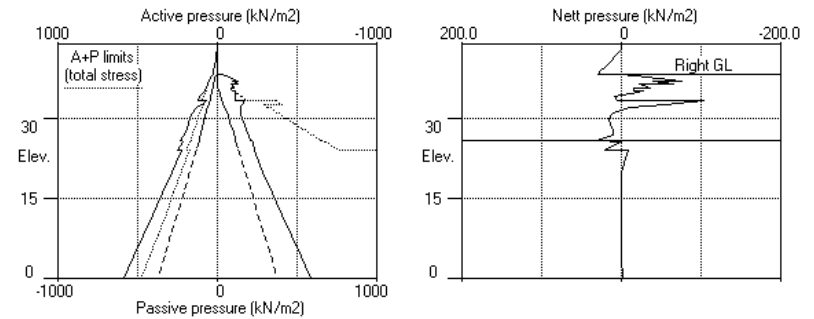
Note: 66.96a Soil pressure at active limit  
 106.57p Soil pressure at passive limit  
 2665.46b Passive limit reduced because of berm  
 71.21A Arching - soil pressure below active limit

Units: kN,m

Stage No.8 Apply load no.1 at elev. 39.70



Stage No.8 Apply load no.1 at elev. 39.70





TONKIN and TAYLOR GROUP LTD. | Sheet No.  
 Program: WALLAP Version 6.06 Revision A52.B71.R55 | Job No. 30314.1  
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 Data filename/Run ID: RTW\_Section3\_B01\_DrivewayLongterm(Final)  
 Kohimarama Retirement Village | Date:12-08-2019  
 Concept B02\_6.4m RTH\_900mmdia 1m cc | Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method  
 Factor of safety on soil strength

Stage No.	Ground level		Prop Elev.	FoS for toe elev. = 26.00		Toe elev. for FoS = 1.500		Direction of failure
	Act.	Pass.		Factor of Safety	Moment at elev.	Toe elev.	Wall Penetration	
1	44.00	44.00	Cant.	Conditions not suitable for FoS calc.				
2	44.00	44.00	Cant.	Conditions not suitable for FoS calc.				
3	44.00	44.00		No analysis at this stage				
4	44.00	44.00	Cant.	Conditions not suitable for FoS calc.				
5	44.00	38.30	Cant.	1.535	26.91	26.55	11.75	L to R
6	44.00	38.30	Cant.	1.522	26.89	26.36	11.94	L to R
7	44.00	38.30		No analysis at this stage				
8	44.00	38.30	Cant.	1.456	26.94	***	***	L to R

Legend: \*\*\* Result not found

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 Program: WALLAP Version 6.06 Revision A52.B71.R55 | Job No. 30314.1  
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 Data filename/Run ID: RTW\_Section3\_B01\_DrivewayLongterm(Final)  
 Kohimarama Retirement Village | Date:12-08-2019  
 Concept B02\_6.4m RTH\_900mmdia 1m cc | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 5.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No  
 All soil moduli were factored to take account of  
 3-D effects due to the finite length of wall:  
 Modulus factors - Left side = 1.84  
 Right side = 1.72

Rigid boundaries: Left side 50.00 from wall Rough boundary  
 Right side 50.00 from wall Rough boundary  
 Lower rigid boundary at elevation 0.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m		kN.m/m		kN/m	
		m		kN.m/m		kN/m	
1	44.00	0.031	0.000	0.0	0.0	0.0	0.0
2	43.00	0.028	0.000	2.0	-0.3	0.3	-1.1
3	42.00	0.026	0.000	4.1	-1.5	3.3	-2.5
4	41.00	0.023	0.000	12.6	-4.5	13.0	-3.8
5	40.00	0.020	0.000	34.0	-8.8	28.9	-6.8
6	39.70	0.019	0.000	43.6	-10.3	78.4	-7.2
7	39.00	0.017	0.000	104.3	-13.1	94.8	-9.1
8	38.30	0.015	0.000	177.8	-19.7	114.6	-11.6
9	38.00	0.014	0.000	212.3	-23.3	112.5	-13.1
10	37.00	0.011	0.000	321.0	-34.9	69.5	-9.3
11	36.40	0.010	0.000	355.8	-39.1	38.3	-4.5
12	35.80	0.009	0.000	375.1	-40.0	21.2	-3.1
13	35.23	0.007	0.000	384.8	-37.5	12.7	-6.4
14	34.65	0.006	0.000	387.6	-31.6	13.1	-4.4
15	34.08	0.005	0.000	386.7	-22.5	18.5	0.0
16	33.50	0.005	0.000	389.0	-10.5	24.1	0.0
17	32.75	0.004	0.000	363.7	0.0	13.4	-54.2
18	32.00	0.003	0.000	307.4	0.0	6.4	-78.5
19	31.00	0.002	0.000	223.9	0.0	1.0	-78.0
20	30.00	0.002	0.000	150.9	0.0	0.0	-64.5
21	29.00	0.002	0.000	94.2	0.0	0.0	-49.2
22	28.00	0.001	0.000	51.8	0.0	0.0	-36.7
23	27.00	0.001	0.000	20.3	0.0	0.0	-25.6
24	26.00	0.001	0.000	0.0	-0.0	0.0	-4.0
25	25.75	0.001	0.000	0.0	0.0	0.0	0.0
26	24.00	0.001	0.000	0.0	0.0	19.0	0.0
27	20.00	0.000	0.000	0.0	0.0	0.9	0.0
28	16.00	0.000	0.000	0.0	0.0	1.0	0.0
29	12.00	0.000	0.000	0.0	0.0	1.0	0.0
30	8.00	0.000	0.000	0.0	0.0	1.0	0.0
31	4.00	0.000	0.000	0.0	0.0	1.0	0.0
32	0.00	0.000	0.000	0.0	0.0	0.0	-0.0

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**Summary of results (continued)**

**Maximum and minimum bending moment and shear force at each stage**

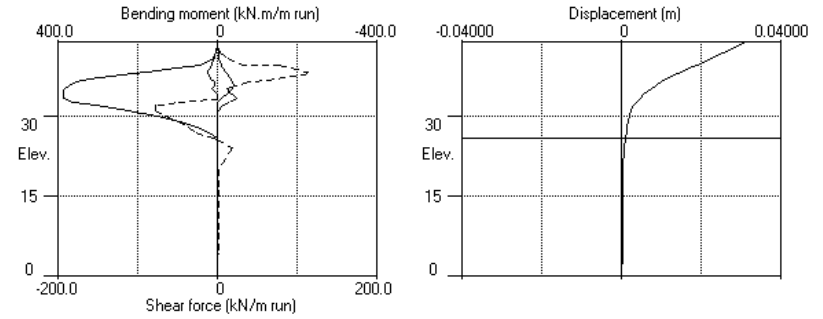
Stage no.	Bending moment				Shear force			
	maximum kN.m/m	elev. kN.m/m	minimum kN.m/m	elev. kN.m/m	maximum kN/m	elev. kN/m	minimum kN/m	elev. kN/m
1	4.2	32.00	-5.2	38.30	3.2	33.50	-1.5	42.00
2	8.0	31.00	-16.7	37.00	10.7	33.50	-5.2	40.00
3	No calculation at this stage							
4	12.0	31.00	-40.0	35.80	24.1	33.50	-13.1	38.00
5	213.4	35.80	-0.0	26.00	69.9	38.30	-42.9	31.00
6	218.9	35.80	-0.0	26.00	71.2	38.30	-44.3	31.00
7	No calculation at this stage							
8	389.0	33.50	0.0	44.00	114.6	38.30	-78.5	32.00

**Maximum and minimum displacement at each stage**

Stage no.	Displacement				Stage description
	maximum m	elev. m	minimum m	elev. m	
1	0.001	44.00	0.000	44.00	Apply surcharge no.1 at elev. 44.00
2	0.001	38.30	0.000	44.00	Apply surcharge no.2 at elev. 44.00
3	Wall displacements reset to zero Change EI of wall to 450887kN.m2/m run				
4	0.001	35.80	0.000	44.00	Apply water pressure profile no.1
5	0.051	44.00	0.000	44.00	Excav. to elev. 38.30 on RIGHT side
6	0.053	44.00	0.000	44.00	Apply surcharge no.3 at elev. 44.00
7	Wall displacements reset to zero Change EI of wall to 450887kN.m2/m run				
8	0.031	44.00	0.000	44.00	Apply load no.1 at elev. 39.70

Units: kN,m

Bending moment, shear force, displacement envelopes





Lower rigid boundary at elevation 0.00 - Rough  
 Rigid boundary on Left side - Rough  
 Rigid boundary on Right side - Rough  
 Wall / soil interface - Smooth

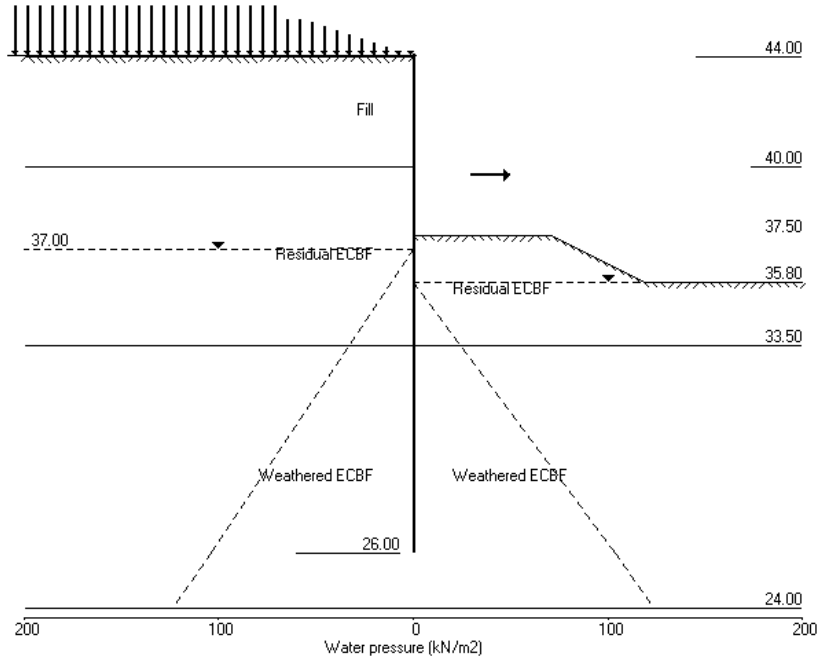
**OUTPUT OPTIONS**

Stage no.	Stage description	Output options		
		Displacement	Active,	Graph.
		Bending mom.	Passive	output
		Shear force	pressures	
1	Apply surcharge no.1 at elev. 44.00	No	No	No
2	Apply surcharge no.2 at elev. 44.00	Yes	Yes	No
3	Change EI of wall to 450887kN.m2/m run	Yes	Yes	Yes
4	Apply water pressure profile no.1	Yes	Yes	Yes
5	Excav. to elev. 37.50 on RIGHT side	Yes	Yes	Yes
6	Apply surcharge no.3 at elev. 44.00	Yes	Yes	Yes
7	Change EI of wall to 450887kN.m2/m run	Yes	Yes	Yes
8	Apply load no.1 at elev. 39.70	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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Units: kN,m

Stage No.8 Apply load no.1 at elev. 39.70



Units: kN,m

Stage No. 8 Apply load no.1 at elevation 39.70

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**  
 Factor of safety on soil strength

Stage No.	Ground level Act.	Pass.	Prop Elev.	FOS for toe Factor of Safety	FOS for toe elev. = 26.00 Moment of equil. at elev.	Toe elev. for FOS = 1.500 Toe elev. Penetr-action	Direction of failure
8	44.00	37.50	Cant.	1.486	27.01	***	L to R

Legend: \*\*\* Result not found

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**  
 Analysis options

Length of wall perpendicular to section = 5.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No  
 All soil moduli were factored to take account of  
 3-D effects due to the finite length of wall:  
 Modulus factors - Left side = 1.84  
 Right side = 1.70

Rigid boundaries: Left side 50.00 from wall Rough boundary  
 Right side 50.00 from wall Rough boundary  
 Lower rigid boundary at elevation 0.00 Rough boundary

\*\*\* Wall displacements reset to zero at stage 7

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
1	44.00	0.00	0.035	3.21E-03	0.0	0.0		450887
2	43.00	0.07	0.032	3.21E-03	0.0	1.9		450887
3	42.00	6.53	0.029	3.21E-03	3.3	4.0		450887
4	41.00	12.85	0.026	3.21E-03	13.0	12.5		450887
5	40.00	18.99	0.022	3.21E-03	28.9	33.7		450887
6	39.70	21.08	0.021	3.21E-03	35.0	43.3	43.4	450887
		21.08	0.021	3.21E-03	78.4	43.3		
7	39.15	24.87	0.020	3.19E-03	91.0	89.9		450887
8	38.60	28.61	0.018	3.15E-03	105.7	144.1		450887
9	38.05	32.32	0.016	3.07E-03	122.5	206.9		450887
10	37.50	35.98	0.015	2.97E-03	141.2	279.5		450887
		9.01	0.015	2.97E-03	141.2	279.5		
11	37.00	-26.38	0.013	2.86E-03	136.9	351.2		450887
12	36.40	-64.98	0.011	2.68E-03	109.5	429.0		450887
13	35.80	-99.68	0.010	2.47E-03	60.1	483.3		450887
		-37.61	0.010	2.47E-03	60.1	483.3		
14	35.23	-44.07	0.008	2.25E-03	36.6	511.6		450887
		-43.33	0.008	2.25E-03	36.6	511.6		
15	34.65	-33.68	0.007	2.00E-03	14.5	525.5		450887
16	34.08	-3.93	0.006	1.75E-03	3.7	528.2		450887
17	33.50	-8.13	0.005	1.49E-03	0.2	529.6		450887
		-139.35	0.005	1.49E-03	0.2	529.6		
18	32.75	-71.43	0.004	1.18E-03	-78.9	490.5		450887
19	32.00	-10.57	0.003	9.10E-04	-109.6	411.3		450887
20	31.00	16.07	0.003	6.30E-04	-106.9	296.2		450887



(continued)

(continued)

Stage No.8 Apply load no.1 at elevation 39.70

Stage No.8 Apply load no.1 at elevation 39.70

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
21	30.00	23.13	0.002	4.38E-04	-87.3	197.3		450887
22	29.00	20.15	0.002	3.15E-04	-65.6	121.5		450887
23	28.00	15.18	0.002	2.43E-04	-47.9	65.8		450887
24	27.00	15.19	0.001	2.07E-04	-32.8	25.3		450887
25	26.00	40.26	0.001	1.97E-04	-5.0	0.0		0
26	25.75	0.14	0.001	0	0.0	0.0		0
27	24.00	24.32	0.001	0	21.4	0.0		0
		-10.27	0.001	0	21.4	0.0		0
28	20.00	0.03	0.000	0	1.0	0.0		0
29	16.00	0.02	0.000	0	1.0	0.0		0
30	12.00	0.01	0.000	0	1.1	0.0		0
31	8.00	0.00	0.000	0	1.1	0.0		0
32	4.00	0.00	0.000	0	1.1	0.0		0
33	0.00	-0.57	0.000	0	0.0	0.0		---

LEFT side

Node no.	Y coord	Effective stresses					Total earth pressure kN/m2	Adjusted soil modulus kN/m2
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	44.00	0.00	0.00	0.00	26.97	0.00a	36898	
2	43.00	0.00	21.24	0.07	109.14	0.07a	36898	
3	42.00	0.00	42.17	6.53	190.10	6.53a	36898	
4	41.00	0.00	62.60	12.85	269.15	12.85a	36898	
5	40.00	0.00	82.48	18.99	346.05	18.99a	36898	
6	39.70	0.00	89.24	21.08	372.19	21.08a	36898	
7	39.15	0.00	101.51	24.87	419.64	24.87a	36898	
8	38.60	0.00	113.63	28.61	466.52	28.61a	36898	
9	38.05	0.00	125.61	32.32	512.86	32.32a	36898	
10	37.50	0.00	137.46	35.98	558.71	35.98a	36898	
11	37.00	0.00	148.13	39.28	599.99	39.28a	36898	
12	36.40	5.65	155.16	41.45	627.19	41.45a	36898	
13	35.80	11.31	162.08	43.59	653.95	43.59a	36898	
14	35.23	16.73	168.61	45.60	679.20	50.03	36898	
15	34.65	22.14	175.05	47.59	704.11	67.46	36898	
16	34.08	27.56	181.41	49.56	728.72	83.65	36898	
17	33.50	32.98	187.69	51.50	753.04	76.26	36898	
		32.98	187.69	36.85	995.08	24.66	57.64A	
18	32.75	40.05	195.80	38.96	1035.31	53.55	93.60	
19	32.00	47.12	203.81	41.04	1075.08	84.03	131.14	
20	31.00	56.54	214.37	43.77	1127.46	99.09	155.63	
21	30.00	65.96	224.80	46.48	1179.24	104.81	170.77	
22	29.00	75.38	235.13	49.16	1230.52	106.29	181.68	
23	28.00	84.81	245.38	51.82	1281.41	107.46	192.27	
24	27.00	94.23	255.57	54.47	1331.97	111.78	206.01	
25	26.00	103.65	265.71	57.10	1382.29	129.77	233.43	
26	25.75	106.15	268.09	57.72	1394.12	109.69	215.85	
27	24.00	123.65	284.72	62.03	1476.68	126.88	250.53	
		123.65	284.72	42.49	1877.50	95.24	218.90	
28	20.00	163.65	330.56	52.88	2156.41	116.72	280.38	
29	16.00	203.65	376.42	63.28	2435.40	135.24	338.90	
30	12.00	243.65	422.45	73.72	2715.46	155.18	398.83	
31	8.00	283.65	468.71	84.21	2996.90	175.93	459.59	
32	4.00	323.65	515.20	94.76	3279.76	197.31	520.96	
33	0.00	363.65	561.90	105.35	3563.91	216.61	580.26	

Node no.	Y coord	Effective stresses					Total earth pressure kN/m2	Adjusted soil modulus kN/m2
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	44.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	43.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	42.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	41.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	40.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	39.70	0.00	0.00	0.00	0.00	0.00	0.00	
7	39.15	0.00	0.00	0.00	0.00	0.00	0.00	
8	38.60	0.00	0.00	0.00	0.00	0.00	0.00	
9	38.05	0.00	0.00	0.00	0.00	0.00	0.00	
10	37.50	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	26.97	26.97	26.97p	
11	37.00	0.00	10.00	0.00	65.66	65.66	65.66p	
12	36.40	0.00	22.00	0.30	112.08	112.08	112.08p	
13	35.80	0.00	34.00	4.01	158.50	154.57	154.57	
		0.00	34.00	4.01	92.50b	92.50	92.50p	
14	35.23	6.08	39.42	5.68	104.74b	104.74	110.82p	
		6.08	39.42	5.68	104.00b	104.00	110.08p	
15	34.65	12.16	44.85	7.36	116.16b	111.12	123.28	
		12.16	44.85	7.36	124.54b	111.12	123.28	
16	34.08	18.25	50.27	9.04	137.58b	96.90	115.15	
		18.25	50.27	9.04	145.17b	96.90	115.15	
17	33.50	24.33	55.70	10.71	158.93b	93.05	117.37	
		24.33	55.70	2.60	339.90	172.66	196.98	
18	32.75	32.26	62.78	4.44	375.06	132.78	165.04	
		32.26	62.78	4.44	275.62b	132.78	165.04	
19	32.00	40.19	69.87	6.28	301.49b	101.52	141.71	
		40.19	69.87	6.28	308.03b	101.52	141.71	
20	31.00	50.77	79.34	8.74	343.31b	88.78	139.55	
		50.77	79.34	8.74	354.45b	88.78	139.55	
21	30.00	61.35	88.82	11.20	390.93b	86.30	147.65	
		61.35	88.82	11.20	401.04b	86.30	147.65	
22	29.00	71.92	98.31	13.66	438.53b	89.60	161.52	
		71.92	98.31	13.66	447.79b	89.60	161.52	
23	28.00	82.50	107.83	16.13	486.14b	94.58	177.08	
		82.50	107.83	16.13	494.69b	94.58	177.08	
24	27.00	93.08	117.36	18.60	533.79b	97.74	190.82	
		93.08	117.36	18.60	541.73b	97.74	190.82	
25	26.00	103.65	126.92	21.08	581.50b	89.51	193.16	
		103.65	126.92	21.08	588.70b	89.51	193.16	
26	25.75	106.15	129.46	21.74	599.39b	109.55	215.70	
		106.15	129.46	21.74	606.56b	109.55	215.70	
27	24.00	123.65	147.25	26.36	682.45b	102.55	226.21	
		123.65	147.25	11.31	973.44b	105.51	229.17	
28	20.00	163.65	196.21	22.41	1251.96b	116.70	280.35	
		163.65	196.21	22.41	1227.17b	116.70	280.35	
29	16.00	203.65	245.59	33.61	1502.49b	135.23	338.88	
		203.65	245.59	33.61	1525.56b	135.23	338.88	
30	12.00	243.65	295.37	44.90	1807.38b	155.17	398.82	
		243.65	295.37	44.90	1826.96b	155.17	398.82	
31	8.00	283.65	345.51	56.27	2113.91b	175.93	459.58	
		283.65	345.51	56.27	2130.91b	175.93	459.58	
32	4.00	323.65	395.95	67.71	2421.91b	197.31	520.96	
		323.65	395.95	67.71	2436.94b	197.31	520.96	
33	0.00	363.65	446.63	79.21	2731.09b	217.18	580.83	

Run ID: RTW\_Section3\_B01\_DrivewayShortterm(Final)  
 Kohimarama Retirement Village  
 Concept B02\_6.4m RTH\_900mmdia 1m cc

Sheet No.  
 Date:12-08-2019  
 Checked :

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Sheet No.  
 Job No. 30314.1  
 Made by : DNT

Data filename/Run ID: RTW\_Section3\_B01\_DrivewayShortterm(Final)  
 Kohimarama Retirement Village  
 Concept B02\_6.4m RTH\_900mmdia 1m cc

Date:12-08-2019  
 Checked :

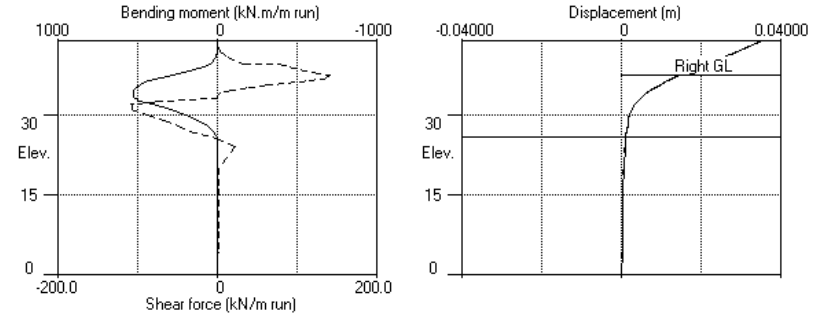
Stage No.8 Apply load no.1 at elevation 39.70

(continued)

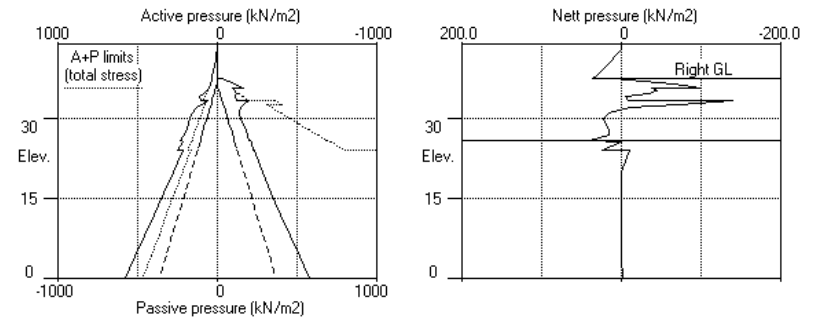
- Note:
- 54.89a Soil pressure at active limit
  - 110.08p Soil pressure at passive limit
  - 2731.09b Passive limit reduced because of berm
  - 57.64A Arching - soil pressure below active limit

Units: kN,m

Stage No.8 Apply load no.1 at elev. 39.70



Stage No.8 Apply load no.1 at elev. 39.70



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 Data filename/Run ID: RTW\_Section3\_B01\_DrivewayShorttterm(Final)  
 Kohimarama Retirement Village | Date:12-08-2019  
 Concept B02\_6.4m RTH\_900mmdia 1m cc | Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method  
 Factor of safety on soil strength

Stage No.	Ground level		Prop Elev.	FoS for toe elev. = 26.00		Toe elev. for FoS = 1.500		Direction of failure
	Act.	Pass.		Factor of Safety	Moment at elev.	Toe elev.	Wall Penetration	
1	44.00	44.00	Cant.	Conditions not suitable for FoS calc.				
2	44.00	44.00	Cant.	Conditions not suitable for FoS calc.				
3	44.00	44.00		No analysis at this stage				
4	44.00	44.00	Cant.	Conditions not suitable for FoS calc.				
5	44.00	37.50	Cant.	1.568	26.98	26.91	10.59	L to R
6	44.00	37.50	Cant.	1.555	26.96	26.77	10.73	L to R
7	44.00	37.50		No analysis at this stage				
8	44.00	37.50	Cant.	1.486	27.01	***	***	L to R

Legend: \*\*\* Result not found

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 Program: WALLAP Version 6.06 Revision A52.B71.R55 | Job No. 30314.1  
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 Data filename/Run ID: RTW\_Section3\_B01\_DrivewayShorttterm(Final)  
 Kohimarama Retirement Village | Date:12-08-2019  
 Concept B02\_6.4m RTH\_900mmdia 1m cc | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 5.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No  
 All soil moduli were factored to take account of  
 3-D effects due to the finite length of wall:  
 Modulus factors - Left side = 1.84  
 Right side = 1.70

Rigid boundaries: Left side 50.00 from wall Rough boundary  
 Right side 50.00 from wall Rough boundary  
 Lower rigid boundary at elevation 0.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m		kN.m/m		kN/m	
1	44.00	0.035	0.000	0.0	-0.0	0.0	0.0
2	43.00	0.032	0.000	1.9	-0.3	0.0	-1.1
3	42.00	0.029	0.000	4.0	-1.5	3.3	-2.4
4	41.00	0.026	0.000	12.5	-4.5	13.0	-3.8
5	40.00	0.022	0.000	33.7	-8.8	28.9	-5.2
6	39.70	0.021	0.000	43.3	-10.3	78.4	-5.0
7	39.15	0.020	0.000	89.9	-12.6	91.0	-4.8
8	38.60	0.018	0.000	144.1	-14.4	105.7	-4.7
9	38.05	0.016	0.000	206.9	-15.8	122.5	-4.8
10	37.50	0.015	0.000	279.5	-18.5	141.2	-5.2
11	37.00	0.013	0.000	351.2	-21.2	136.9	-5.7
12	36.40	0.011	0.000	429.0	-24.5	109.5	-4.7
13	35.80	0.010	0.000	483.3	-26.3	60.1	-0.9
14	35.23	0.008	0.000	511.6	-25.4	36.6	0.0
15	34.65	0.007	0.000	525.5	-21.9	14.5	-0.4
16	34.08	0.006	0.000	528.2	-15.7	13.2	0.0
17	33.50	0.005	0.000	529.6	-6.8	18.2	0.0
18	32.75	0.004	0.000	490.5	0.0	10.0	-78.9
19	32.00	0.003	0.000	411.3	0.0	4.6	-109.6
20	31.00	0.003	0.000	296.2	0.0	0.4	-106.9
21	30.00	0.002	0.000	197.3	0.0	0.0	-87.3
22	29.00	0.002	0.000	121.5	0.0	0.0	-65.6
23	28.00	0.002	0.000	65.8	0.0	0.0	-47.9
24	27.00	0.001	0.000	25.3	0.0	0.0	-32.8
25	26.00	0.001	0.000	0.0	0.0	0.0	-5.0
26	25.75	0.001	0.000	0.0	0.0	0.0	0.0
27	24.00	0.001	0.000	0.0	0.0	21.4	0.0
28	20.00	0.000	0.000	0.0	0.0	1.0	0.0
29	16.00	0.000	0.000	0.0	0.0	1.0	0.0
30	12.00	0.000	0.000	0.0	0.0	1.1	0.0
31	8.00	0.000	0.000	0.0	0.0	1.1	0.0
32	4.00	0.000	0.000	0.0	0.0	1.1	0.0
33	0.00	0.000	0.000	0.0	0.0	0.0	-0.0

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

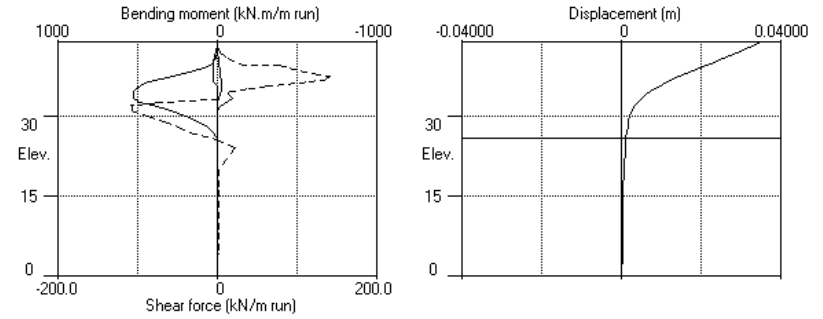
Stage no.	Bending moment				Shear force			
	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	4.2	32.00	-5.2	38.60	3.2	33.50	-1.5	42.00
2	8.0	31.00	-16.7	37.00	10.7	33.50	-5.2	40.00
3	No calculation at this stage							
4	9.8	31.00	-26.3	35.80	18.2	33.50	-5.7	37.00
5	318.4	33.50	0.0	44.00	96.0	37.50	-64.8	31.00
6	330.6	33.50	0.0	44.00	97.8	37.50	-67.5	31.00
7	No calculation at this stage							
8	529.6	33.50	0.0	44.00	141.2	37.50	-109.6	32.00

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum m	elev.	minimum m	elev.	
1	0.001	44.00	0.000	44.00	Apply surcharge no.1 at elev. 44.00
2	0.001	38.60	0.000	44.00	Apply surcharge no.2 at elev. 44.00
3	Wall displacements reset to zero Change EI of wall to 450887kN.m2/m run				
4	0.000	35.23	0.000	44.00	Apply water pressure profile no.1
5	0.068	44.00	0.000	44.00	Excav. to elev. 37.50 on RIGHT side
6	0.071	44.00	0.000	44.00	Apply surcharge no.3 at elev. 44.00
7	Wall displacements reset to zero Change EI of wall to 450887kN.m2/m run				
8	0.035	44.00	0.000	44.00	Apply load no.1 at elev. 39.70

Units: kN,m

Bending moment, shear force, displacement envelopes



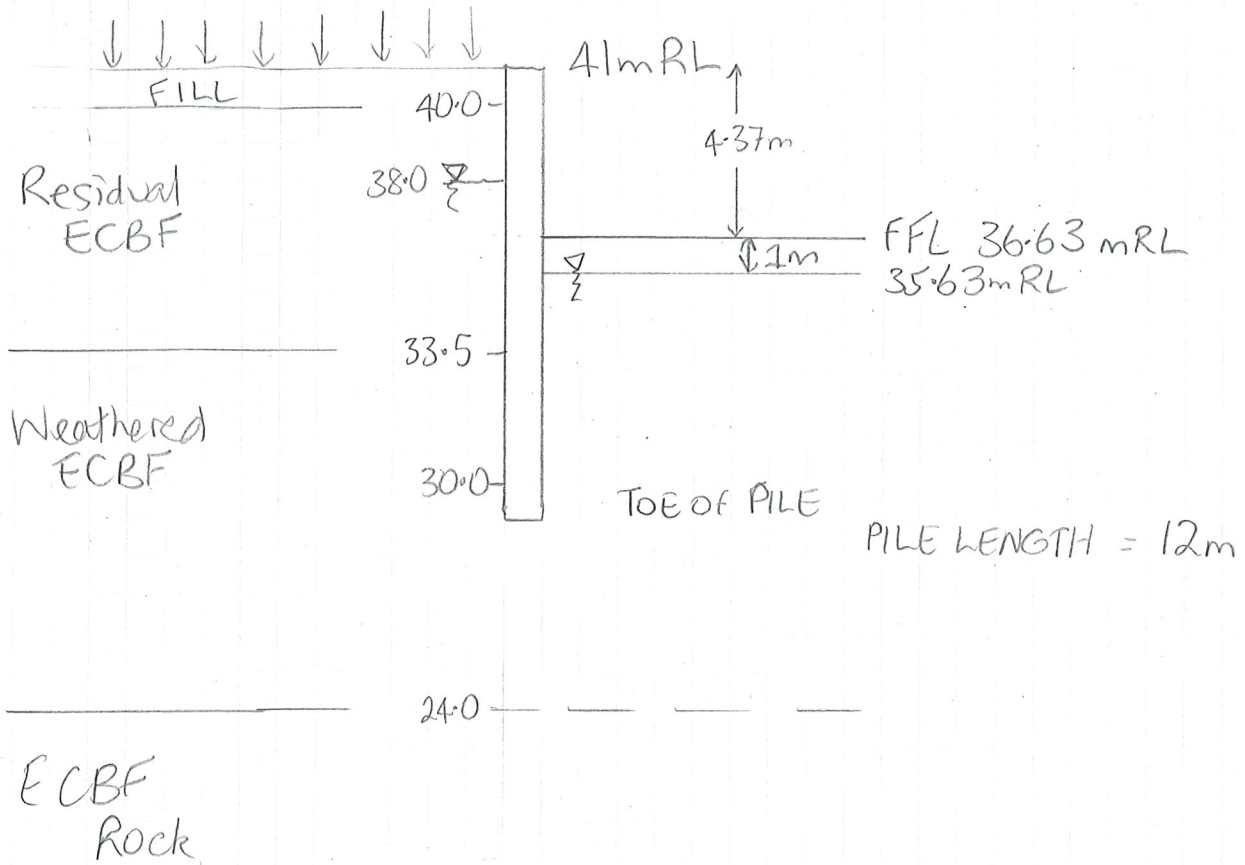
Wallap file: "RTW\_Section2\_BO1\_IL3"

Concept Design RTW

Section 2 BO1 IL3

Retained Height 5.37m includes construction  
Final Wall Height 4.37m

Traffic Load 12kPa  
10m wide road



Average GWL from BHO1 = 38mRL  
Also equals 1/3 wall height.





OUTPUT OPTIONS

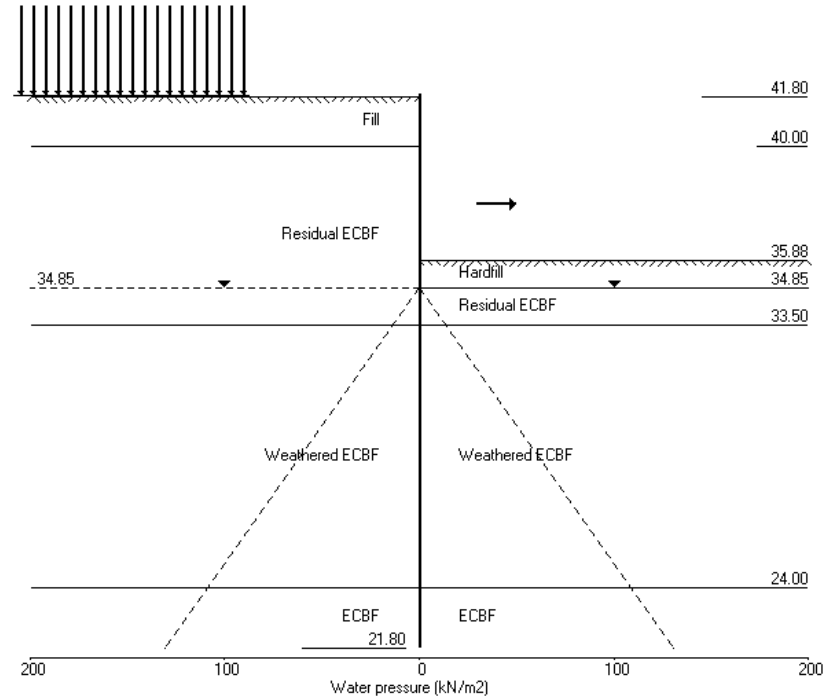
Stage no.	Stage description	Displacement Bending mom. Shear force	Active Passive pressures	Graph. output
1	Apply surcharge no.2 at elev. 41.80	Yes	Yes	Yes
2	Change EI of wall to 676340kN.m2/m run	Yes	Yes	Yes
3	Apply water pressure profile no.1	No	No	No
4	Excav. to elev. 34.85 on RIGHT side	Yes	Yes	Yes
5	Fill to elev. 35.88 on RIGHT side	Yes	Yes	Yes
6	Apply water pressure profile no.2	Yes	Yes	Yes
7	Change EI of wall to 450887kN.m2/m run	No	No	No
8	Apply water pressure profile no.1	Yes	Yes	Yes
9	Apply water pressure profile no.2	Yes	Yes	Yes
10	Apply load no.1 at elev. 37.88	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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 Data filename/Run ID: RTW\_Section1\_B02-IL3-pt  
 Kohimarama Retirement Village  
 Concept\_Section2\_B01\_4.37m RTH\_900mmdia 1m cc

Sheet No.  
 Job No. 30314.1  
 Made by : DNT  
 Date:12-08-2019  
 Checked :

Units: kN,m  
 Stage No.10 Apply load no.1 at elev. 37.88



(continued)

Stage No.10 Apply load no.1 at elevation 37.88

Units: kN,m  
 Stage No. 10 Apply load no.1 at elevation 37.88

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**  
 Factor of safety on soil strength

Stage No.	Ground level Act.	Prop. Pass.	FoS for toe elev. =	Moment of equilib. at elev.	Toe elev. for FoS =	Wall Penetr -ation	Direction of failure
10	41.80	35.88	Cant.	2.028	23.11	26.87	9.01 L to R

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 50.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 50.00 from wall Rough boundary  
 Right side 50.00 from wall Rough boundary  
 Lower rigid boundary at elevation 0.00 Rough boundary

\*\*\* Wall displacements reset to zero at stage 2

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
1	41.80	0.00	0.114	1.00E-02	0.0	-0.0		450887
2	40.90	0.00	0.105	1.00E-02	0.0	1.2		450887
3	40.00	3.17	0.096	1.00E-02	1.4	2.4		450887
4	38.94	9.58	0.085	1.00E-02	8.2	7.8		450887
5	37.88	16.29	0.075	9.98E-03	21.9	24.0	97.0	450887
		16.29	0.075	9.98E-03	118.9	24.0		
6	37.60	18.11	0.072	9.96E-03	123.7	58.0		450887
7	36.74	23.74	0.063	9.78E-03	141.7	172.2		450887
8	35.88	29.41	0.055	9.39E-03	164.6	303.9		450887
9	34.85	-28.44	0.046	8.63E-03	165.1	489.1		450887
		-26.37	0.046	8.63E-03	165.1	489.1		
10	34.17	-27.69	0.040	7.96E-03	146.8	594.6		450887
11	33.50	-39.58	0.035	7.19E-03	124.1	687.4		450887
		-112.01	0.035	7.19E-03	124.1	687.4		
12	32.35	-107.62	0.028	5.75E-03	-2.2	756.4		450887
13	31.20	-48.73	0.022	4.35E-03	-92.1	683.0		450887
14	30.00	-6.36	0.017	3.14E-03	-125.1	537.7		450887
15	28.80	14.41	0.014	2.23E-03	-120.3	383.1		450887
16	27.60	21.37	0.012	1.61E-03	-98.8	249.3		450887
17	26.40	23.66	0.010	1.21E-03	-71.8	146.2		450887
18	25.20	27.99	0.009	9.90E-04	-40.8	77.2		450887
19	24.00	22.72	0.008	8.63E-04	-10.4	48.4		450887
		-12.36	0.008	8.63E-04	-10.4	48.4		
20	22.90	-8.79	0.007	7.95E-04	-22.0	29.5		450887
21	21.80	38.39	0.006	7.71E-04	-5.8	0.0		0
22	21.50	0.01	0.006	0	0.0	0.0		0
23	17.95	0.08	0.005	0	0.2	0.0		0
24	14.40	0.16	0.004	0	0.6	0.0		0
25	9.60	0.07	0.003	0	1.2	0.0		0
26	4.80	0.04	0.002	0	1.4	0.0		0
27	0.00	-0.63	0.000	0	0.0	0.0		---

Node no.	Y coord	Effective stresses				Earth pressure kN/m2	Total earth pressure kN/m2	Adjusted soil modulus kN/m2
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2			
1	41.80	0.00	0.00	0.00	26.97	0.00	0.00a	20247
2	40.90	0.00	15.39	0.00	86.51	0.00	0.00a	20247
3	40.00	0.00	31.27	3.17	147.95	3.17	3.17a	20247
4	38.94	0.00	52.02	9.58	228.20	9.58	9.58a	20247
5	37.88	0.00	73.76	16.29	312.30	16.29	16.29a	20247
6	37.60	0.00	79.63	18.11	334.99	18.11	18.11a	20247
7	36.74	0.00	97.85	23.74	405.47	23.74	23.74a	20247
8	35.88	0.00	116.21	29.41	476.52	29.41	29.41a	20247
9	34.85	0.00	138.18	36.20	561.50	36.20	36.20a	20247
10	34.17	6.75	145.73	38.54	590.71	41.08	47.83	20247
11	33.50	13.50	153.17	40.83	619.49	42.94	56.44	20247
		13.50	153.17	27.90	823.71	30.10	43.60	50616
12	32.35	25.00	167.84	31.70	896.54	45.56	70.56	50616
13	31.20	36.50	182.12	35.41	967.38	56.29	92.79	50616
14	30.00	48.50	196.59	39.16	1039.24	77.02	125.52	50616
15	28.80	60.50	210.68	42.82	1109.15	90.80	151.30	50616
16	27.60	72.50	224.41	46.38	1177.31	98.68	171.18	50616
17	26.40	84.50	237.83	49.86	1243.92	104.94	189.44	50616
18	25.20	96.50	250.97	53.27	1309.17	112.80	209.30	50616
19	24.00	108.50	263.88	56.62	1373.25	114.28	222.78	50616
		108.50	263.88	37.76	1750.73	86.95	195.45	101233
20	22.90	119.50	277.74	40.90	1835.01	91.37	210.87	101233
21	21.80	130.50	291.44	44.01	1918.37	120.01	250.51	101233
22	21.50	133.50	295.15	44.85	1940.96	101.14	234.64	101233
23	17.95	169.00	338.46	54.67	2204.48	118.80	287.80	101233
24	14.40	204.50	380.92	64.30	2462.80	136.39	340.89	101233
25	9.60	252.50	437.53	77.14	2807.22	161.07	413.57	101233
26	4.80	300.50	493.65	89.87	3148.67	186.29	486.79	101233
27	0.00	348.50	549.57	102.55	3488.85	209.52	558.02	101233

Node no.	Y coord	Effective stresses				Earth pressure kN/m2	Total earth pressure kN/m2	Adjusted soil modulus kN/m2
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2			
1	41.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	40.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	38.94	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	37.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	37.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	36.74	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	35.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	40403
9	34.85	0.00	22.66	4.07	201.50	64.64	64.64	40403
		0.00	22.66	0.50	114.63	62.58	62.58	20202
10	34.17	6.75	28.06	2.17	135.53	68.77	75.52	20202
11	33.50	13.50	33.46	3.84	156.43	82.52	96.02	20202
		13.50	33.46	0.00	229.54	142.11	155.61	50504
12	32.35	25.00	44.98	0.00	286.67	153.18	178.18	50504
13	31.20	36.50	56.50	2.81	343.86	105.03	141.53	50504
14	30.00	48.50	68.53	5.93	403.59	83.38	131.88	50504
15	28.80	60.50	80.58	9.06	463.42	76.39	136.89	50504
16	27.60	72.50	92.66	12.19	523.34	77.31	149.81	50504

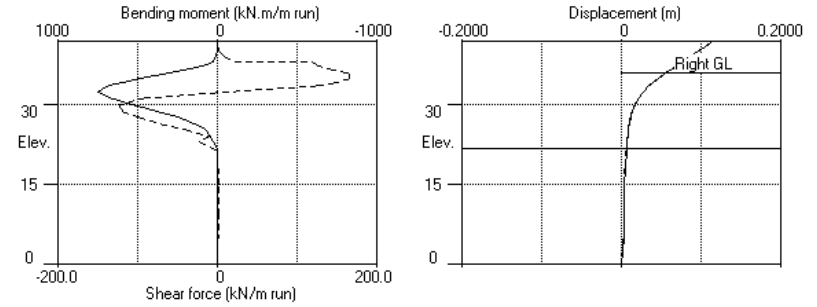
Stage No.10 Apply load no.1 at elevation 37.88

(continued)

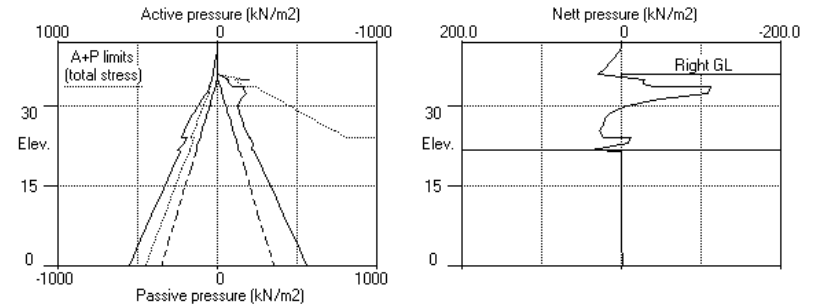
Node no.	Y coord	Effective stresses					Total earth pressure	Adjusted soil modulus
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
17	26.40	84.50	104.75	15.33	583.37	81.28	165.78	50504
18	25.20	96.50	116.87	18.48	643.53	84.81	181.31	50504
19	24.00	108.50	129.02	21.63	703.83	91.55	200.05	50504
		108.50	129.02	7.17	930.18	99.30	207.80	101008
20	22.90	119.50	142.38	10.20	1011.47	100.16	219.66	101008
21	21.80	130.50	155.77	13.24	1092.92	81.62	212.12	101008
22	21.50	133.50	159.42	14.07	1115.16	101.12	234.62	101008
23	17.95	169.00	202.83	23.91	1379.27	118.72	287.72	101008
24	14.40	204.50	246.53	33.83	1645.16	136.23	340.73	101008
25	9.60	252.50	306.07	47.33	2007.37	161.01	413.51	101008
26	4.80	300.50	366.05	60.93	2372.30	186.25	486.75	101008
27	0.00	348.50	426.38	74.61	2739.37	210.15	558.65	101008

Note: 36.20a Soil pressure at active limit  
 123.45p Soil pressure at passive limit

Units: kN,m  
 Stage No.10 Apply load no.1 at elev. 37.88



Stage No.10 Apply load no.1 at elev. 37.88



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 Kohimarama Retirement Village  
 Concept\_Section2\_B01\_4.37m RTH\_900mmdia 1m cc

Sheet No.  
 Job No. 30314.1  
 Made by : DNT  
 Date:12-08-2019  
 Checked :

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method  
 Factor of safety on soil strength

Stage No.	Ground level		Prop Elev.	FoS for toe elev. = 21.80		Toe elev. for FoS = 1.500		Direction of failure
	Act.	Pass.		Factor of Safety	Moment at elev.	Toe elev.	Wall Penetration	
1	41.80	41.80	Cant.	Conditions not suitable for FoS calc.				
2	41.80	41.80		No analysis at this stage				
3	41.80	41.80		No analysis at this stage				
4	41.80	34.85	Cant.	1.589	22.84	23.06	11.79	L to R
5	41.80	35.88	Cant.	2.070	22.97	27.87	8.01	L to R
6	41.80	35.88	Cant.	2.245	22.98	28.98	6.90	L to R
7	41.80	35.88		No analysis at this stage				
8	41.80	35.88	Cant.	2.070	22.97	27.87	8.01	L to R
9	41.80	35.88	Cant.	2.245	22.98	28.98	6.90	L to R
10	41.80	35.88	Cant.	2.028	23.11	26.87	9.01	L to R

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 Data filename/Run ID: RTW\_Section1\_B02-IL3-pt  
 Kohimarama Retirement Village  
 Concept\_Section2\_B01\_4.37m RTH\_900mmdia 1m cc

Sheet No.  
 Job No. 30314.1  
 Made by : DNT  
 Date:12-08-2019  
 Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 50.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 50.00 from wall Rough boundary  
 Right side 50.00 from wall Rough boundary  
 Lower rigid boundary at elevation 0.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	41.80	0.114	0.000	0.0	-0.0	0.0	0.0
2	40.90	0.105	0.000	1.4	0.0	0.8	-0.1
3	40.00	0.096	0.000	3.9	-0.1	3.8	-0.6
4	38.94	0.085	0.000	13.2	-1.2	13.5	-1.7
5	37.88	0.075	0.000	36.7	-3.3	118.9	-2.4
6	37.60	0.072	0.000	58.0	-4.0	123.7	-2.6
7	36.74	0.063	0.000	172.2	-6.3	141.7	-2.7
8	35.88	0.055	0.000	303.9	-8.3	164.6	-2.1
9	34.85	0.046	0.000	489.1	-9.7	165.1	-0.5
10	34.17	0.040	0.000	594.6	-9.5	146.8	0.0
11	33.50	0.035	0.000	687.4	-7.9	137.5	0.0
12	32.35	0.028	0.000	756.4	-5.0	45.5	-2.2
13	31.20	0.022	0.000	683.0	-4.3	0.0	-92.1
14	30.00	0.017	0.000	537.7	-5.1	0.0	-125.1
15	28.80	0.014	0.000	383.1	-6.6	0.0	-120.3
16	27.60	0.012	0.000	249.3	-8.2	0.0	-98.8
17	26.40	0.011	0.000	146.2	-8.9	0.2	-71.8
18	25.20	0.009	0.000	77.2	-7.6	2.6	-40.8
19	24.00	0.008	0.000	49.3	-2.6	6.6	-10.4
20	22.90	0.007	0.000	31.9	0.0	1.1	-22.2
21	21.80	0.006	0.000	0.0	0.0	0.0	-6.2
22	21.50	0.006	0.000	0.0	0.0	0.0	-0.0
23	17.95	0.005	0.000	0.0	0.0	0.2	-0.1
24	14.40	0.004	0.000	0.0	0.0	0.7	0.0
25	9.60	0.003	0.000	0.0	0.0	1.3	0.0
26	4.80	0.003	0.000	0.0	0.0	1.5	0.0
27	0.00	0.000	0.000	0.0	0.0	0.0	-0.0

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

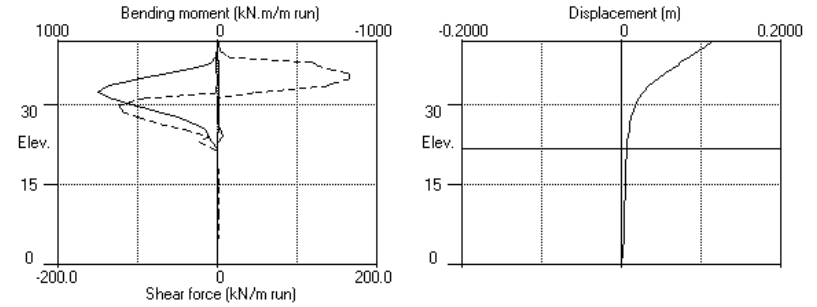
Stage no.	Bending moment				Shear force			
	maximum kN.m/m	elev. m	minimum kN.m/m	elev. m	maximum kN/m	elev. m	minimum kN/m	elev. m
1	0.7	22.90	-9.7	34.85	6.6	24.00	-2.7	36.74
2	No calculation at this stage							
3	No calculation at this stage							
4	517.3	32.35	-0.0	41.80	137.5	33.50	-89.0	28.80
5	527.2	32.35	-0.0	41.80	136.9	34.17	-89.3	28.80
6	536.3	32.35	-0.0	41.80	130.7	34.17	-90.8	28.80
7	No calculation at this stage							
8	530.4	32.35	-0.0	41.80	136.0	34.17	-90.0	28.80
9	536.3	32.35	-0.0	41.80	130.7	34.17	-90.8	28.80
10	756.4	32.35	-0.0	41.80	165.1	34.85	-125.1	30.00

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum m	elev. m	minimum m	elev. m	
1	0.002	31.20	0.000	41.80	Apply surcharge no.2 at elev. 41.80
2					Wall displacements reset to zero Change EI of wall to 676340kN.m <sup>2</sup> /m run
3					No calculation at this stage Apply water pressure profile no.1
4	0.081	41.80	0.000	41.80	Excav. to elev. 34.85 on RIGHT side
5	0.081	41.80	0.000	41.80	Fill to elev. 35.88 on RIGHT side
6	0.079	41.80	0.000	41.80	Apply water pressure profile no.2
7					No calculation at this stage Change EI of wall to 450887kN.m <sup>2</sup> /m run
8	0.080	41.80	0.000	41.80	Apply water pressure profile no.1
9	0.079	41.80	0.000	41.80	Apply water pressure profile no.2
10	0.114	41.80	0.000	41.80	Apply load no.1 at elev. 37.88

Units: kN,m

Bending moment, shear force, displacement envelopes

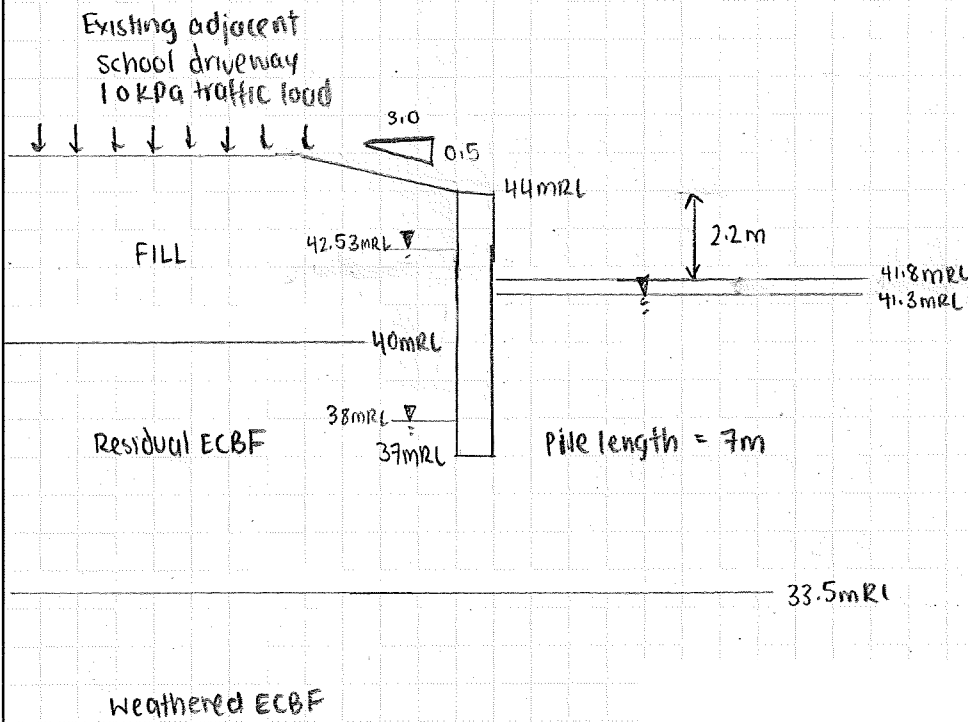




Wallap file :Section2\_B01\_DrivewayIL2.dat

Concept Design RTW

SECTION 3





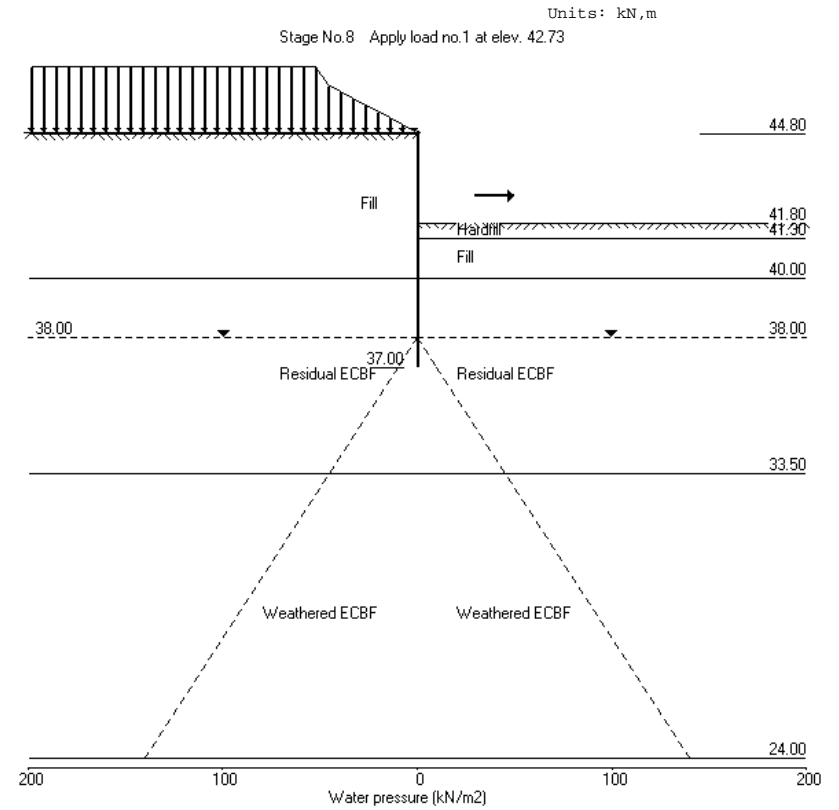
OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement	Active, Bending mom. Shear force	Graph. Passive output pressures
1	Apply surcharge no.1 at elev. 44.80	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 44.80	Yes	Yes	Yes
3	Change EI of wall to 24357kN.m2/m run	Yes	Yes	Yes
4	Excav. to elev. 41.30 on RIGHT side	Yes	Yes	Yes
5	Fill to elev. 41.80 on RIGHT side	Yes	Yes	Yes
6	Apply water pressure profile no.1	Yes	Yes	Yes
7	Apply water pressure profile no.2	Yes	Yes	Yes
8	Apply load no.1 at elev. 42.73	No	No	No
*	Summary output	Yes	-	Yes

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 Data filename/Run ID: Section2\_B01\_Driveway3-5-final  
 Kohimarama Retirement Village  
 Section5\_B01\_Driveway

Sheet No.  
 Job No. 30214.1  
 Made by : RECA  
 Date:12-08-2019  
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 Data filename/Run ID: Section2\_B01\_Driveway3-5-final  
 Kohimarama Retirement Village  
 Section5\_B01\_Driveway

Sheet No.  
 Job No. 30214.1  
 Made by : RECA  
 Date:12-08-2019  
 Checked :

Run ID: Section2\_B01\_Driveway3-5-final  
 Kohimarama Retirement Village  
 Section5\_B01\_Driveway

Sheet No.  
 Date:12-08-2019  
 Checked :

Stage No.8 Apply load no.1 at elevation 42.73

(continued)

Units: kN,m  
 Stage No. 8 Apply load no.1 at elevation 42.73

**STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method**  
 Factor of safety on nett available passive  
 Active limit pressures calculated by Wedge Stability  
 Passive limit pressures calculated by Wedge Stability

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe of Safety at elev.	Moment of equilib. at elev.	Toe elev.	Wall Penetr-ation	Direction of failure
8	44.80	41.80	Cant.	2.269	37.75	37.41	4.39	L to R

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**  
 Analysis options

Length of wall perpendicular to section = 1000.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Active limit pressures calculated by Wedge Stability  
 Passive limit pressures calculated by Wedge Stability  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 50.00 from wall Smooth boundary  
 Right side 50.00 from wall Smooth boundary  
 Lower rigid boundary at elevation -10.00 Smooth boundary

\*\*\* Wall displacements reset to zero at stage 3

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear Force kN/m	Bending moment kN.m/m	Prop Forces kN/m
1	44.80	0.00	0.095	1.49E-02	0.0	0.0	
2	44.40	0.00	0.089	1.49E-02	0.0	0.1	
3	44.00	0.00	0.083	1.49E-02	0.0	0.3	
4	43.60	2.00	0.077	1.49E-02	0.4	0.4	
5	43.20	4.92	0.071	1.49E-02	1.8	0.8	
6	42.97	6.60	0.068	1.49E-02	3.1	1.4	
7	42.73	8.27	0.064	1.49E-02	4.9	2.4	40.0
8	42.53	9.71	0.061	1.49E-02	46.7	11.7	
9	42.17	12.25	0.056	1.45E-02	50.7	29.4	
10	41.80	15.84	0.050	1.40E-02	55.8	48.9	
11	41.55	-29.33	0.047	1.34E-02	54.1	63.3	
12	41.30	-76.12	0.044	1.27E-02	41.0	75.9	
13	41.05	-64.50	0.041	1.18E-02	26.7	84.6	
14	40.80	-63.11	0.038	1.09E-02	10.7	89.3	
15	40.40	-41.90	0.034	9.50E-03	-10.3	88.6	
16	40.00	-18.59	0.030	8.09E-03	-22.4	81.1	
17	39.60	-24.65	0.030	8.09E-03	-22.4	81.1	
18	39.20	-11.40	0.027	6.83E-03	-29.6	70.2	
19	38.80	-1.15	0.025	5.77E-03	-32.1	57.5	
20	38.40	3.90	0.023	4.92E-03	-31.5	44.5	
21	38.00	6.20	0.021	4.28E-03	-29.5	32.2	
22	37.60	7.87	0.019	3.84E-03	-26.7	20.9	
23	37.30	10.95	0.018	3.57E-03	-22.9	10.9	
24	37.00	21.10	0.017	3.47E-03	-18.1	4.5	
25	36.90	74.84	0.016	3.45E-03	-3.7	-0.0	

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear Force kN/m	Bending moment kN.m/m	Prop Forces kN/m
25	36.90	-0.03	0.016	0.016	0	-0.0	0.0
26	36.05	0.01	0.014	0.014	0	-0.0	0.0
27	35.20	0.01	0.013	0.013	0	0.0	0.0
28	34.35	0.01	0.011	0.011	0	0.0	0.0
29	33.50	16.05	0.010	0.010	0	6.8	0.0
30	31.95	-8.72	0.010	0.010	0	6.8	0.0
31	30.40	0.01	0.008	0.008	0	0.1	0.0
32	28.80	0.01	0.007	0.007	0	0.1	0.0
33	27.20	0.00	0.006	0.006	0	0.1	0.0
34	25.60	0.00	0.005	0.005	0	0.1	0.0
35	24.00	-0.00	0.004	0.004	0	0.1	0.0
36	22.40	10.10	0.004	0.004	0	8.2	0.0
37	20.80	-10.10	0.004	0.004	0	8.2	0.0
38	19.20	-0.00	0.003	0.003	0	0.1	0.0
39	17.60	-0.00	0.003	0.003	0	0.1	0.0
40	16.00	-0.00	0.002	0.002	0	0.1	0.0
41	14.40	-0.00	0.002	0.002	0	0.1	0.0
42	12.80	-0.00	0.002	0.002	0	0.1	0.0
43	11.20	-0.00	0.002	0.002	0	0.1	0.0
44	9.60	-0.00	0.002	0.002	0	0.1	0.0
45	8.00	-0.00	0.001	0.001	0	0.1	0.0
46	6.40	-0.00	0.001	0.001	0	0.1	0.0
47	4.80	-0.00	0.001	0.001	0	0.1	0.0
48	3.20	-0.00	0.001	0.001	0	0.1	0.0
49	1.60	-0.00	0.001	0.001	0	0.1	0.0
50	0.00	-0.00	0.001	0.001	0	0.1	0.0
51	-1.60	-0.00	0.001	0.001	0	0.1	0.0
52	-3.20	-0.00	0.001	0.001	0	0.1	0.0
53	-4.80	-0.00	0.001	0.001	0	0.0	0.0
54	-6.40	-0.00	0.001	0.001	0	0.0	0.0
55	-8.00	-0.02	0.001	0.001	0	0.0	0.0
56	-9.00	-0.00	0.001	0.001	0	0.0	0.0
57	-10.00	-0.03	0.001	0.001	0	0.0	0.0

Node no.	Y coord	Effective stresses				Earth pressure kN/m2	Total earth pressure kN/m2	Adjusted soil modulus kN/m2
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2			
1	44.80	0.00	0.00	0.00	26.98	0.00	0.00a 19999	
2	44.40	0.00	9.09	0.00	91.70	0.00	0.00a 19999	
3	44.00	0.00	18.15	0.00	189.67	0.00	0.00a 19999	
4	43.60	0.00	27.15	2.00	257.66	2.00	2.00a 19999	
5	43.20	0.00	36.07	4.92	324.95	4.92	4.92a 19999	
6	42.97	0.00	41.21	6.60	363.80	6.60	6.60a 19999	
7	42.73	0.00	46.31	8.27	402.29	8.27	8.27a 19999	
8	42.53	0.00	50.70	9.71	435.42	9.71	9.71a 19999	
9	42.17	0.00	58.48	12.25	494.19	12.25	12.25a 19999	
10	41.80	0.00	66.12	15.84	431.55	15.84	15.84a 19999	
11	41.55	0.00	71.28	19.41	273.89	19.41	19.41a 19999	
12	41.30	0.00	76.36	21.38	291.69	21.38	21.38a 19999	
13	41.05	0.00	81.39	23.32	309.27	23.39	23.39 19999	
14	40.80	0.00	86.35	25.24	326.65	31.77	31.77 19999	
15	40.40	0.00	94.17	28.26	354.02	40.79	40.79 19999	
16	40.00	0.00	101.86	31.23	380.93	48.82	48.82 19999	
17	39.60	0.00	101.86	31.21	380.92	46.60	46.60 19999	

(continued)

Stage No.8 Apply load no.1 at elevation 42.73

Stage No.8 Apply load no.1 at elevation 42.73

(continued)

LEFT side								
Node no.	Y coord	Effective stresses					Total earth pressure	Adjusted soil modulus
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2
17	39.60	0.00	110.62	34.60	411.60	52.47	52.47	19999
18	39.20	0.00	119.27	37.94	441.88	59.21	59.21	19999
19	38.80	0.00	127.82	38.85	456.88	63.95	63.95	19999
20	38.40	0.00	136.29	39.35	469.68	67.74	67.74	19999
21	38.00	0.00	144.66	42.22	497.15	71.52	71.52	19999
22	37.60	4.00	148.97	44.11	510.66	74.22	78.22	19999
23	37.30	7.00	152.15	45.51	520.64	80.14	87.14	19999
24	37.00	10.00	155.30	46.90	530.51	108.19	118.19	19999
		10.00	155.30	44.31	534.46	108.19	118.19	19999
25	36.90	11.00	156.35	44.71	537.76	70.55	81.55	19999
26	36.05	19.50	165.08	48.02	565.37	74.44	93.94	19999
27	35.20	28.00	173.62	51.28	592.32	78.31	106.31	19999
28	34.35	36.50	182.00	54.48	618.74	82.63	119.13	19999
29	33.50	45.00	190.25	57.64	644.76	92.88	137.88	19999
		45.00	190.25	42.36	1074.58	79.55	124.55	49998
30	31.95	60.50	205.07	46.15	1057.65	89.12	149.62	49998
31	30.40	76.00	219.68	49.44	1024.84	95.57	171.57	49998
32	28.80	92.00	234.65	54.02	1089.66	102.71	194.71	49998
33	27.20	108.00	249.57	58.60	1154.24	110.15	218.15	49998
34	25.60	124.00	264.47	63.16	1218.76	117.86	241.86	49998
35	24.00	140.00	279.39	67.74	1283.36	130.00	270.00	49998
		140.00	279.39	41.48	1816.06	103.27	243.27	99955
36	22.40	156.00	297.54	45.61	1924.66	115.22	271.22	99955
37	20.80	172.00	315.74	49.76	2033.55	122.90	294.90	99955
38	19.20	188.00	333.99	53.93	2142.74	130.70	318.70	99955
39	17.60	204.00	352.30	58.10	2252.27	138.57	342.57	99955
40	16.00	220.00	370.66	62.29	2362.14	146.51	366.51	99955
41	14.40	236.00	389.08	66.49	2472.34	154.50	390.50	99955
42	12.80	252.00	407.56	70.70	2582.85	162.52	414.52	99955
43	11.20	268.00	426.08	74.92	2693.66	170.58	438.58	99955
44	9.60	284.00	444.65	79.15	2804.76	178.66	462.66	99955
45	8.00	300.00	463.26	83.40	2916.13	186.77	486.77	99955
46	6.40	316.00	481.92	87.65	3027.75	194.89	510.89	99955
47	4.80	332.00	500.61	91.91	3139.60	203.03	535.03	99955
48	3.20	348.00	519.35	96.18	3251.66	211.19	559.19	99955
49	1.60	364.00	538.11	100.46	3363.92	219.35	583.35	99955
50	0.00	380.00	556.90	104.75	3476.37	227.53	607.53	99955
51	-1.60	396.00	575.73	109.04	3588.98	235.72	631.72	99955
52	-3.20	412.00	594.57	113.33	3701.75	243.92	655.92	99955
53	-4.80	428.00	613.45	117.64	3814.66	252.12	680.12	99955
54	-6.40	444.00	632.34	121.94	3927.70	260.33	704.33	99955
55	-8.00	460.00	651.25	126.26	4040.86	268.54	728.54	99955
56	-9.00	470.00	663.09	128.95	4111.65	273.69	743.69	99955
57	-10.00	480.00	674.92	131.65	4182.47	278.82	758.82	99955

RIGHT side								
Node no.	Y coord	Effective stresses					Total earth pressure	Adjusted soil modulus
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2
1	44.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	44.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	44.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	43.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0

RIGHT side								
Node no.	Y coord	Effective stresses					Total earth pressure	Adjusted soil modulus
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2
5	43.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	42.97	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	42.73	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	42.53	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	41.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	39998
11	41.55	0.00	5.50	0.92	48.75	48.75	48.75p	39998
12	41.30	0.00	11.00	1.84	97.50	97.50	97.50p	39998
		0.00	11.00	0.00	71.08	71.08	71.08p	19999
13	41.05	0.00	15.25	0.00	87.88	87.88	87.88p	19999
14	40.80	0.00	19.50	0.00	104.69	94.88	94.88	19999
15	40.40	0.00	26.30	1.69	131.58	82.70	82.70	19999
16	40.00	0.00	33.10	3.86	158.48	67.41	67.41	19999
		0.00	33.10	3.86	158.47	71.25	71.25	19999
17	39.60	0.00	41.10	6.41	190.11	63.87	63.87	19999
18	39.20	0.00	49.10	8.97	221.75	60.36	60.36	19999
19	38.80	0.00	57.10	11.53	253.39	60.05	60.05	19999
20	38.40	0.00	65.10	14.09	285.02	61.53	61.53	19999
21	38.00	0.00	73.10	16.64	316.66	63.65	63.65	19999
22	37.60	4.00	77.10	18.06	332.57	63.27	67.27	19999
23	37.30	7.00	80.10	19.13	344.50	59.04	66.04	19999
24	37.00	10.00	83.10	20.19	356.43	33.34	43.34	19999
		10.00	83.10	19.44	346.04	33.34	43.34	19999
25	36.90	11.00	84.10	19.76	349.88	70.58	81.58	19999
26	36.05	19.50	92.60	22.49	382.49	74.43	93.93	19999
27	35.20	28.00	101.10	25.21	415.10	78.30	106.30	19999
28	34.35	36.50	109.61	27.94	447.71	82.63	119.13	19999
29	33.50	45.00	118.11	30.67	480.32	76.83	121.83	19999
		45.00	118.11	19.59	654.45	88.28	133.28	49998
30	31.95	60.50	133.61	23.86	732.06	89.11	149.61	49998
31	30.40	76.00	149.12	28.13	809.67	95.56	171.56	49998
32	28.80	92.00	165.13	32.53	889.80	102.70	194.70	49998
33	27.20	108.00	181.15	36.94	969.94	110.15	218.15	49998
34	25.60	124.00	197.17	41.35	1050.10	117.86	241.86	49998
35	24.00	140.00	213.19	45.76	1130.28	119.90	259.90	49998
		140.00	213.19	27.99	1449.81	113.37	253.37	99996
36	22.40	156.00	232.41	32.56	1567.41	115.23	271.23	99996
37	20.80	172.00	251.64	37.14	1685.03	122.90	294.90	99996
38	19.20	188.00	270.87	41.71	1802.68	130.70	318.70	99996
39	17.60	204.00	290.11	46.28	1920.36	138.58	342.58	99996
40	16.00	220.00	309.35	50.86	2038.07	146.51	366.51	99996
41	14.40	236.00	328.60	55.44	2155.80	154.50	390.50	99996
42	12.80	252.00	347.85	60.01	2273.57	162.53	414.53	99996
43	11.20	268.00	367.11	64.59	2391.36	170.58	438.58	99996
44	9.60	284.00	386.37	69.17	2509.19	178.67	462.67	99996
45	8.00	300.00	405.64	73.75	2627.05	186.77	486.77	99996
46	6.40	316.00	424.91	78.34	2744.95	194.89	510.89	99996
47	4.80	332.00	444.19	82.92	2862.87	203.04	535.04	99996
48	3.20	348.00	463.47	87.50	2980.83	211.19	559.19	99996
49	1.60	364.00	482.76	92.09	3098.82	219.36	583.36	99996
50	0.00	380.00	502.05	96.68	3216.84	227.53	607.53	99996
51	-1.60	396.00	521.35	101.27	3334.89	235.72	631.72	99996
52	-3.20	412.00	540.66	105.86	3452.98	243.92	655.92	99996
53	-4.80	428.00	559.97	110.45	3571.09	252.12	680.12	99996

Stage No.8 Apply load no.1 at elevation 42.73

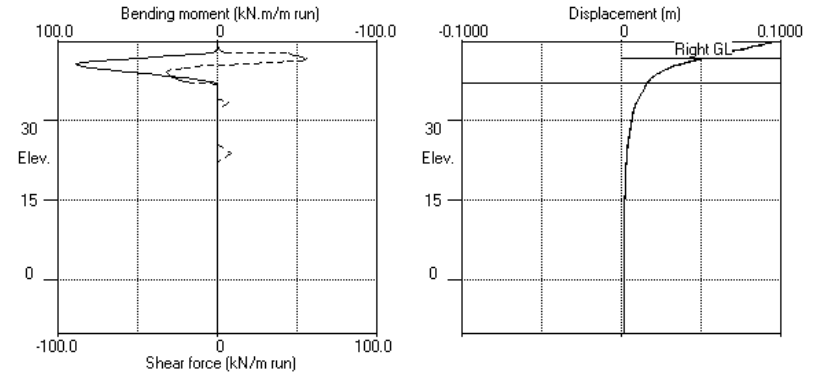
(continued)

Node no.	Y coord	Water press.	Vertic -al	Effective stresses		Earth pressure	Total earth pressure	Adjusted soil modulus
				Active limit	Passive limit			
54	-6.40	444.00	579.28	115.04	3689.24	260.34	704.34	99996
55	-8.00	460.00	598.60	119.63	3807.41	268.56	728.56	99996
56	-9.00	470.00	610.68	122.50	3881.29	273.69	743.69	99996
57	-10.00	480.00	622.76	125.38	3955.17	278.85	758.85	99996

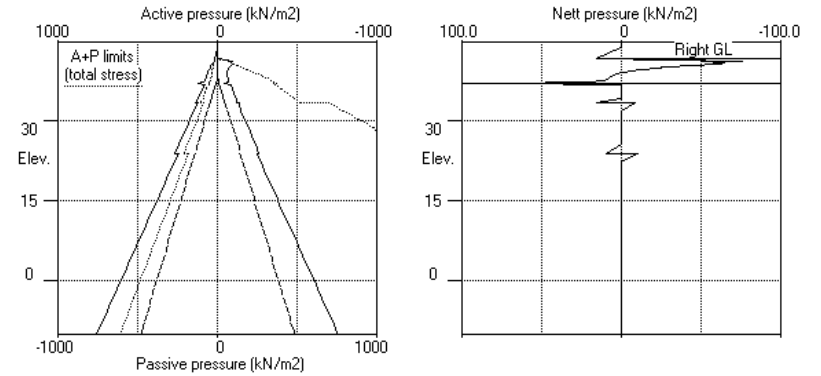
Note: 21.38a Soil pressure at active limit  
 87.88p Soil pressure at passive limit

Units: kN,m

Stage No.8 Apply load no.1 at elev. 42.73



Stage No.8 Apply load no.1 at elev. 42.73



Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Burland-Potts method

Factor of safety on nett available passive  
 Active limit pressures calculated by Wedge Stability  
 Passive limit pressures calculated by Wedge Stability

Stage No.	Ground level		Prop Elev.	FoS for toe elev. = 37.00		Toe elev. for FoS = 2.000		Direction of failure
	Act.	Pass.		Factor of Safety	Moment at elev.	Toe elev.	Wall Penetration	
1	44.80	44.00	Cant.	17.930	40.67	***	***	L to R
2	44.80	44.00	Cant.	18.472	40.40	***	***	L to R
3	44.80	44.00		No analysis at this stage				
4	44.80	41.30	Cant.	2.681	37.53	37.90	3.40	L to R
5	44.80	41.80	Cant.	4.254	37.65	39.41	2.39	L to R
6	44.80	41.80	Cant.	2.449	37.44	38.07	3.73	L to R
7	44.80	41.80	Cant.	4.254	37.65	39.41	2.39	L to R
8	44.80	41.80	Cant.	2.269	37.75	37.41	4.39	L to R

Legend: \*\*\* Result not found

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m  
 2-D finite element model. Soil arching modelled.  
 Soil deformations are elastic until the active or passive limit is reached  
 Active limit pressures calculated by Wedge Stability  
 Passive limit pressures calculated by Wedge Stability  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 50.00 from wall Smooth boundary  
 Right side 50.00 from wall Smooth boundary  
 Lower rigid boundary at elevation -10.00 Smooth boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m		kN.m/m		kN/m	
1	44.80	0.095	0.000	0.0	0.0	0.0	0.0
2	44.40	0.089	0.000	0.2	0.0	0.1	0.0
3	44.00	0.083	0.000	0.3	0.0	0.8	0.0
4	43.60	0.077	0.000	0.5	0.0	0.5	0.0
5	43.20	0.071	0.000	0.9	0.0	2.1	-0.3
6	42.97	0.068	0.000	1.6	0.0	3.6	-0.5
7	42.73	0.064	0.000	2.6	0.0	44.9	-0.6
8	42.53	0.061	0.000	11.7	0.0	46.7	-0.7
9	42.17	0.056	0.000	29.4	-0.1	50.7	-0.7
10	41.80	0.050	0.000	48.9	-0.3	55.8	-0.7
11	41.55	0.047	0.000	63.3	-0.5	54.1	-0.6
12	41.30	0.044	0.000	75.9	-0.6	41.0	-0.6
13	41.05	0.041	0.000	84.6	-0.8	26.7	-0.5
14	40.80	0.038	0.000	89.3	-0.9	15.6	-0.3
15	40.40	0.034	0.000	88.6	-0.9	3.0	-10.3
16	40.00	0.030	0.000	81.1	-0.9	0.4	-22.4
17	39.60	0.027	0.000	70.2	-0.8	0.2	-29.6
18	39.20	0.025	0.000	57.5	-0.7	0.2	-32.1
19	38.80	0.023	0.000	44.5	-0.6	0.2	-31.5
20	38.40	0.021	0.000	32.2	-0.5	0.2	-29.5
21	38.00	0.019	0.000	20.9	-0.4	0.3	-26.7
22	37.60	0.018	0.000	10.9	-0.3	0.4	-22.9
23	37.30	0.017	0.000	4.5	-0.1	0.4	-18.1
24	37.00	0.016	0.000	0.0	-0.0	0.1	-3.7
25	36.90	0.016	0.000	0.0	0.0	0.0	-0.0
26	36.05	0.014	0.000	0.0	0.0	0.0	-0.0
27	35.20	0.013	0.000	0.0	0.0	0.0	0.0
28	34.35	0.011	0.000	0.0	0.0	0.0	0.0
29	33.50	0.010	0.000	0.0	0.0	7.8	0.0
30	31.95	0.008	0.000	0.0	0.0	0.1	0.0
31	30.40	0.007	0.000	0.0	0.0	0.1	0.0
32	28.80	0.006	0.000	0.0	0.0	0.1	0.0
33	27.20	0.005	0.000	0.0	0.0	0.1	0.0
34	25.60	0.004	0.000	0.0	0.0	0.1	0.0
35	24.00	0.004	0.000	0.0	0.0	9.5	0.0
36	22.40	0.003	0.000	0.0	0.0	0.1	0.0
37	20.80	0.003	0.000	0.0	0.0	0.1	0.0
38	19.20	0.002	0.000	0.0	0.0	0.1	0.0
39	17.60	0.002	0.000	0.0	0.0	0.1	0.0
40	16.00	0.002	0.000	0.0	0.0	0.1	0.0
41	14.40	0.002	0.000	0.0	0.0	0.1	0.0



**Bending moment, shear force and displacement envelopes**

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m		kN.m/m		kN/m	
42	12.80	0.002	0.000	0.0	0.0	0.1	0.0
43	11.20	0.002	0.000	0.0	0.0	0.1	0.0
44	9.60	0.002	0.000	0.0	0.0	0.1	0.0
45	8.00	0.002	0.000	0.0	0.0	0.1	0.0
46	6.40	0.002	0.000	0.0	0.0	0.1	0.0
47	4.80	0.002	0.000	0.0	0.0	0.1	0.0
48	3.20	0.002	0.000	0.0	0.0	0.1	0.0
49	1.60	0.002	0.000	0.0	0.0	0.1	0.0
50	0.00	0.002	0.000	0.0	0.0	0.1	0.0
51	-1.60	0.002	0.000	0.0	0.0	0.1	0.0
52	-3.20	0.002	0.000	0.0	0.0	0.1	0.0
53	-4.80	0.002	0.000	0.0	0.0	0.1	0.0
54	-6.40	0.002	0.000	0.0	0.0	0.1	0.0
55	-8.00	0.002	0.000	0.0	0.0	0.0	0.0
56	-9.00	0.002	0.000	0.0	0.0	0.0	0.0
57	-10.00	0.002	0.000	0.0	0.0	0.0	-0.0

Units: kN,m

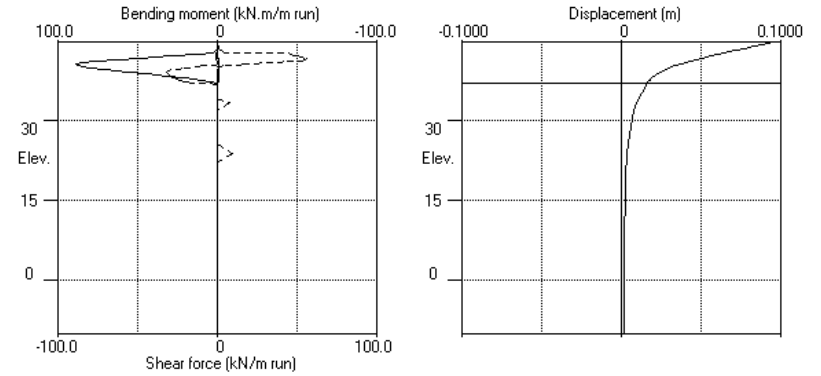
**Maximum and minimum bending moment and shear force at each stage**

Stage no.	Bending moment				Shear force				
	maximum	elev.	minimum	elev.	maximum	elev.	minimum	elev.	
		kN.m/m		kN/m		kN/m			
1	0.4	43.60	-0.3	40.80	2.3	24.00	-0.4	42.73	
2	0.5	43.60	-0.9	40.40	4.2	24.00	-0.7	42.17	
3	No calculation at this stage								
4	36.1	40.40	-0.0	37.00	25.3	41.30	-14.1	38.80	
5	37.7	40.40	-0.0	37.00	26.7	41.30	-14.6	38.80	
6	37.6	40.40	-0.0	37.00	26.0	41.30	-14.5	38.80	
7	39.0	40.40	-0.0	37.00	26.5	41.30	-15.1	38.80	
8	89.3	40.80	-0.0	37.00	55.8	41.80	-32.1	39.20	

**Maximum and minimum displacement at each stage**

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
		m			
1	0.005	44.80	0.000	44.80	Apply surcharge no.1 at elev. 44.80
2	0.006	44.80	0.000	44.80	Apply surcharge no.2 at elev. 44.80
3	Wall displacements reset to zero				
4	0.046	44.80	0.000	44.80	Excav. to elev. 41.30 on RIGHT side
5	0.046	44.80	0.000	44.80	Fill to elev. 41.80 on RIGHT side
6	0.048	44.80	0.000	44.80	Apply water pressure profile no.1
7	0.048	44.80	0.000	44.80	Apply water pressure profile no.2
8	0.095	44.80	0.000	44.80	Apply load no.1 at elev. 42.73

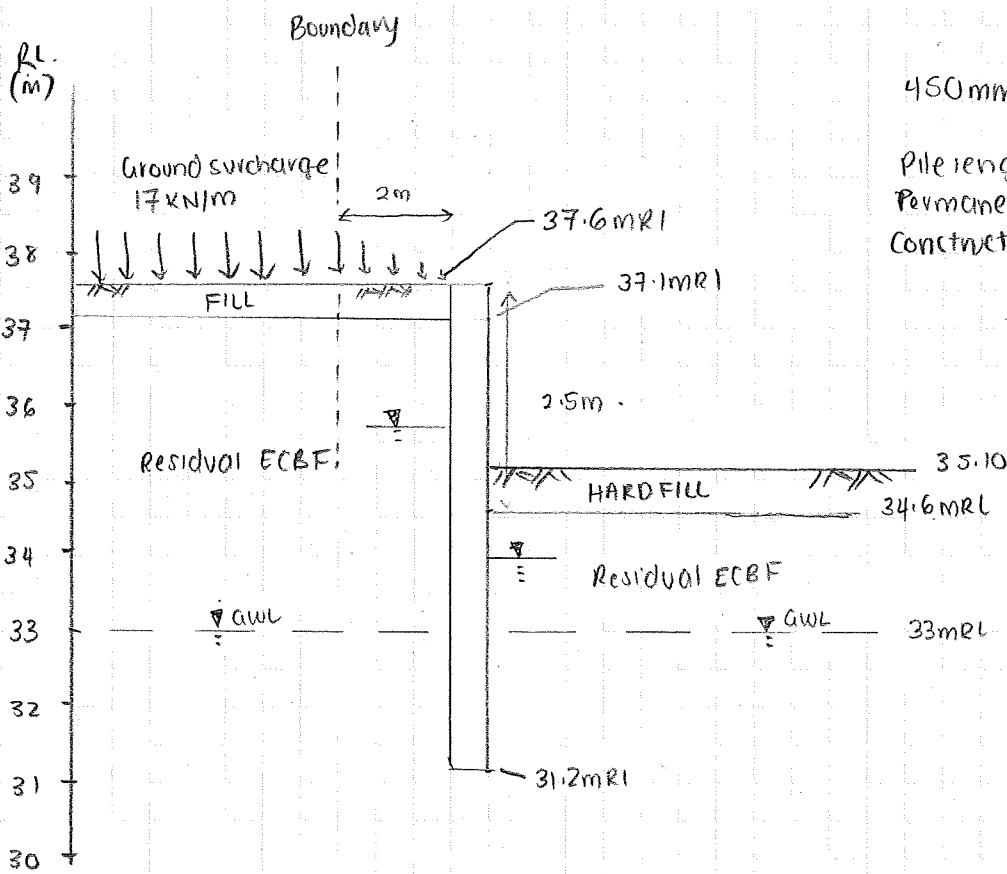
Bending moment, shear force, displacement envelopes



Description: *wallap section 4 - Eastern RTW*

Concept Design RTW  
 section 4

Wallap File: *Chainage 35 Eastern RTW*



450mm timber piles 1.2m c/c.

Pile length = 6.5m.  
 Permanent height = 2.5m  
 Construction height = 3.0m.