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Groundwater Drawdown and Settlement Assessment at

538 Karangahape Road, Auckland City

Rev E **21 August 2024** **Job No. 20111**

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Name of Project:	538 Karangahape Road, Auckland City
Client:	James Kirkpatrick Ltd
Author:	Michael Chan, Senior Geotechnical Engineer, MEngNZ
Reviewer:	Byron Smith, Senior Engineering Geologist, MEngNZ
Authoriser:	Dave Ouwejan, Principal Geotechnical Engineer, CMEngNZ, CPEng.
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Appendices:

1.0 Introduction and Scope

Soil & Rock Consultants (S&RC) were engaged by James Kirkpatrick Limited to carry out a detailed settlement assessment at 538 Karangahape Road, Auckland City, with regard to the proposed boundary excavations. This report provides a summary of our detailed settlement assessment in support of a Resource Consent application to Auckland Council and is informed by the requirements of a Restricted Discretionary Activity in accordance with Section E7 of the AUP (OIP).

As such, in accordance with Section E7.8.2 of the AUP (OIP), the objective of this assessment is to demonstrate the proposal avoids, remedies or mitigates any ground settlement that may cause distress, including reducing the ability of an existing building or structure to meet the relevant requirements of the Building Act 2004 or the New Zealand Building Code, to existing:

(i) buildings;
(ii) structures; and
(iii) services including roads, pavements, power, gas, electricity, water supply and wastewater networks and fibre optic cables.

A soldier pile wall solution will be adopted to provide temporary support along the basement excavations along the property boundaries. The poles are to remain in place as part of the permanent structure and will be supported by the basement concrete floor slabs prior to completion of construction, i.e. top-down construction. Accordingly, S&RC has undertaken the following scope of work:

1. Review of existing S&RC reporting pertaining to retaining walls.
2. Review of the drawing sets provided to us.
3. Analysis and assessment of ground settlement behind the proposed basement walls based on the adopted soldier pile wall design solution and the effect of the basement excavations on neighbouring properties.

1.1 Limitations

This report has been prepared by S&RC the sole benefit of our Client, James Kirkpatrick Ltd, in respect to 538 Karangahape Road, Auckland City, and the brief given to us. This report may be used by the client's appointed consultants and can be relied upon by Auckland Council to support both a Resource Consent and Building Consent application for the proposal. The data and/or opinions contained in this report may not be used by any other party or for any other purpose without our prior review and agreement. S&RC should be contacted should the scope or scale of the development proposal vary from that currently indicated.

2.0 Previous Reporting

S&RC have issued a geotechnical investigation report for the subject site titled *"Geotechnical Investigation for Proposed Multi-level Commercial Building at 538 Karangahape Road, Newton"*, Rev. A, dated 22 August 2023, Job No. 20111. That report is herein referred to as the GIR.

The findings, geotechnical constraints and design recommendations provided in that report are summarised as follows:

- Fill was encountered to a maximum depth of 5.9m bpgl, inferred to be associated with existing retaining.
- Natural soils comprised stiff to very stiff weathered Waitemata Group soils underlain by Waitemata Group rock at depth.
- The site is deemed Class C – "Shallow Soil Site" (NZS1170.5:2004).
- In terms of soil expansivity, the soils present are considered to lie in 'Expansive Soil Class H – Highly Expansive' in accordance with B1/AS1.
- The proposed development is outside the 'Permitted Activity' criteria of E7.6.1.6 and E7.6.1.10 of the AUP and therefore a detailed assessment of dewatering and settlement effects of the basement excavation against the relevant criteria in Section E7.8.2 of the AUP is required to support Resource Consent application.

2.1 Groundwater Monitoring and Compliance

The following fieldwork was undertaken to assist with the hydrogeological assessment during preparation of the GIR:

- Visual Appraisal of the site.
- Drilling of three machine boreholes (MB04 to MB06 inclusive).
- Installation of piezometers in each borehole (labelled PZ04 to PZ06, respectively).
- Groundwater level monitoring from 6th July to 21st July and assessment of those levels against rainfall response.

Groundwater levels were modelled using the maximum groundwater elevations recorded during the monitoring period, exclusive of an anomalous result recorded in PZ05 on 21 July and the levels recorded on 6 July which are inferred to have still been stabilising following drilling as outlined in Section 5.0 of the GIR. The PZ05 result recorded on 13 July was elevated (adjusted) by 0.3m based on similar rises recorded in PZ04 and PZ06 between 13 and 21 July.

The results of our groundwater monitoring are presented in the GIR and reiterated in Table 1. The appended "Typical Details 3" by Enovate Consultants, drawing No. S402, Project No. 22-0034, dated 10 October 2023 was received following our GIR and indicates a temporary cut level of 62.65mRL, 800mm below B2 finished floor level and these levels have been compared against our monitoring results.

Localised transient excavations for foundation beams are expected but their dimensions will be determined during detailed design and given their very brief exposure, the effect on drawdown settlement is negligible.

Modelled groundwater contours are shown in Figure 1.

Table 1 – Groundwater Elevations, Finished Floor Levels and Estimated Excavation Levels

Piezometer Location	Modelled Groundwater Elevation (mRL)	Basement 02 Finished Floor Level (mRL)	Temporary Cut Level (mRL)	Groundwater Depth Above Excavation (m)
PZ04	65.6	63.45	62.65	3.0
PZ05	63.2	63.45	62.65	0.6
PZ06	62.8	63.45	62.65	0.2

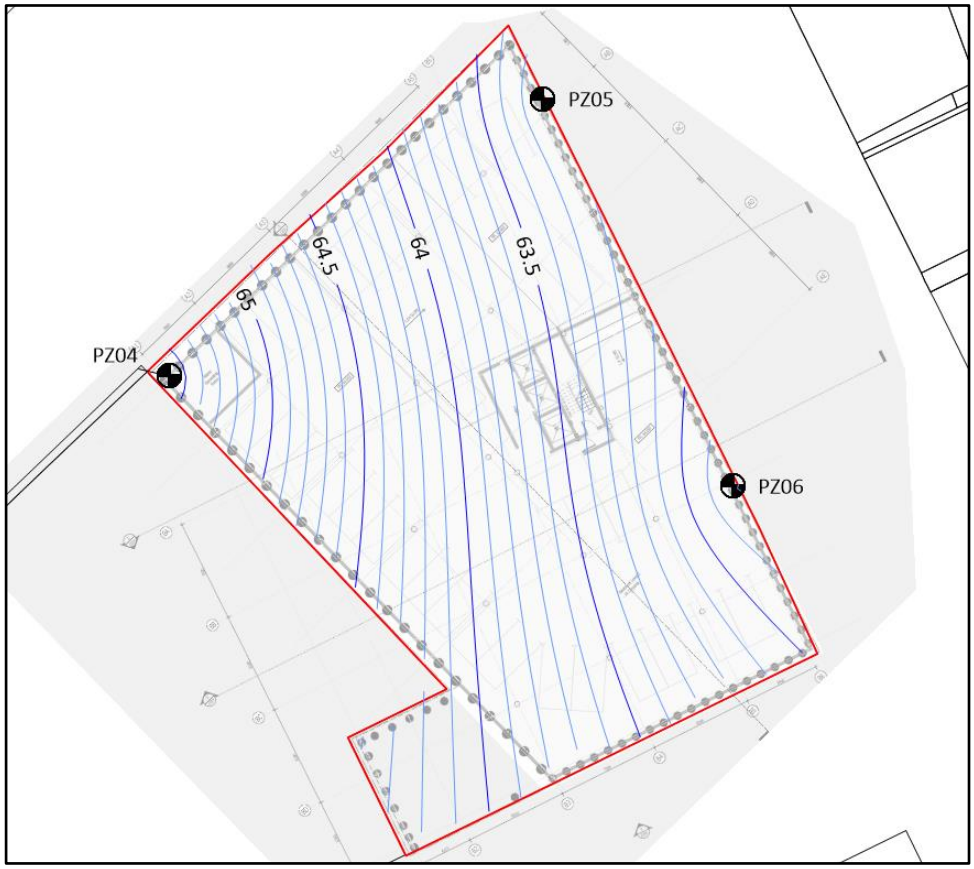

Figure 1: Groundwater Elevation vs. Proposed Basement

3.0 Assessment of Effects

3.1 Critical Sections and Assumptions

Three critical sections have been identified based on the drawings provided to us in Appendix A, our geological model/sections, distance to neighbouring structures, and groundwater elevations. For continuity with the GIR, these sections are named Sections C to F.

The retaining wall members for critical sections are assumed to comprise 750mm-diameter soldier piles of steel-reinforced concrete construction. We have also undertaken a sensitivity analysis for the basement excavation along the southern boundary where 600mm-diameter piles are proposed and confirmed that these are less critical than the analyses presented herein.

Settlement effects on the neighbouring properties were assessed through the critical sections as outlined below. A critical section alignment plan is presented in Appendix B.

- **Critical Section C.** This section was selected to target the potential settlement effects to the west of the basement excavation on the neighbouring building at 582 Karangahape Road. The underside of the masonry wall has been measured onsite at 70.0mRL. The underside of the basement foundations is assumed at 68.4mRL based on design drawings available in the Property File (see Figure 2 below). Our analysis is based on the sketch presented in Appendix A and inserted for reference in Figure 2.
- **Critical Section D.** This section was selected to target the potential settlement effects to the north of the basement excavation on the Karangahape Road footpath, road reserve, and neighbouring services through the expected deepest point of excavation.
- **Critical Section E.** This section was selected to target the potential settlement effects to the southeast of the basement excavations on Gundry Street road reserve, footpath and watermain.
- **Critical Section F.** This section was selected to target the potential settlement effects to the carparking area at 582 Karangahape Road immediately to the southwest of the excavation and the existing building further set back.

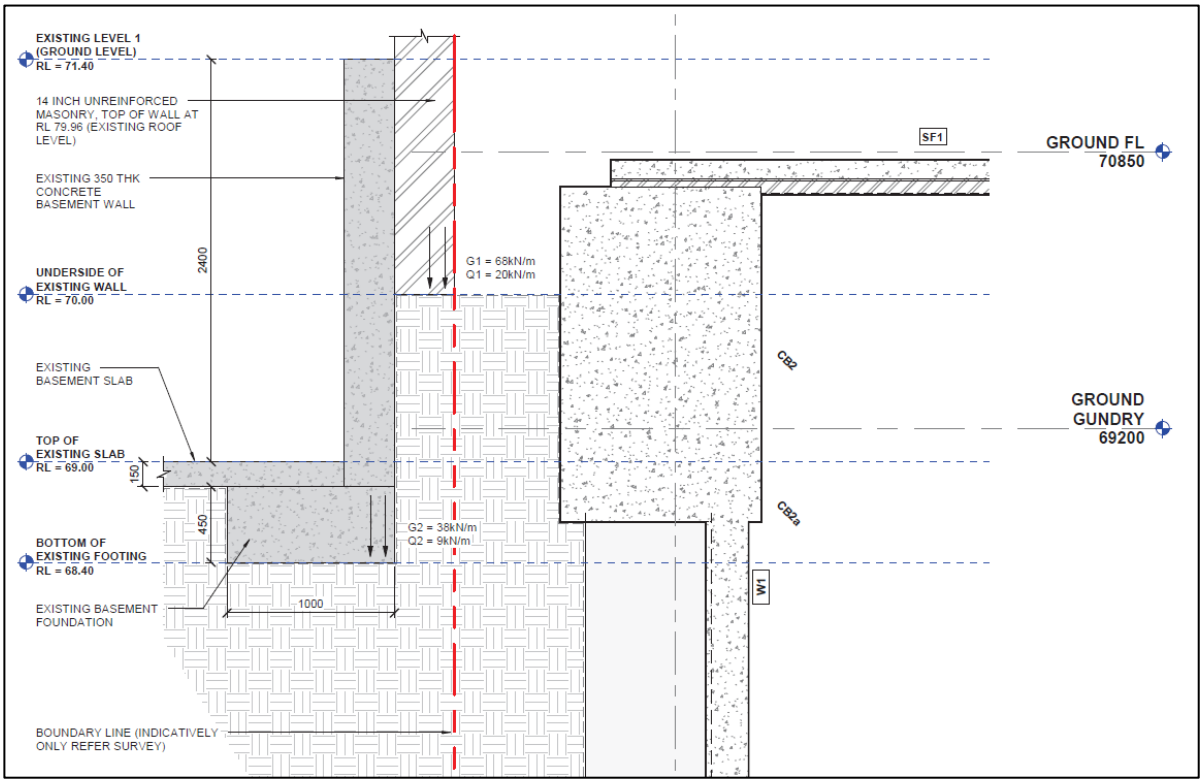

Figure 2: 582 Karangahape Road Western Boundary Cross Section *(Source: Sheet S312, Enovate Consultants)*

Top-down construction using a steel-reinforced concrete soldier pile walls is proposed as a temporary support solution. The soldier pile wall will be incorporated into the permanent retaining wall.

For Sections C and F, temporary props (braces) are adopted prior to full depth excavation.

For Sections D and E, a construction berm will remain between the B01 and B02 floors until the B1 floor is installed to buttress the wall prior to full depth excavation as shown on "Foundation Detail Palisade Wall Sheet 1" draft by Enovate Consultants, drawing no. S310, Project No. 22-0034, dated 17 June 2024. The design cut level of 62.65mRL is also shown on that detail, which takes into account the excavation beneath the B02 floor slab to install ground beams beneath it.

The proposal incorporates a substantial and robust permanent subsoil drainage network through the soldier pile wall and subfloor of the B2 level to 62.65mRL to eliminate the risk of hydrostatic loading.

As shown in Figure 1, groundwater is expected to be encountered above the finished floor level of the B02 basement. Based on our groundwater monitoring, the prevailing groundwater in the area of Critical Section E is below the excavation and therefore drawdown effects are not expected at this location.

4.0 Ground Model

Soil Permeability - Drawdown

In-situ hydraulic (falling head) testing was conducted by S&RC in PZ06 in October 2023 using digital down-hole level loggers. The piezometer was rapidly filled and the falling groundwater level continuously measured until a static water level was achieved (to at least 90% of the initial groundwater level). The recorded data was analysed within the Aqtesolv software package under the Bouwer & Rice and Hvorslev methods to calculate the hydraulic conductivity average. The results of the analyses are presented in Table 2 and the outputs attached in Appendix C.

Table 2 – Hydraulic Permeability Testing Results

Piezometers	Bouwer & Rice Method m/sec	Hvorslev Method m/sec
PZ06	1.25E-9	3.92E-9
Average Hydraulic Conductivity	2.59E-9	

The temporary excavation level 62.65mRL is within the weathered Waitemata Group Soils, therefore we have conservatively assumed that the hydraulic permeability is homogeneous for drawdown modelling.

Soil Strength Parameters – WALLAP

The soil parameters recommended in Table 7 of the GIR have been adopted for our assessment with the exception of the modulus of elasticity for Waitemata Group Rock which has been conservatively reduced as per the WALLAP outputs in Appendix D of this report.

4.1 Groundwater Drawdown

An assessment of potential dewatering effects arising from the proposed cut/excavation was undertaken for Critical Sections C, D and F. No groundwater drawdown is expected through Section E-E' as discussed in Section 3.1 of this report.

A worst-case scenario drawdown effect has been adopted for the planned dewatering by adopting groundwater levels considered at or near the seasonal-high.

Drawdown has been analysed adopting the average hydraulic conductivity (K) value of $2.59E^{-9}$ m/s.

Predicted drawdown has been calculated via Steady-State Finite Element Analysis using the RocScience Inc. SLIDE2 software. Total head back-analysis has been undertaken beyond the site in order to reproduce the measured groundwater levels within the site. The analysis extends some 50m beyond the excavation with the existing ground levels taken from Auckland Council contour data and our understanding of the neighbouring building's basement level at 582 Karangahape Road based on drawings available in the Property File.

Calculated drawdown depths across critical sections are presented in Table 3 and full results are presented in Appendix C.

Table 3 – Estimated Drawdown vs. Horizontal Distance from Wall

Distance From Cut (m)	Drawdown (m)		
	C-C' To Southwest	D-D' To Northwest	F-F' To Southwest
0.0	2.9	1.4	1.9
1.0	2.7	1.3	1.6
2.0	2.5	1.2	1.4
3.0	2.3	1.1	1.3
4.0	2.2	1.0	1.2
5.0	2.1	1.1	1.1
10.0	1.6	0.8	0.7

As shown in Table 3, maximum estimated groundwater drawdown through the critical sections as a result of the basement excavation is 2.9m through Section C-C'.

4.1.1 Consolidation Settlements due to Groundwater Drawdown

For the assessment of consolidation settlement, we have assumed the weathered Waitemata Group soils to be compressible and the transitional Waitemata Group material to be incompressible. The results of the assessment outlined in Section 3.3 of this report have been adopted to determine the predicted drawdown induced consolidation settlement component of the settlement analyses (refer Appendix E).

The increase in effective stress resulting from lowered groundwater may induce consolidation settlements within compressible soils within and below the drawdown zone. For the purpose of this assessment, one-dimensional consolidation settlement has been calculated using the below equation:

$\Delta S = m_v \times \Delta\sigma' \times \Delta H$;

where: ΔS = consolidation settlement

m_v= coefficient of compressibility = 1 / M; where: M = stiffness modulus

$M = E \times \frac{(1-\vartheta)}{(1+\vartheta)\times(1-2\vartheta)}$; where ϑ = Poisson's ratio

$\Delta\sigma'$ = change in effective stress due to groundwater drawdown

ΔH = thickness of the compressible layer

A summary of the groundwater drawdown assessment results, including consolidation settlements, is presented in Tables 4 to 6. Consolidation settlement calculations are attached in Appendix E.

Table 4 – Groundwater Drawdown Assessment Results for Critical Section C

Observed Area	Distance from Excavation [m]	Calculated Consolidation Settlement [mm]
No. 582 K Road Building (Near Edge)	0.0	7
No. 582 K Road Building (Far Edge)	35.5	2

Table 5 – Groundwater Drawdown Assessment Results for Critical Section D

Observed Area	Distance from Excavation [m]	Calculated Consolidation Settlement [mm]
Site Boundary / K Road Footpath	0.0	1
Gas Main – 50 PE	2.0	1
Water Pipe – 250 CI	4.7	1
Water Main – 630 CLS	8.8	1
Water Main – 525 UNDEF	18.6	0
537 K Road Building (Near Edge)	27.4	0

Table 6 – Groundwater Drawdown Assessment Results for Critical Section F

Observed Area	Distance from Excavation [m]	Calculated Consolidation Settlement [mm]
No. 582 K Road Carpark / Site Boundary	0.0	4
No. 582 Building (Near Edge)	23.0	1
Newton Road	44.0	0

4.2 Mechanical Settlements due to Wall Deflections (WALLAP Analysis)

The following structural design limiting criteria have been considered:

(i) Factor of Safety greater than 1.5 for embedment, maintained during and post-construction,
(ii) Strain (deflection) less than 2% of maximum retained height.

Specific detailed design of the wall is excluded from the scope of this (deflection) assessment, and it should be noted that member sizes may be amended once final load demands has been assessed (i.e., loads may be greater or smaller than the serviceability load conditions analysed herein). Detailed design is the responsibility of the wall designer and will be completed prior to Building Consent.

To determine horizontal deflections for the proposed wall during construction (temporary support), we have completed a staged analysis using the Geosolve software package WALLAP. WALLAP uses a single dimension finite element model to analyse each stage.

The mechanically induced settlement assessment was carried out using the Hsieh and Ou method (1998) for concave or spandrel deflection profiles.

The following assumptions were adopted and utilised for the design:

- Through Section C, long-term serviceability (SLS) surcharges of 88kPa, 47kPa, and 3.6kPa have been applied where adjacent to 582 Karangahape Road building to model the masonry wall, a basement footing and a concrete slab respectively as advised by Enovate Consultants. Active earth pressure is also conservatively applied from 70.0mRL.
- A long-term serviceability (SLS) surcharge of 12kPa has been applied where adjacent to Road Reserves and carparking areas for Sections D, E and F.
- An unfactored Young's Modulus, E, of 31,685 MPa has been adopted for concrete as advised by Enovate Consultants.
- Cracked section factors of 0.7 and 0.5 have been applied to pile stiffness (EI) for short-term and long-term serviceability cases respectively.
- Pre-development groundwater levels are adopted from Section 3.3 of this report and as shown in Figure 1 of this report.
- The Waitemata Group weathered profile has been interpolated between borehole locations.

The staging used in the temporary support (deflection) analysis model includes the following stages and the application for each construction stage section is presented in Table 7:

- Application of surcharge modelling nearby existing structures and/or Council-prescribed boundary surcharges.
- Installation of a soldier pile wall (via changing wall stiffness to 100%).
- Installation of temporary propping where applicable. Temporary bracing at the ground floor level is assumed to be installed in the form of diagonally propped Universal Beams or similar, spanning between the southwestern and northwestern walls, fixed to the capping beam of the walls.
- Groundwater drawdown on left (neighbour's) side of wall due of temporary drainage.
- Excavation of construction berm on right hand (basement) side of wall where applicable.
- Installation of permanent B01 floor propping
- Reduce wall stiffness to 70% (short-term crack factored)
- Excavation of proposed bulk cut level
- Installation of permanent B02 floor propping where applicable
- Removal of temporary propping where applicable
- Installation of permanent GF floor propping where applicable
- Reduction of wall stiffness to 50% (long-term crack factored)

Table 7 – Construction Stage Application Requirements

Construction Stage	Required for Limiting Settlement Criteria			
	C-C'	D-D'	E-E'	F-F'
Surcharge Application	Yes	Yes	Yes	Yes
Installation of Pile Wall and Capping Beam	Yes	Yes	Yes	Yes
Temporary GF Bracing (70.0mRL)	Yes	No	No	No
Groundwater Drawdown	Yes	Yes	No	Yes
Temporary Lower-Level Bracing	Yes	No	No	Yes
Construction Berm	No	Yes	No	No
Installation of Permanent B02 Floor Prop	Yes	No	No	No
Installation of Permanent B01 Floor Prop	Yes	Yes	No	Yes
Installation of Permanent GF Floor Propping	Yes	No	No	No

4.2.1 WALLAP and Mechanical Deflection Results

A summary of the details and results of WALLAP analyses is presented in Table 8. Settlement calculations and WALLAP output sheets are provided in Appendix D.

Table 8 – WALLAP Details – Serviceability

Element	Section C	Section D	Section E	Section F
Total Excavation Depth / Design Retained Height (m)	7.4	8.2	4.4	6.0
Pile Diameter, D (mm)	750	750	750	750
Pile Spacing (m)	0.9 (1.2D)	1.5 (2D)	1.5 (2D)	1.5 (2D)
Minimum Pile Length (m)	13.0	14.4	11.0	11.0
Wall Unfactored Moment of Inertia, I (m^4/m of wall)	0.017250	0.010350	0.010350	0.010350
Young's Modulus of Concrete, E (kPa)	3.169E+07	3.169E+07	3.169E+07	3.169E+07
Max Bending Moment (kNm per m of wall)	144.9	117.8	52.6	53.5
Max Shear Force (kN per m of wall)	91.2	93.1	28.9	56.5
Max Bending Moment (kNm per pile)	130.4	176.7	78.9	80.4
Max Shear Force (kN per pile)	82.1	139.7	43.4	84.8
Calculated Min. Factor of Safety rounded to 1D.P. (1)	2.5 (7)	1.5 (6)	1.5 (5)	1.7 (11)
Max Pile Deflection (mm)	8	17	13	9
Max Deflection Level (mRL)	62.65	70.80	67.00	68.70
Mechanical Settlement at Wall (mm)	3	11	8	9
Max Mechanical Settlement (mm)	5	11	8	6
Distance to Max Mechanical Settlement behind Wall (m)	3.7	0.0	0.0	0.0

(1) Number in brackets refers to critical construction stage

4.3 Total Ground Movement

The magnitude of combined settlement relates to both the deflection of the proposed wall along the property boundaries as well as groundwater drawdown effects. The expected settlement of adjacent property has been compared against limiting settlement documented criteria as listed below:

(i) Within Burland Damage Category 1 (maximum vertical settlements of 10mm and differential settlements of 1 in 500). Refer to Section 5.1.

(ii) O'Rourke & Trautmann 1982 (recommended by CIRIA PR 30) for maximum differential settlement of 1 in 140 for cast iron pipes and brittle utilities with a diameter of 200mm or greater. Refer to Section 5.2 for further discussion.

(iii) Bridge Manual Third Edition, Amendment 3 in respect to potential damage to roads – maximum vertical settlements of 50mm and maximum differential settlements of 1 in 300 for roads with average daily traffic less than 2500 (carparks) or 1 in 500 for roads with average daily traffic greater than 2500 (roading). Refer to Section 5.3

Limiting settlement criteria for Burland (1995) is presented in Table 9.

Table 9 – Approximate Equivalent Ground Settlement and Slopes (Burland 1995)

Category of Damage	Description of Degree of Damage	Max. 'Gradient' of Ground	Maximum Settlement of Building (mm)
1	Negligible to Very Slight	Less than 1:500	Less than 10mm
2	Slight	1:500 to 1:200	10mm to 50mm
3	Moderate	1:200 to 1:50	50mm to 75mm
4	Severe	Greater than 1:50	Greater than 75mm

The estimated total and differential settlements (i.e., maximum 'gradient' of ground) behind the excavations for impacted boundaries and structures are summarised in Tables 10 to 13.

Table 10 – Vertical Ground Settlements for Critical Section C

Observed Area	Distance from Excavation (m)	Total Vertical Settlement (mm)	Max 'Gradient' of Ground
Site Boundary / No. 582 Basement (Near Edge)	0.0	9	1:1111
Maximum Settlement	3.0	10	
No. 582 Basement (Far Edge)	35.5	2	

Table 11 – Vertical Ground Settlements for Critical Section D

Observed Area	Distance from Excavation (m)	Total Vertical Settlement (mm)	Max 'Gradient' of Ground
Site Boundary / Karangahape Road Footpath	0.0	12	1:909
Gas Main – 50 PE	2.0	9	
Water Pipe – 250 CI	4.7	6	
Water Main – 630 CLS	8.8	3	
Water Main – 525 UNDEF	18.6	1	
537 K Road Building (Near Edge)	27.4	0	

Table 12 – Vertical Ground Settlements for Critical Section E

Observed Area	Distance from Excavation (m)	Total Vertical Settlement (mm)	Max 'Gradient' of Ground
Site Boundary / Abbey Street Footpath / Water Pipe 200 CI	0.0	8	1:952
Abbey St Carriageway (Near Edge)	2.2	6	
Water Main – 100 UNDEF	11.1	1	
Abbey St Carriageway (Far Edge)	12.6	1	
3 Abbey St Building (Near Edge)	15.5	0	

Table 13 – Vertical Ground Settlements for Critical Section F

Observed Area	Distance from Excavation (m)	Total Vertical Settlement (mm)	Max 'Gradient' of Ground
Site Boundary / No. 582 Carparking	0.0	10	1:1000
No. 582 Building	23.0	1	
Newton Road	44.0	0	

5.0 Conclusions

The settlement outputs are attached in Appendix E. The results of the Assessment of Effects with respect to neighbouring property are discussed below.

In our experience any settlement observed at the time of construction is typically much lower than that estimated, particularly if construction is undertaken in summer as is typical. Further, soil strength parameters have been selected with a conservative bias, particularly with respect to soil stiffness, resulting in conservative total mechanical settlement outputs.

In addition, measured groundwater levels adopted in the drawdown analysis are considered at or near the seasonal high, as such, the consolidation settlement components are very conservative in this regard. Realistically, the prevailing groundwater levels are likely to be much lower and most of the modelled consolidation is expected to have occurred previously given typical seasonal variation and the topographical and geological setting, i.e., being an East Coast Bays Formation ridgeline.

Furthermore, we understand the neighbouring building has recently undergone seismic strengthening, which may also contribute to its ability to tolerate any residual settlements compared to other buildings of its age, although this has been conservatively ignored in our analyses.

We therefore consider that damage occurring as a result of any 'actual' settlement will be less than minor. In any case, a Groundwater & Settlement Monitoring & Contingency Plan (GSMCP) is being prepared concurrently as outlined in Section 6.0 of this report.

5.1 Existing Buildings

The neighbouring building at 582 Karangahape Road is estimated to be subject to a maximum combined vertical settlement of 10mm and differential settlements of up to 1:1000. The degree of damage is therefore classified as *Damage Category 1: Negligible to Very Slight*. All other nearby buildings are well set back from the site excavations such that the predicted settlements, and their effects on buildings, are negligible.

5.2 Existing Services

Maximum differential settlements over the boundary are flatter than 1 in 900 indicating a safety factor of 6 against 1 in 140 criteria given in the industry standard empirical approach provided in O'Rourke and Trautmann which is endorsed by CIRIA PR 30. Hence, both mechanical and consolidation settlement effects of the proposed development on the public and private services are considered negligible.

Although we do not have as-built service locations, based on the above the effects on neighbouring private services are also considered negligible. CCTV has been proposed as a monitoring requirement in our Groundwater & Settlement Monitoring & Contingency Plan (GSMCP) where it is considered a practical undertaking.

5.3 Existing Roading and Pavements

Similar to the above, all estimated settlements are less than the requirements of the Bridge Manual guidelines. i.e., less than 50mm total vertical settlement and flatter than 1 in 500 differential settlements . The effects on existing roading are therefore considered negligible.

6.0 Construction Methodology

We recommend and have adopted in our assessments, a top-down construction methodology is implemented i.e., soldier piles are installed (and temporary bracing installed to the southwestern boundary wall) prior to excavation to support neighbouring property from instability and undue settlement prior to permanent walls being installed. Floor propping of the B1 basement is required along northwestern and northeastern boundaries to ensure an adequate factor of safety is maintained and wall deflections are limited during construction.

Temporary propping prior to the construction berm excavation (and deeper excavations) will also be required at capping beam level to support the southwestern boundary excavations where adjacent to the No. 582 neighbouring basement to minimise deflection and associated settlement effects.

A high-level construction methodology for excavations is outlined below:

- Installation of boundary soldier pile wall and capping beam.
- Install first level of temporary diagonal bracing between the capping beams of the southwestern and northwestern walls (to support the southwestern boundary).
- Excavation to 65.5mRL and install second temporary brace (to support the southwestern boundary).
- Bulk excavation with construction berm remaining (southwestern and northwestern boundaries).
- Installation of permanent B02 columns and B01 steelwork and slab to prop soldier pile wall (to support the northwestern and northeastern boundaries).
- Removal of construction berm and excavation of proposed cut level below B02 once B01 slab is fully cured.
- Installation of remaining B02 foundations, waterproofing/tanking and shotcrete from B02 to B01, installation of drainage, steel and shotcrete from B01 to GF.
- Removal of temporary diagonal brace propping (southwestern boundary).
- Construction of permanent GF slab.

Groundwater inflow should be controlled via sumps and pumps during temporary excavation.

We expect that design liaison between the structural engineer and S&RC and a review of the above construction methodology for each boundary excavation will be required at detailed design stage to ensure that excavation effects on neighbouring properties remain minimised.

7.0 Groundwater and Settlement Monitoring & Contingency Plan

A Groundwater & Settlement Monitoring & Contingency Plan (GSMCP) is required to establish monitoring requirements for the development such that any excavation effects to neighbouring properties remain within the estimated parameters herein and a contingency plan is laid out to mitigate adverse effects beyond those expected to occur.

A draft GMSCP will be prepared by S&RC as a separate document and a finalised GSMCP will be provided following issue of Consent by Council or via iterative liaison with Council regarding draft consent conditions.

End of Report Text - Appendices Follow

Appendix A

Enovate Consultants Drawings

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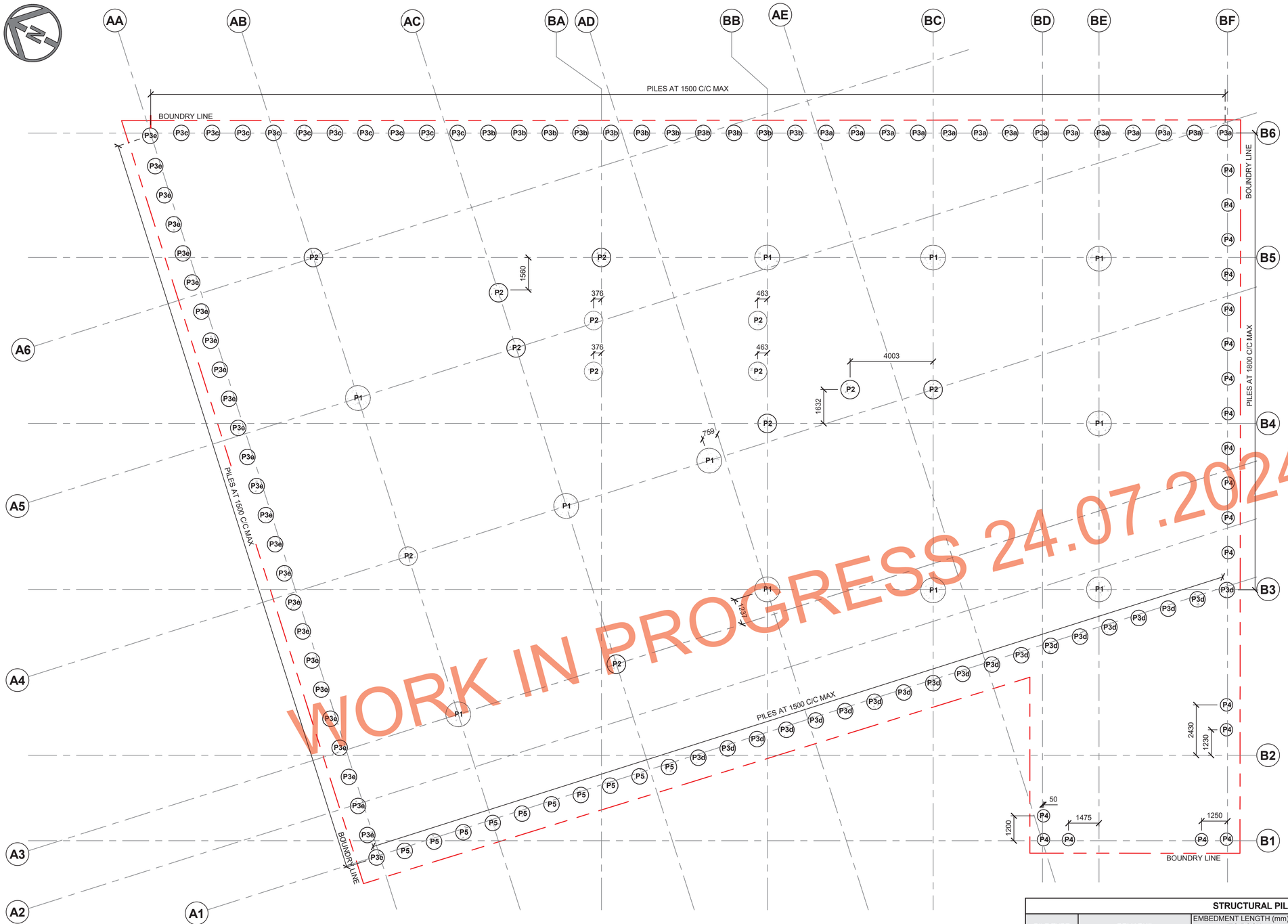

EXISTING SERVICES

IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO LOCATE PIPELINES AND SERVICES PRIOR TO COMMENCING EXCAVATING WORKS, DRILLING PILE HOLES OR DRIVING PILES ON SITE TO ENSURE THE REQUIRED CLEARANCES TO SERVICES ARE ACHIEVED. REFER TO GEOTECHNICAL REPORT AND CIVIL ENGINEERS INFORMATION.

PILE NOTES:

1. REFER TO THE GEOTECHNICAL REPORT BY SOIL AND ROCK "GEOTECHNICAL INVESTIGATION FOR MULTI-LEVEL COMMERCIAL BUILDING AT 538 KARANGAHAPE ROAD, AUCKLAND CITY" REV B DATED 22 AUGUST 2023 AND INCLUDING ANY SUBSEQUENT GEOTECH ADVICE FOR THE PILE END BEARING AND SKIN FRICTION USED IN THE DESIGN. ENSURE THE GEOTECHNICAL ENGINEER INSPECTS THE FOUNDATIONS TO CONFIRM THESE DESIGN VALUES HAVE BEEN MET PRIOR TO POURING CONCRETE.
2. THE BASE OF BORED HOLES SHALL BE CLEAR OF COMPRESSIBLE MATERIAL AND THE GEOTECHNICAL ENGINEER SHALL BE GIVEN OPPORTUNITY TO INSPECT THE BORED HOLES AND GROOVES FOR EVERY PILE. NOTE: CONTRACTOR TO ALLOW FOR PUMPING OF WATER (IN BORED HOLES) & VIDEO EQUIPMENT.
3. WHERE SPECIFIED ON THE DRAWINGS, EACH PILE BORE SHALL BE SPIRALLY GROOVED WITH A 50mm WIDE x 15mm DEEP FINGER WITHDRAWN TO ACHIEVE A PITCH OF 200mm, OVER THE ENTIRE LENGTH OF MINIMUM EMBEDMENT SHOWN ON THE DRAWINGS. IF A TEMPORARY OR PERMANENT CASING IS USED, THE MINIMUM LENGTH OF EMBEDMENT, AS SPECIFIED ON THE DRAWINGS, SHALL BE MEASURED FROM BELOW THE BOTTOM OF THE CASING.
4. A GROOVING TRIAL SHALL BE CARRIED OUT ON THE FIRST PRODUCTION PILE TO BE INSPECTED BY GEOTECHNICAL ENGINEER.
5. THE CONTRACTOR IS TO COMPLY WITH ALL REQUIREMENTS OF THE GEOTECHNICAL REPORT BY SOIL AND ROCK "GEOTECHNICAL INVESTIGATION FOR MULTI-LEVEL COMMERCIAL BUILDING AT 538 KARANGAHAPE ROAD, AUCKLAND CITY" REV B DATED 22 AUGUST 2023 AND "GROUNDWATER DRAWDOWN AND SETTLEMENT ASSESSMENT AT 538 KARANGAHAPE ROAD, AUCKLAND CITY" REV B DATED 15 NOVEMBER 2023 AND INCLUDING ANY SUBSEQUENT GEOTECH ADVICE.

STRUCTURAL PILE REINFORCEMENT SCHEDULE

PILE TYPE	REMARKS	EMBEDMENT LENGTH (mm) INTO ROCK	LONGITUTINAL REINF.	TRANS. REINF.	MAX COMPRESSION ULS (kN)	MAX TENSION ULS (kN)
P1	Ø1200 RC PILE	12000	18-HD40	HR16-200 SPIRAL	12350	7200
P2	Ø900 RC PILE	9000	12-HD25	HR16-200 SPIRAL	7250	-
P3a	Ø750 RC PILE	2650	10-HD25	HR16-200 SPIRAL	1250	-
P3b	Ø750 RC PILE	3100	10-HD25	HR16-200 SPIRAL	1250	-
P3c	Ø750 RC PILE	3550	10-HD25	HR16-200 SPIRAL	1250	-
P3d	Ø750 RC PILE	4750	10-HD25	HR16-200 SPIRAL	1250	-
P3e	Ø750 RC PILE	6050	10-HD25	HR16-200 SPIRAL	1250	-
P4	Ø600 RC PILE	2650	8-HD25	HR10-200 SPIRAL	1150	-
P5	Ø750 RC PILE	4000	12-HD25	HR16-200 SPIRAL	2700	1550

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29 CUSTOMS STREET WEST,
AUCKLAND CITY, 1010
NEW ZEALAND

TEL: +64 9 320 3060

EMAIL: contact@enovate.co.nz

WEBSITE: www.enovate.co.nz

CLIENT:

JAMES KIRKPATRICK GROUP LTD

REV	DATE	REVISION DESCRIPTION	ISSUED BY
B	XX-XX-2024	DEVELOPED DESIGN	MN
A	14-02-2024	FOR INFORMATION	MN

ENGINEERS: AM

TECHNICIANS: MF

CHECKED BY: BP/NSG

APPROVED BY: MN/PM

PROJECT: 538 KARANGAHAPE ROAD AUCKLAND

DRAWING TITLE: PILE LAYOUT PLAN

REMARKS:

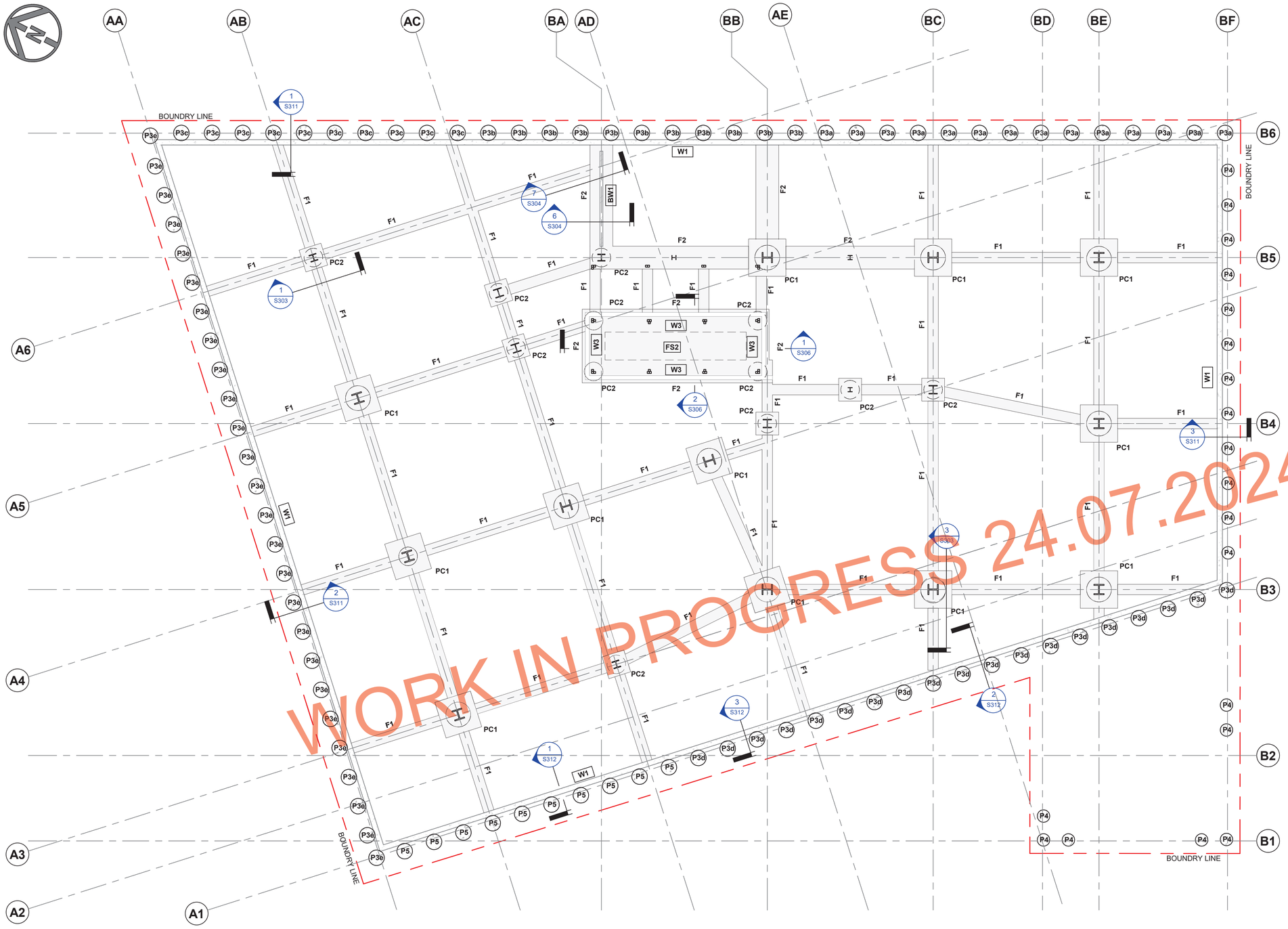
DRAWING STATUS: DEVELOPED DESIGN

PROJECT No. 22-0034 | SHEET No. S100 | REV B

COUNCIL APPROVAL

SHEET SIZE A1 (841x594) | SCALE 1 : 100

Plot Date: 23/07/2024 20:42:28



WORK IN PROGRESS 24.07.2024

STRUCTURAL PAD FOUNDATION SCHEDULE

MARK	DESCRIPTION
FS2	400 THK SLAB ON-GRADE WITH SE82 TOP AND HD16-250 CRS ALONG/HD12-400 CRS ACROSS BOTTOM

STRUCTURAL PILE SCHEDULE

MARK	REMARKS	LONGITUTINAL REINF. (TOP 8m)	TRANS. REINF. (TOP 8m)
P1	Ø1200 RC PILE	18-HD40	HR16-200 SPIRAL
P2	Ø900 RC PILE	12-HD25	HR16-200 SPIRAL
P3a	Ø750 RC PILE	10-HD25	HR16-200 SPIRAL
P3b	Ø750 RC PILE	10-HD25	HR16-200 SPIRAL
P3c	Ø750 RC PILE	10-HD25	HR16-200 SPIRAL
P3d	Ø750 RC PILE	10-HD25	HR16-200 SPIRAL
P3e	Ø750 RC PILE	10-HD25	HR16-200 SPIRAL
P4	Ø600 RC PILE	8-HD25	HR10-200 SPIRAL
P5	Ø750 RC PILE	12-HD25	HR16-200 SPIRAL

STRUCTURAL STRIP FOUNDATION SCHEDULE

MARK	REMARKS
CB1	1050W x 900D CAPPING BEAM
CB2	1200W x 900D CAPPING BEAM
CB2a	1200W x 1100D CONCRTE THICKENING
F1	500W x 500D STRIP FOOTING
F2	1100W x 900D STRIP FOOTING
F3	1100W x 900D STRIP FOOTING

STRUCTURAL PILE CAP SCHEDULE

MARK	REMARKS
PC1	1800 SQ. x 1500D RC PILE CAP
PC2	1100 SQ. x 900D RC PILE CAP

FOUNDATION NOTES

1. REFER TO GEOTECHNICAL REPORT BY SOIL AND ROCK "GEOTECHNICAL INVESTIGATION FOR MULTI-LEVEL COMMERCIAL BUILDING AT 538 KARANGAHAPE ROAD, AUCKLAND CITY" REV B DATED 22 AUGUST 2023 AND INCLUDING SUBSEQUENT GEOTECH ADVICE FOR FOUNDATION GEOTECHNICAL REQUIREMENTS.
2. CONTRACTOR TO CO-ORDINATE ALL CAST IN SERVICES TO FOOTINGS PRIOR TO POURING FOUNDATIONS.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO LOCATE PIPELINES AND SERVICES PRIOR TO COMMENCING EXCAVATING WORKS, DRILLING PILE HOLES OR DRIVING PILES ON SITE TO ENSURE THE REQUIRED CLEARANCES TO SERVICES ARE ACHIEVED. REFER TO GEOTECHNICAL REPORT & CIVIL ENGINEERS INFORMATION.

EXISTING SERVICES

IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO LOCATE PIPELINES AND SERVICES PRIOR TO COMMENCING EXCAVATING WORKS, DRILLING PILE HOLES OR DRIVING PILES ON SITE TO ENSURE THE REQUIRED CLEARANCES TO SERVICES ARE ACHIEVED. REFER TO GEOTECHNICAL REPORT AND CIVIL ENGINEERS INFORMATION.

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AUCKLAND CITY, 1010
NEW ZEALAND
TEL: +64 9 320 3060
EMAIL: contact@enovate.co.nz
WEBSITE: www.enovate.co.nz

CLIENT: JAMES KIRKPATRICK GROUP LTD

REV	DATE	REVISION DESCRIPTION	ISSUED BY
B	XX-XX-2024	DEVELOPED DESIGN	MN
A	14-02-2024	FOR INFORMATION	MN

ENGINEERS	AM
TECHNICIANS	MF
CHECKED BY	BP/NSG
APPROVED BY	MN/PM

PROJECT: 538 KARANGAHAPE ROAD AUCKLAND

DRAWING TITLE: B02 BASEMENT FOUNDATION PLAN

REMARKS:

DRAWING STATUS: DEVELOPED DESIGN

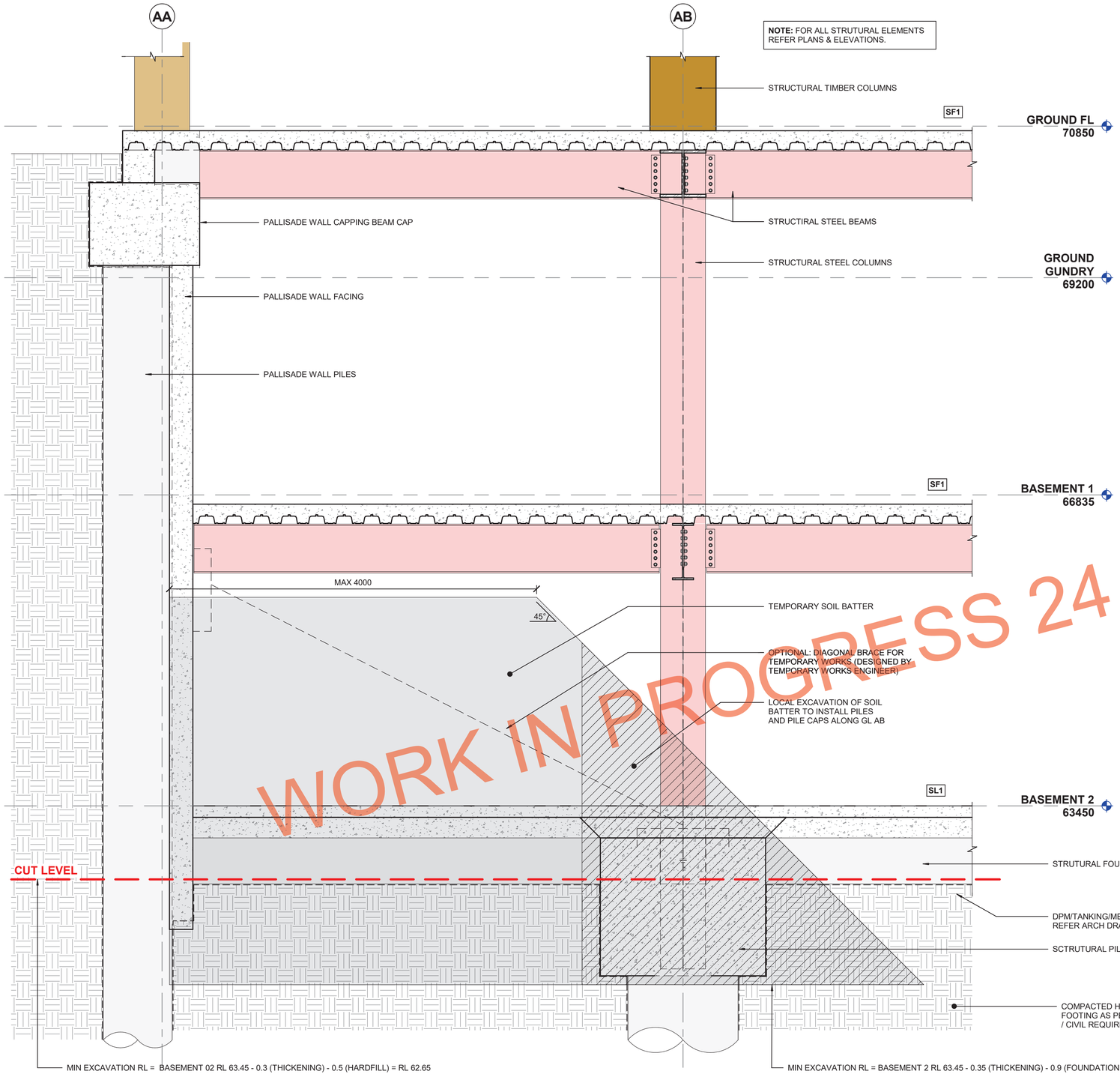
PROJECT No.	SHEET No.	REV
22-0034	S101	B

COUNCIL APPROVAL

SHEET SIZE A1 (841x594)

SCALE 1 : 100

Plot Date: 23/07/2024 20:48:49



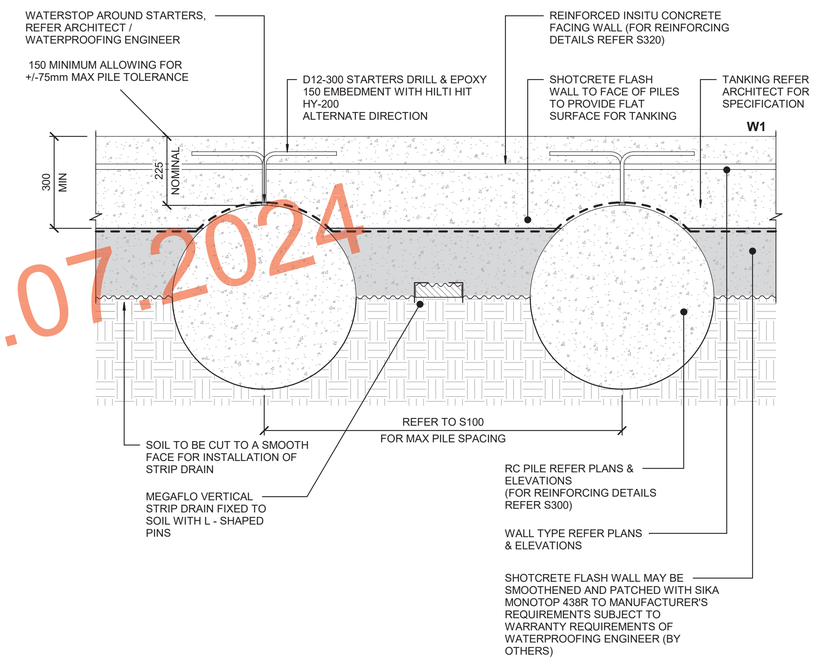
BASEMENT CONSTRUCTION SEQUNCE

SCALE 1 : 25

ASSUMED CONSTRUCTION SEQUENCE FOR BASEMENT

1. INSTALL PALISADE WALL PILES.
2. EXCAVATE DOWN TO THE LEVEL ENSURING THAT A BATTER IS LEFT AGAINST THE PALISADE WALL AS SHOWN TO LIMIT THE TEMPORARY RETAINED HEIGHT OF THE PALISADE WALL.
3. INSTALL ALL OTHER PILES AND PILE CAPS. LOCAL EXCAVATION OF THE BATTER CAN BE DONE IN ORDER TO INSTALL THE PILES AND PILE CAPS ALONG GL AB. FOUNDATION BEAMS AND MOST OF THE B2 SLAB CAN ALSO BE INSTALLED (OTHER THAN ON GL AB AS THIS WOULD COMPRISE THE SOIL BATTER).
4. ERRECT B2 COLUMNS AND B1 STEELWORK, POUR LEVEL 1 FLOOR TO PROVIDE PERMANENT PROPPING OF THE PALISADE WALL.
5. UPON B1 SLAB REACHING FULL STRENGTH, REMOVE TEMPORARY SOIL BATTER, INSTALL PALISADE WALL FACING ALONG GL AA, INSTALL FOUNDATION BEAMS ALONG GL AB AND COMPLETE B2 SLAB.

NOTES: PROCESS WILL BE SIMILAR ALONG GL A2. ALL TO BE CONFIRMED BY GEOTECH ENGINEER



TYPICAL PALISADE WALL DETAILS

SCALE 1 : 10

WORK IN PROGRESS 24.07.2024

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EMAIL: contact@enovate.co.nz
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CLIENT: JAMES KIRKPATRICK GROUP LTD

REV	DATE	REVISION DESCRIPTION	ISSUED BY
A	XX-XX-2024	DEVELOPED DESIGN	MN

ENGINEERS	AM
TECHNICIANS	MF
CHECKED BY	BP/NSG
APPROVED BY	MN/PM

PROJECT: 538 KARANGAHAPE ROAD AUCKLAND

DRAWING TITLE: FOUNDATION DETAIL PALISADE WALL SHEET 1

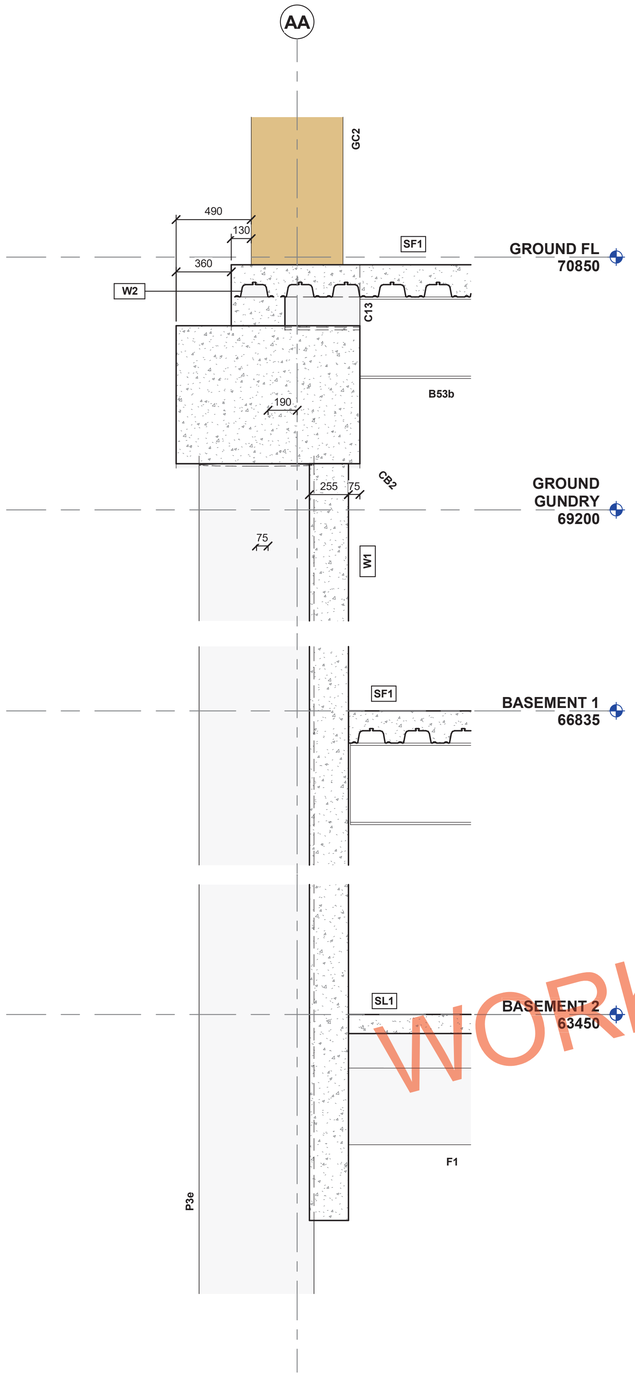
REMARKS:

DRAWING STATUS: DEVELOPED DESIGN

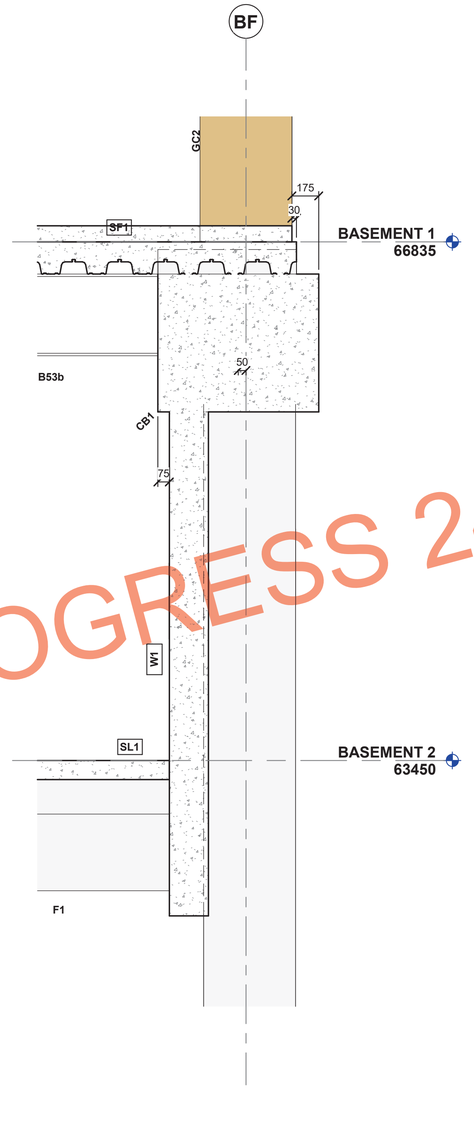
PROJECT No.	SHEET No.	REV
22-0034	S310	A

COUNCIL APPROVAL	SHEET SIZE	SCALE
	A1 (841x594)	As indicated

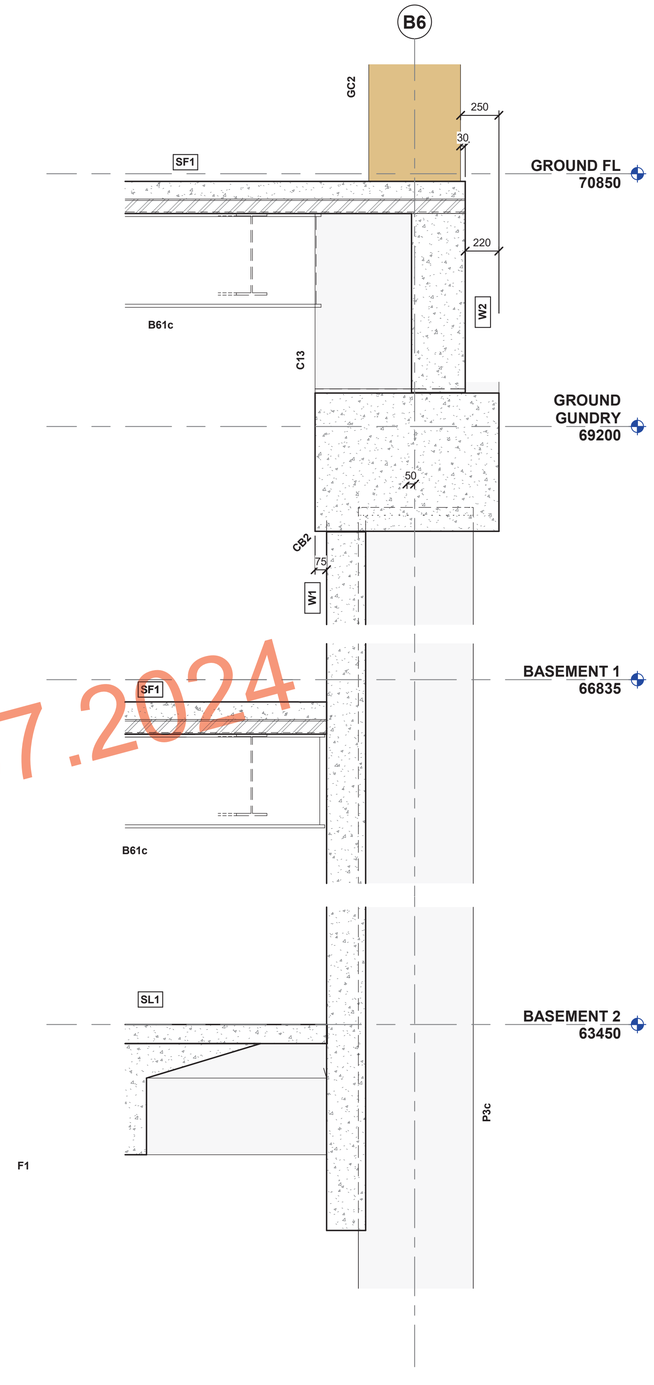
Plot Date: 23/07/2024 20:48:50



2 S101 **W1 paliside wall north side**
SCALE 1 : 20



3 S101 **W1 paliside wall south side**
SCALE 1 : 20



1 S101 **W1 paliside wall east side**
SCALE 1 : 20

WORK IN PROGRESS 24.07.2024

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CLIENT:
JAMES KIRKPATRICK GROUP LTD

REV	DATE	REVISION DESCRIPTION	ISSUED BY
A	XX-XX-2024	DEVELOPED DESIGN	MN

ENGINEERS: AM
TECHNICIANS: MF
CHECKED BY: BP/NSG
APPROVED BY: MN/PM

PROJECT:
538 KARANGAHAPE ROAD
AUCKLAND

DRAWING TITLE:
FOUNDATION DETAIL
PALISADE WALL
SHEET 2

REMARKS:

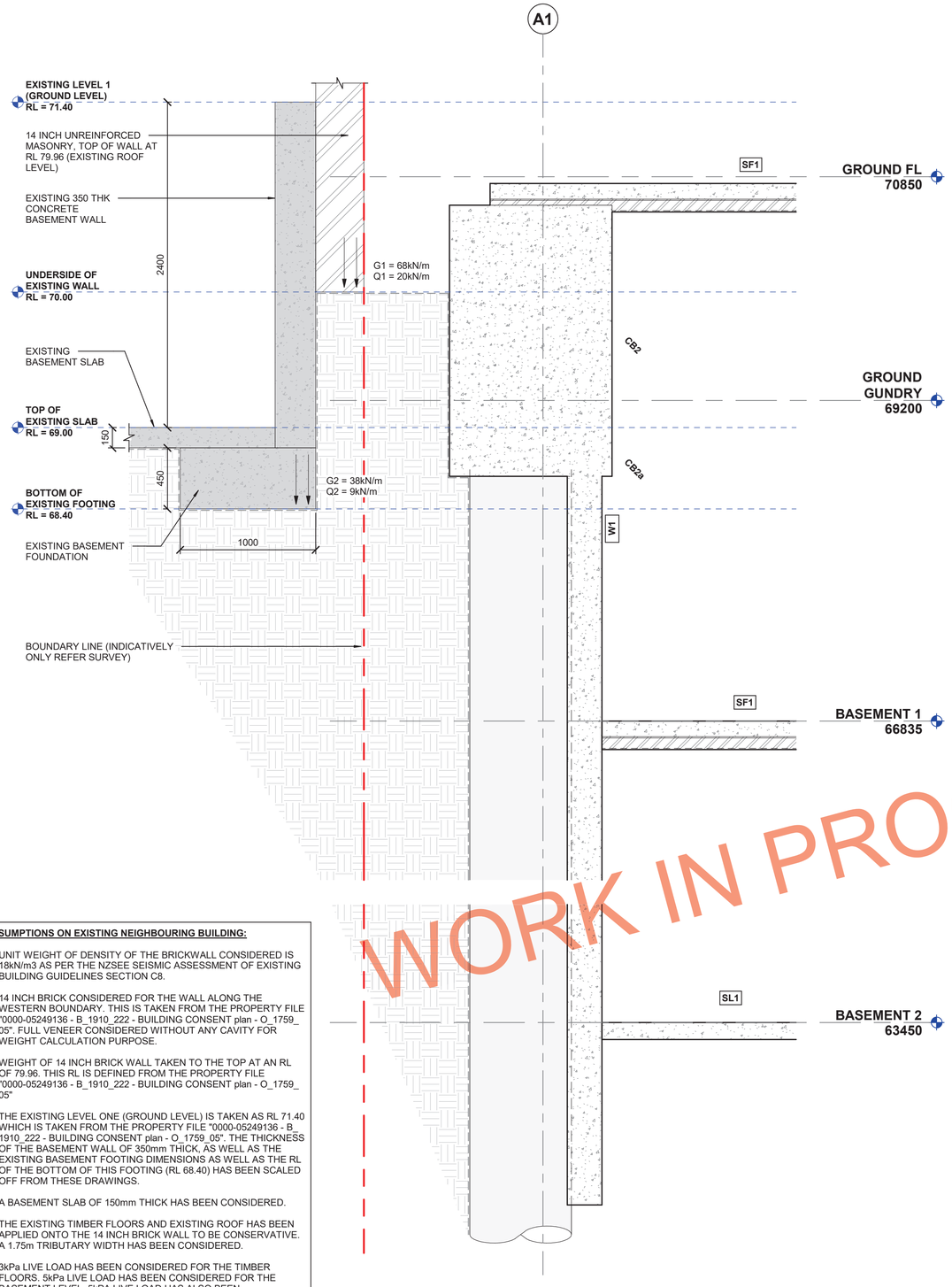
COUNCIL APPROVAL

DRAWING STATUS:
DEVELOPED DESIGN

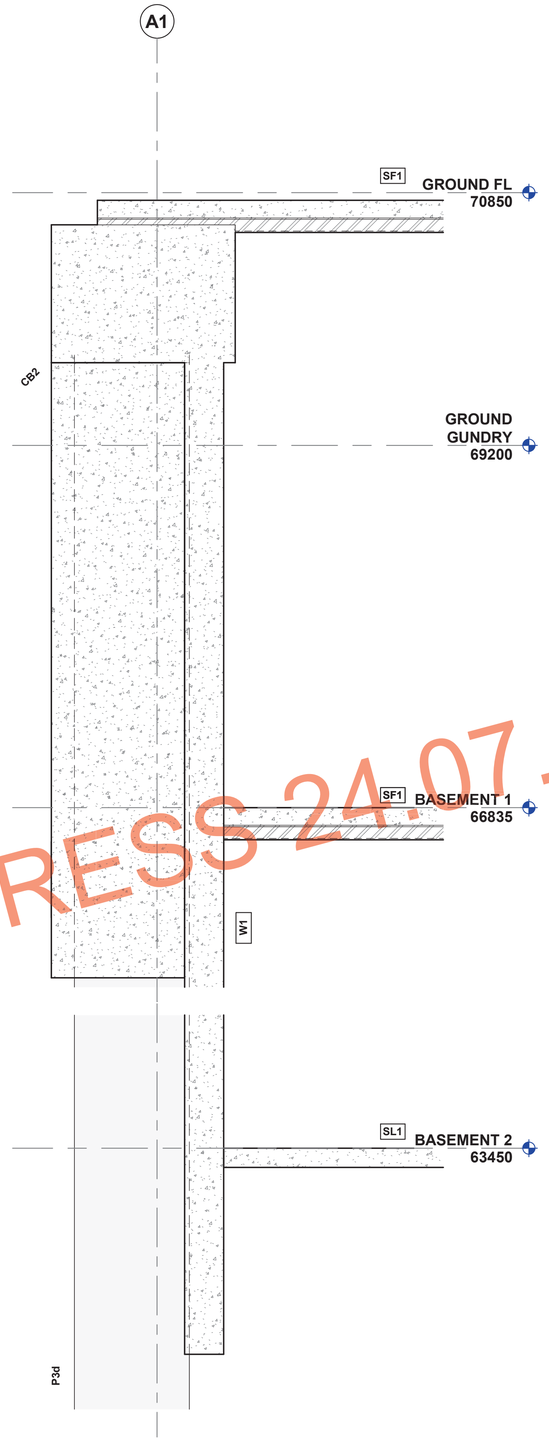
PROJECT No.	SHEET No.	REV
22-0034	S311	A

SHEET SIZE: A1 (841x594)
SCALE: 1 : 20

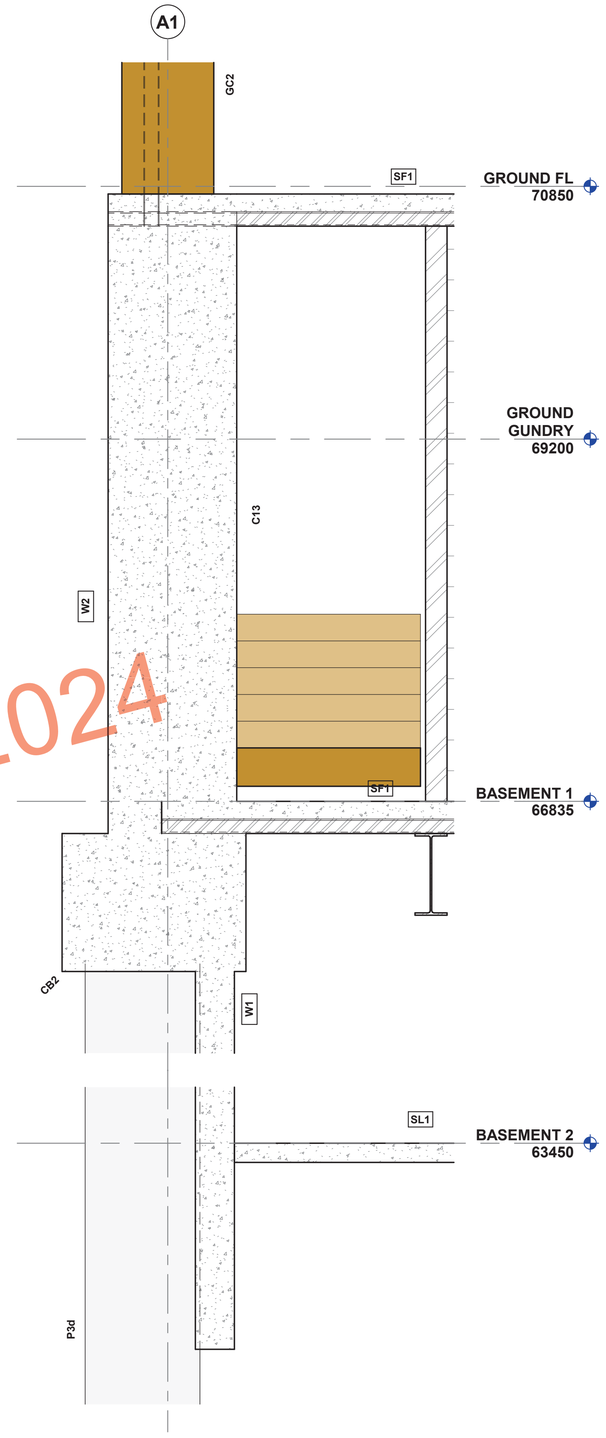
Plot Date: 23/07/2024 20:56:14



1 S101 **W1 paliside wall west side**
SCALE 1 : 20



3 S101 **SECTION**
SCALE 1 : 20



2 S101 **W1 paliside wall west side W1-W3**
SCALE 1 : 20

ASSUMPTIONS ON EXISTING NEIGHBOURING BUILDING:

1. UNIT WEIGHT OF DENSITY OF THE BRICKWALL CONSIDERED IS 18kN/m3 AS PER THE NZSEE SEISMIC ASSESSMENT OF EXISTING BUILDING GUIDELINES SECTION C8.
2. 14 INCH BRICK CONSIDERED FOR THE WALL ALONG THE WESTERN BOUNDARY. THIS IS TAKEN FROM THE PROPERTY FILE "0000-05249136 - B_1910_222 - BUILDING CONSENT plan - O_1759_05". FULL VENEER CONSIDERED WITHOUT ANY CAVITY FOR WEIGHT CALCULATION PURPOSE.
3. WEIGHT OF 14 INCH BRICK WALL TAKEN TO THE TOP AT AN RL OF 79.96. THIS RL IS DEFINED FROM THE PROPERTY FILE "0000-05249136 - B_1910_222 - BUILDING CONSENT plan - O_1759_05"
4. THE EXISTING LEVEL ONE (GROUND LEVEL) IS TAKEN AS RL 71.40 WHICH IS TAKEN FROM THE PROPERTY FILE "0000-05249136 - B_1910_222 - BUILDING CONSENT plan - O_1759_05". THE THICKNESS OF THE BASEMENT WALL OF 350mm THICK, AS WELL AS THE EXISTING BASEMENT FOOTING DIMENSIONS AS WELL AS THE RL OF THE BOTTOM OF THIS FOOTING (RL 68.40) HAS BEEN SCALED OFF FROM THESE DRAWINGS.
5. A BASEMENT SLAB OF 150mm THICK HAS BEEN CONSIDERED.
6. THE EXISTING TIMBER FLOORS AND EXISTING ROOF HAS BEEN APPLIED ONTO THE 14 INCH BRICK WALL TO BE CONSERVATIVE. A 1.75m TRIBUTARY WIDTH HAS BEEN CONSIDERED.
7. 3kPa LIVE LOAD HAS BEEN CONSIDERED FOR THE TIMBER FLOORS. 5kPa LIVE LOAD HAS BEEN CONSIDERED FOR THE BASEMENT LEVEL. 5kPA LIVE LOAD HAS ALSO BEEN CONSIDERED FOR THE PLANT EQUIPMENT ABOVE THE EXISTING ROOF. THE LINELOAD FROM THE EXISTING STRUCTURE IS SHOWN AS GX & QX FOR THE DEAD LOAD AND LIVE LOAD RESPECTIVELY.

WORK IN PROGRESS 24.07.2024

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NEW ZEALAND
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EMAIL: contact@enovate.co.nz
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CLIENT: JAMES KIRKPATRICK GROUP LTD

REV	DATE	REVISION DESCRIPTION	ISSUED BY
A	XX-XX-2024	DEVELOPED DESIGN	MN

ENGINEERS: AM
TECHNICIANS: MF
CHECKED BY: BP/NSG
APPROVED BY: MN/PM

PROJECT: 538 KARANGAHAPE ROAD AUCKLAND

DRAWING TITLE: FOUNDATION DETAIL PALISADE WALL SHEET 3

REMARKS:

DRAWING STATUS: DEVELOPED DESIGN

PROJECT No.	SHEET No.	REV
22-0034	S312	A

COUNCIL APPROVAL

SHEET SIZE: A1 (841x594)
SCALE: 1 : 20

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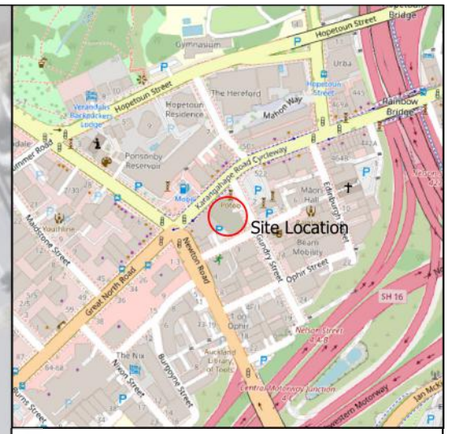
Appendix B

Critical Section Alignment Plan



NOTES:

1. Locations of features approximate only.
2. Buried service locations to be verified on site.
3. Original sheet size A3.
4. Boundary data obtained from Council GIS.

Key:

- Site Boundary
- S&RC CPT Locations
- S&RC Machine Borehole Locations
- S&RC Critical Section Alignments

AMENDMENTS		
Rev	Date	Description

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PO Box 21-424 Henderson, 0650
Ph 09 835 1740 Fax 09 835 1847
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538 Karangahape Road
Auckland City

Critical Section Plan

Dwg No.	20111 /201		
Scale:	1:300	Drawn By:	M. Chan
Date:	24/07/2024	Revision:	A
Filename:	O:\Auckland\20---\100 - 199\20111\QGIS\20111 - Critical Section Plan - Jul2024.qgz		

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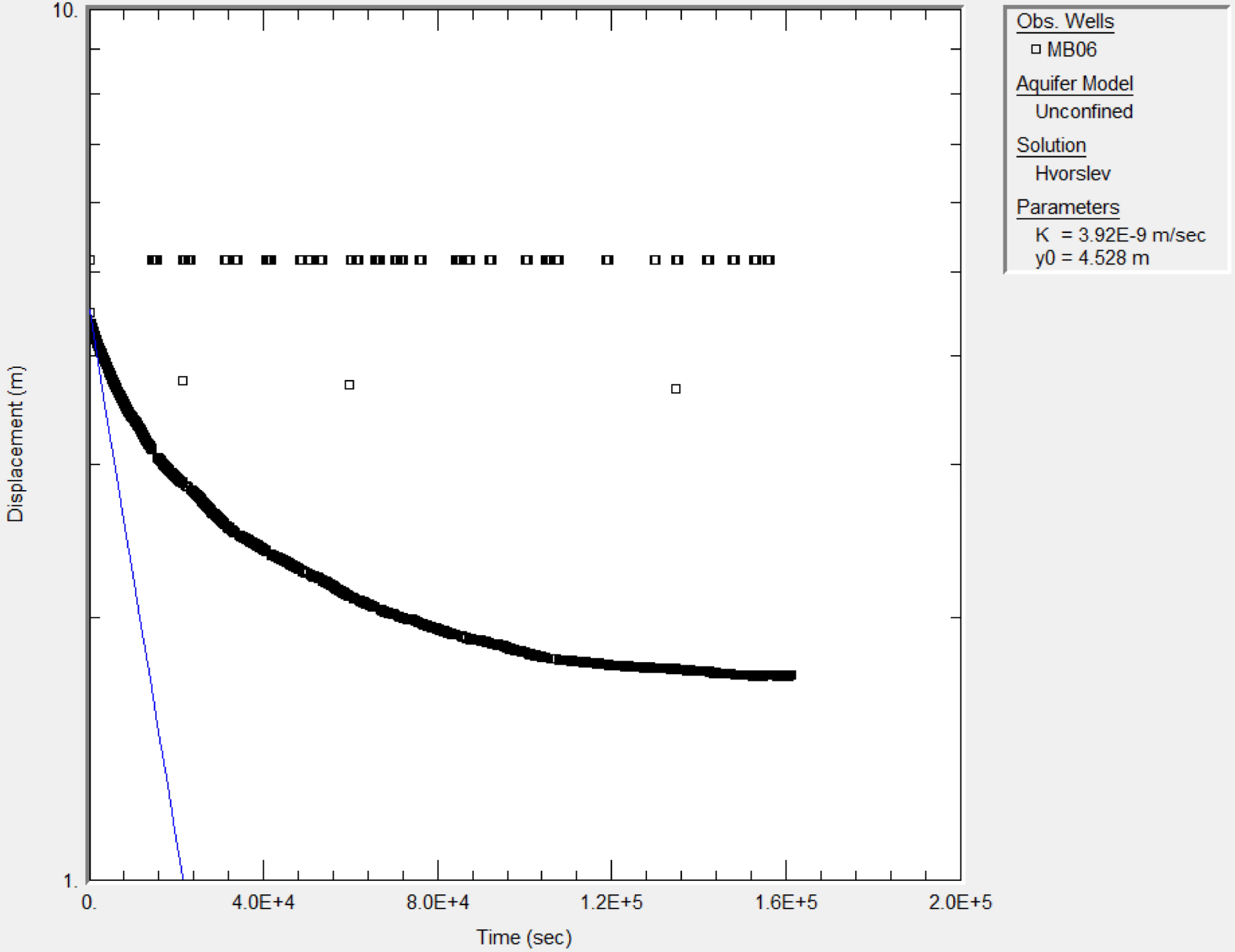
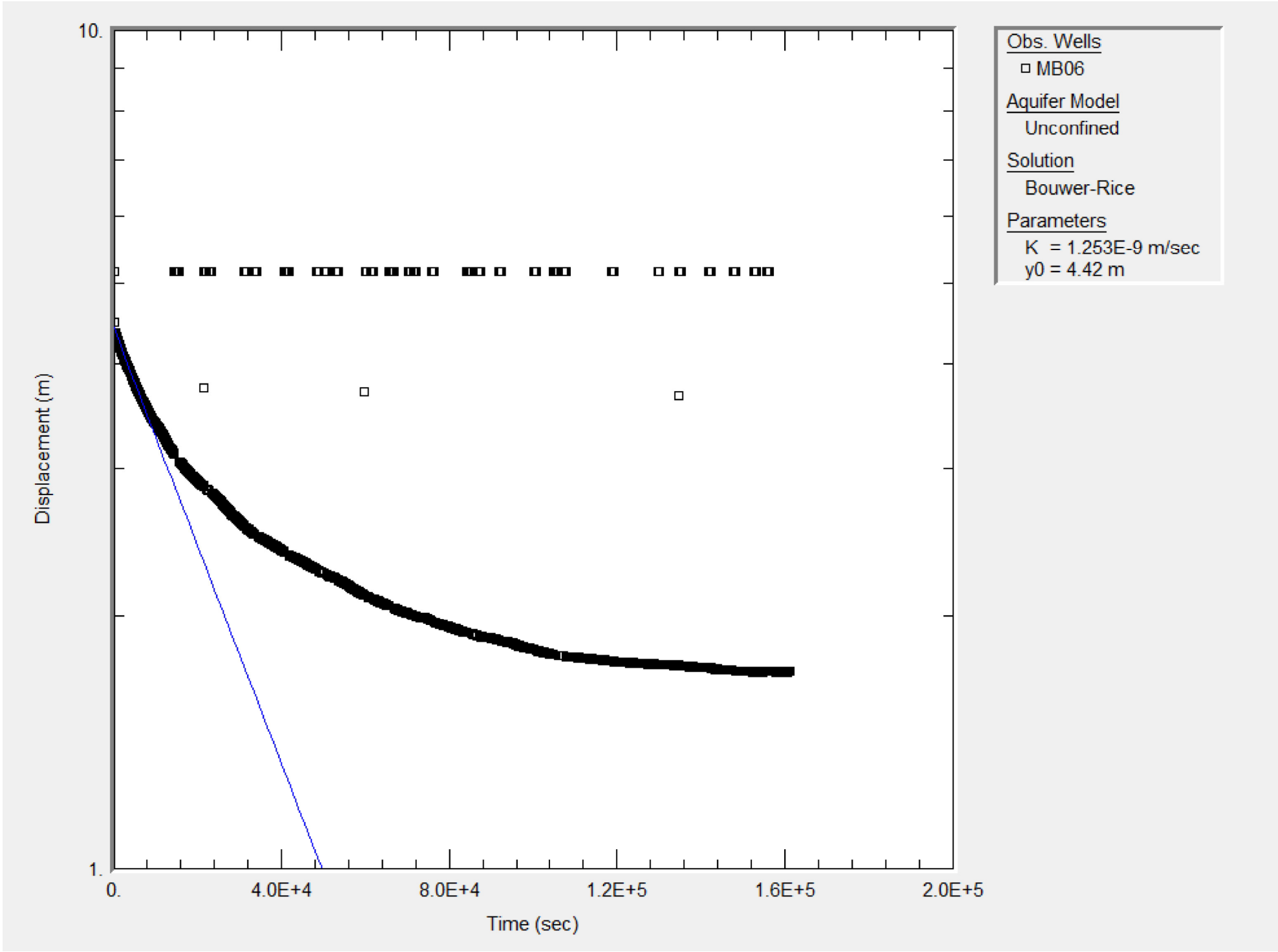
Appendix C

Permeability Testing & Drawdown Outputs


10.
1.
Displacement (m)
0.
4.0E+4
8.0E+4
1.2E+5
1.6E+5
2.0E+5
Time (sec)
Obs. Wells
MB06
Aquifer Model
Unconfined
Solution
Hvorslev
Parameters
K = 3.92E-9 m/sec
y0 = 4.528 m


10.
1.
Displacement (m)
0.
4.0E+4
8.0E+4
1.2E+5
1.6E+5
2.0E+5
Time (sec)
Obs. Wells
MB06
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
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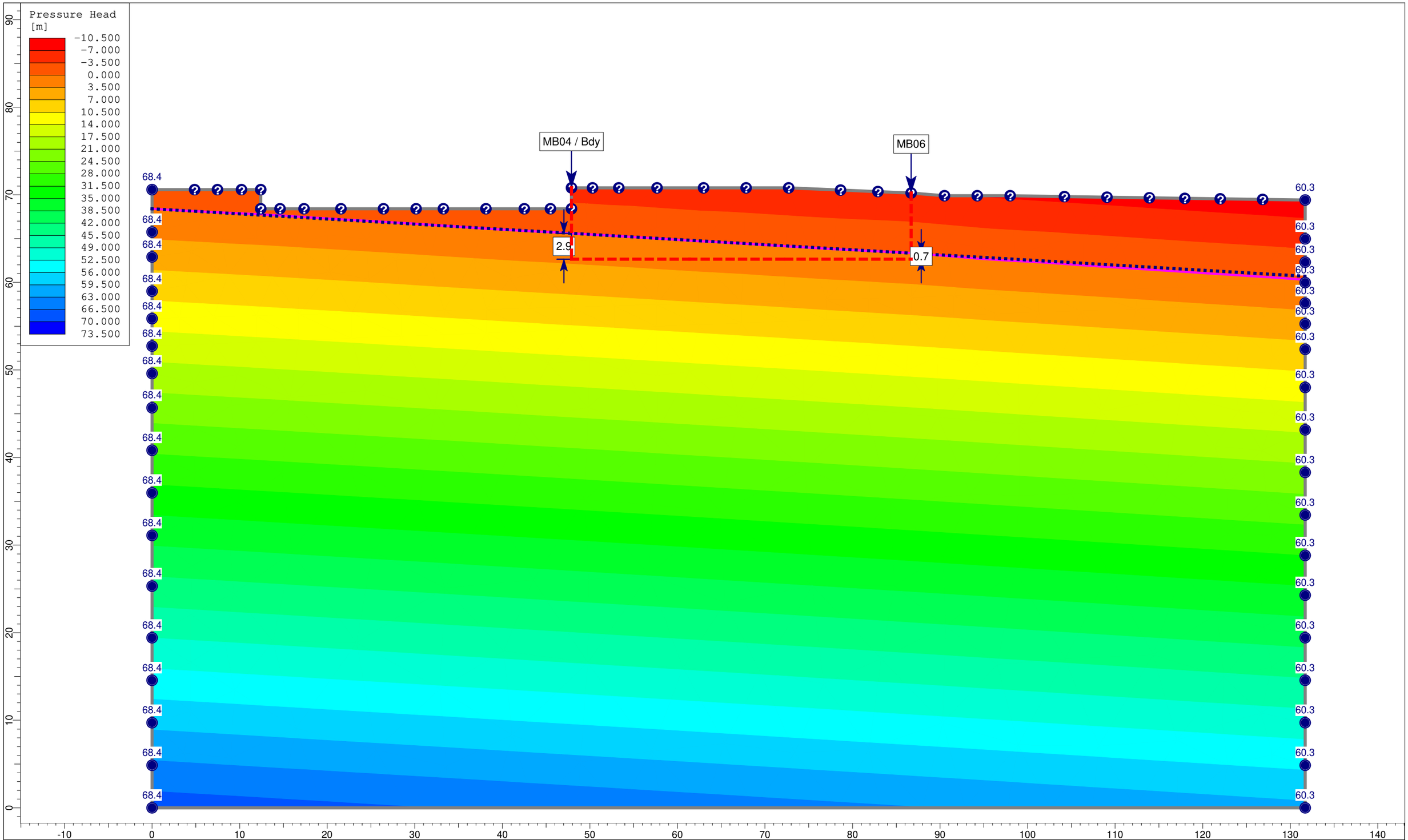
y0 = 4.42 m



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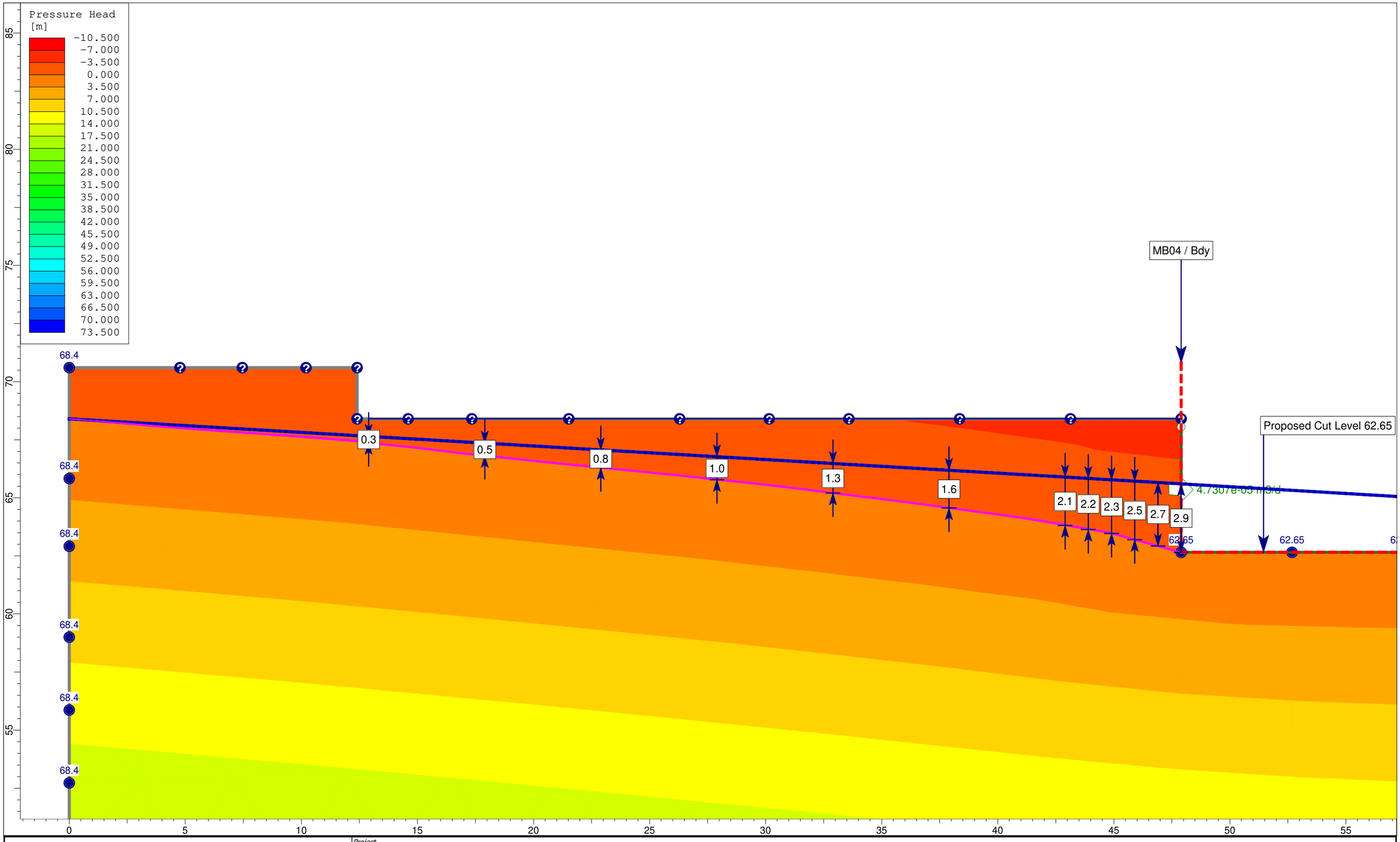
SLIDEINTERPRET 9.016

Project	538 Karangahape Road, Auckland City		
Group	20111 - C-C' Measured Groundwater	*Scenario*	Master Scenario
Drawn By	MC	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:400



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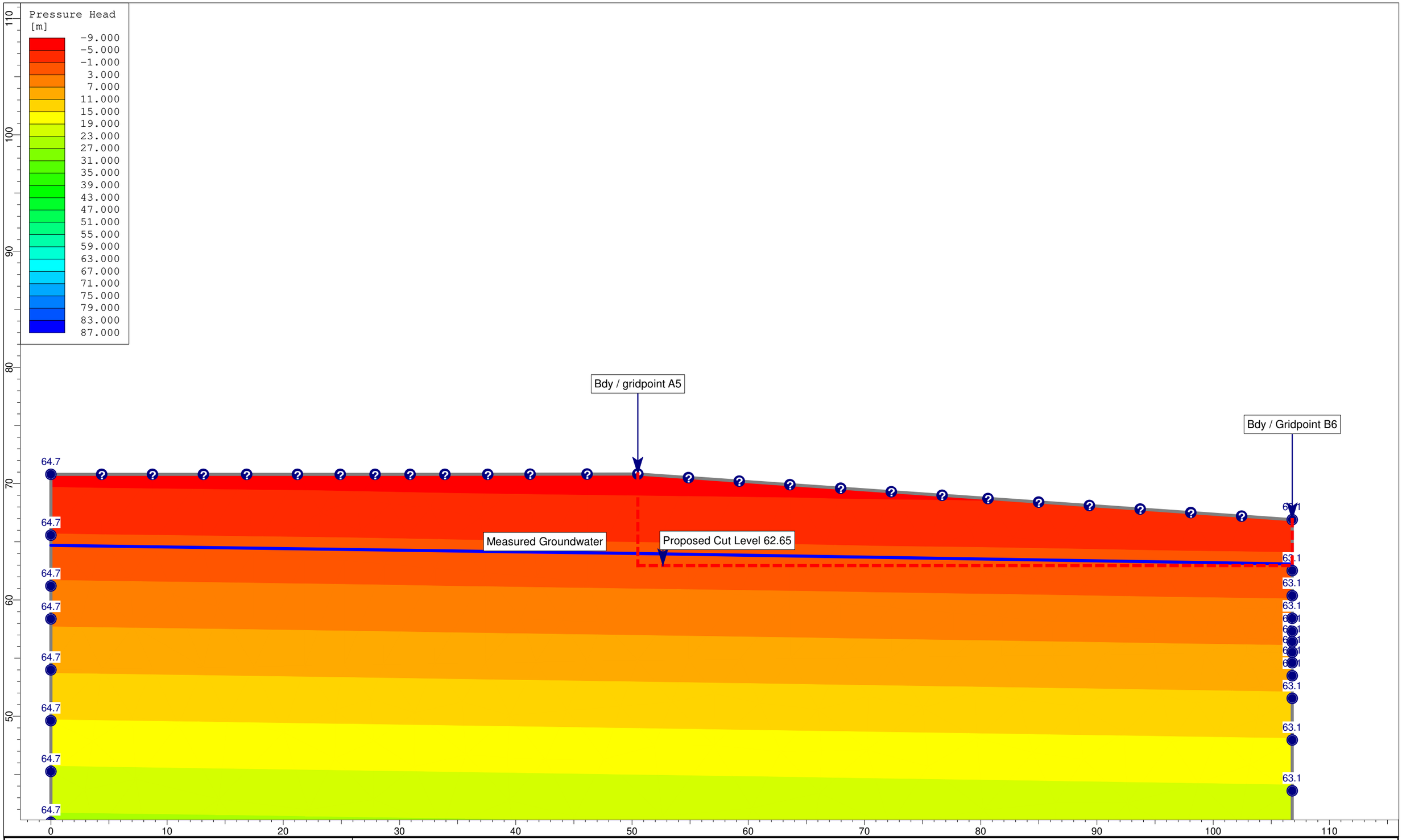
SLIDEINTERPRET 9.016

Project	538 Karangahape Road, Auckland City		
Group	20111 - C-C' Drawdown	*Scenario*	Master Scenario
Drawn By	MC	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:150



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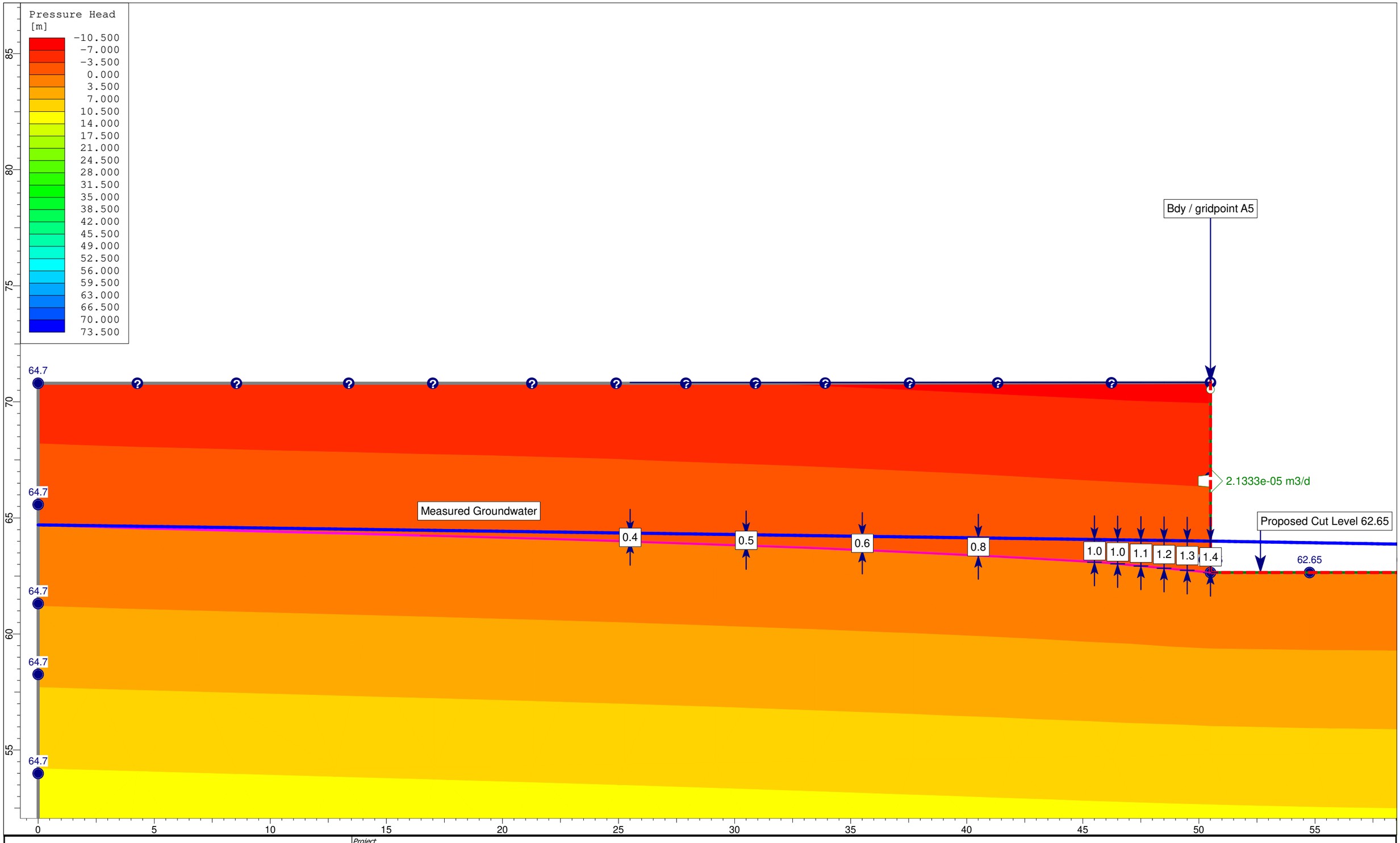
SLIDEINTERPRET 9.016

Project	538 Karangahape Road, Auckland City		
Group	20111 - D-D' Measured Groundwater	*Scenario*	Master Scenario
Drawn By	MC	*Company*	Soil & Rock Consultants
Date	Nov 2023	*Scale*	1:300



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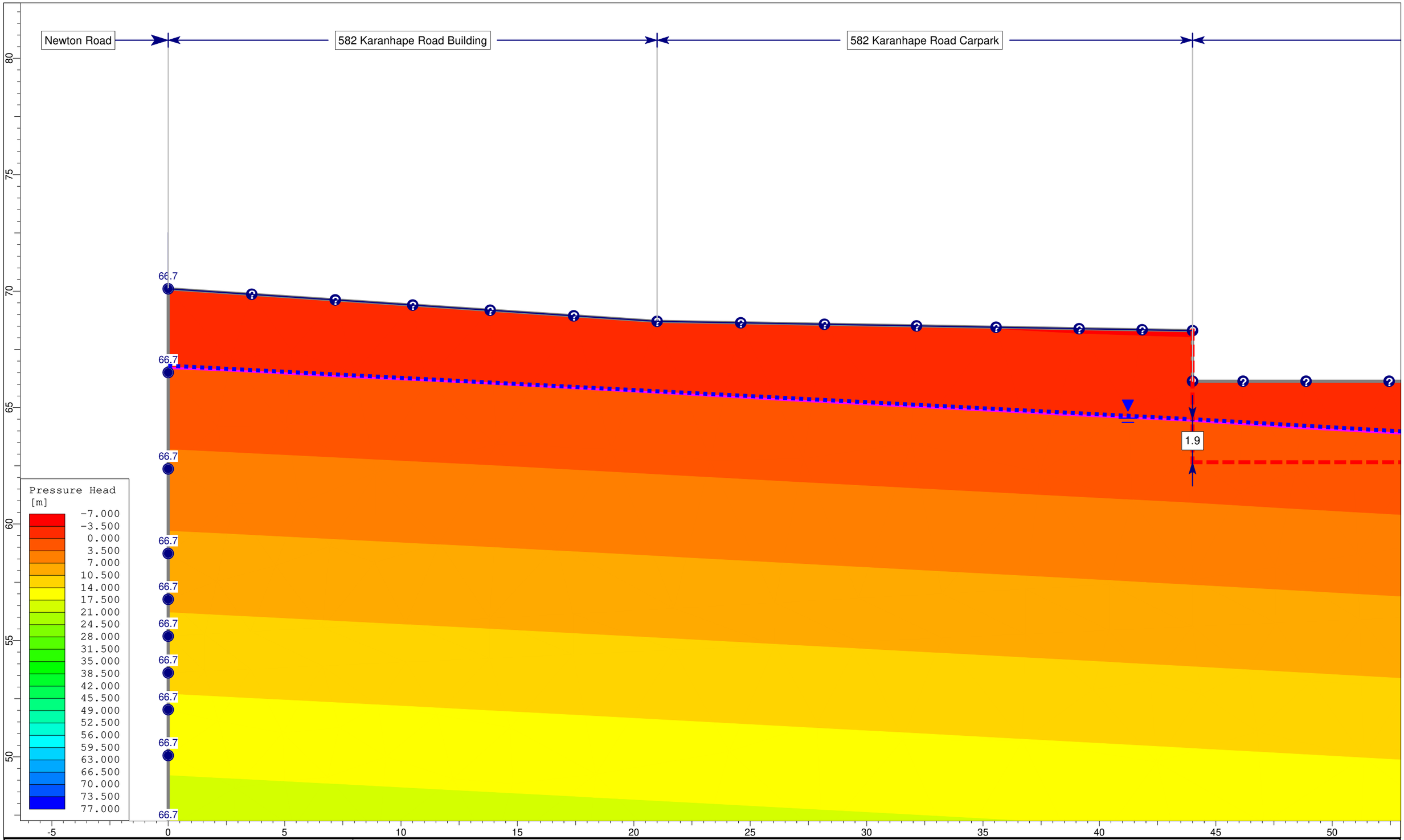
SLIDEINTERPRET 9.016

Project	538 Karangahape Road, Auckland City		
Group	D-D' Drawdown	*Scenario*	Master Scenario
Drawn By	MC	*Company*	Soil & Rock Consultants
Date	Nov 2023	*Scale*	1:150



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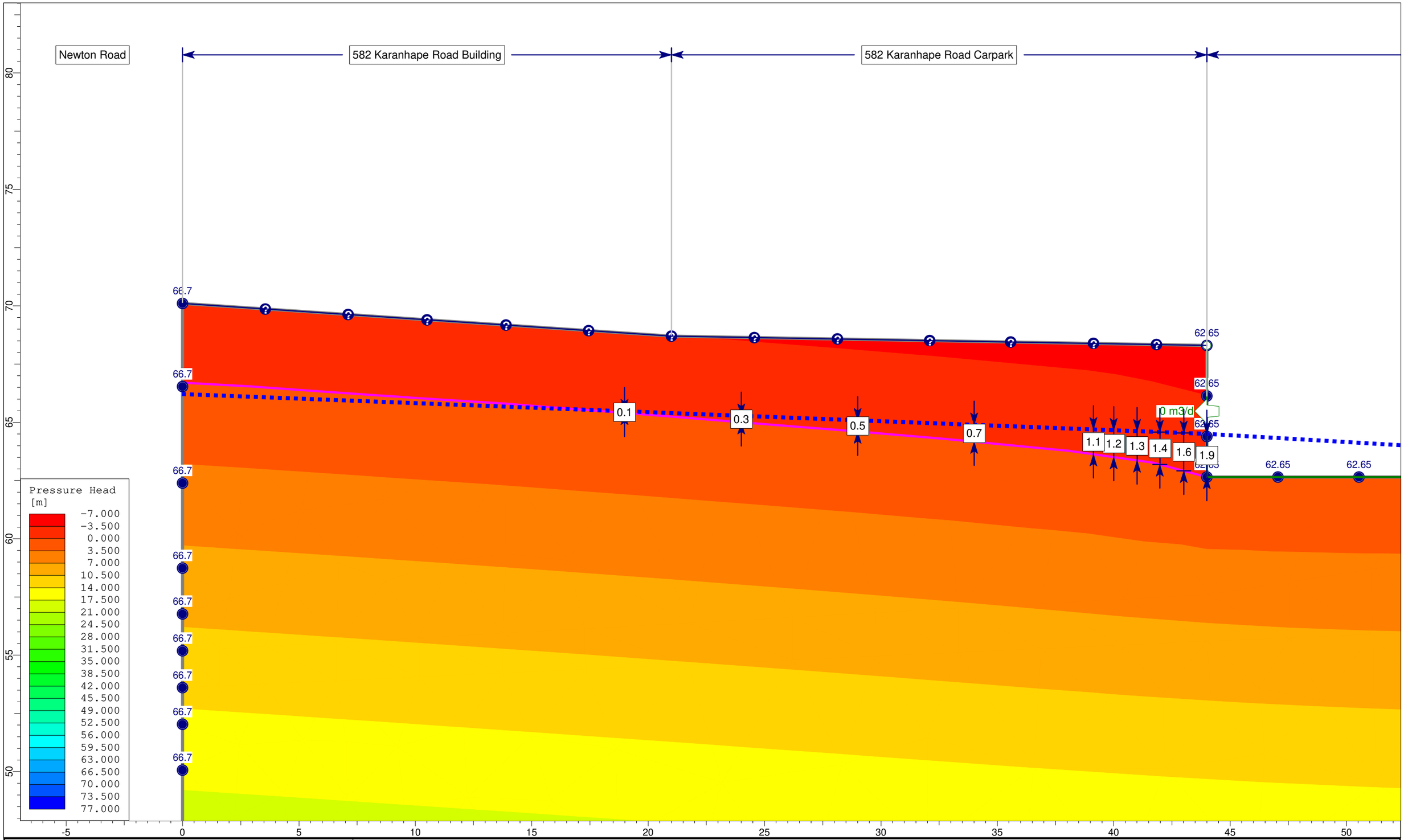
SLIDEINTERPRET 9.016

Project	538 Karangahape Road, Auckland City		
Group	20111 - F-F' Measured Groundwater	*Scenario*	Master Scenario
Drawn By	MC	*Company*	Soil & Rock Consultants
Date	Jun 2024	*Scale*	1:150



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SLIDEINTERPRET 9.016

Project	538 Karangahape Road, Auckland City		
Group	20111 - F-F' Drawdown	*Scenario*	Master Scenario
Drawn By	MC	*Company*	Soil & Rock Consultants
Date	Jun 2024	*Scale*	1:150

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Appendix D

WALLAP Outputs

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	70.00	2 WWGS	2 WWGS
2	57.20	3 Transitional WG	3 Transitional WG
3	54.60	4 Waitemata Group Rock	4 Waitemata Group Rock

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Fill	18.00	9000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	5.000d
2	WWGS	18.00	24000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	7.000d
3	Transition-al WG	19.00	45000	0.470	OC (0.200)	0.262 (1.182)	4.845 (6.154)	12.00d
4	Waitemata Group Rock	19.00	150000	0.412	OC (0.200)	0.219 (1.075)	6.289 (7.279)	30.00d

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Fill	30.00	0.631	0.00	30.00	0.464	0.00
2	WWGS	30.00	0.631	0.00	30.00	0.464	0.00
3	Transitional WG	32.00	0.625	0.00	32.00	0.459	0.00
4	Waitemata Group Rock	36.00	0.613	0.00	36.00	0.447	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	63.45	63.45

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	62.65	62.65	0.0	1	62.65	62.65	0.0

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 57.85
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 3.1685E+07 kN/m2
Moment of inertia of wall I = 0.017250 m4/m run
E.I = 546566 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Prop no.	Elev.	Prop spacing m	Cross-section area sq.m	Youngs modulus kN/m2	Free length m	Inclin-ation (degs)	Pre-stress /prop kN	Strut or Anchor	Allow tension ?	L/R
1	66.84	1.00	0.125000	3.169E+07	4.50	0.00	0	Strut	No	R
2	70.00	1.00	0.036100	2.000E+08	8.00	0.00	0	Strut	No	R
3	70.85	1.00	0.125000	3.169E+07	4.50	0.00	0	Strut	No	R
4	63.45	1.00	0.125000	3.169E+07	4.50	0.00	0	Strut	No	R
5	65.50	1.00	0.036100	2.000E+08	4.00	0.00	0	Strut	No	R

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	64.57	17.90	0	0	N/A

SURCHARGE LOADS

Surch-arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	70.00	0.00(L)	50.00	0.35	88.00	=	N/A	N/A
2	68.40	0.35(L)	50.00	1.00	47.00	=	N/A	N/A
3	68.40	1.35(L)	50.00	35.00	3.60	=	N/A	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Change EI of wall to 1.0000E-04 kN.m2/m run Yield moment not defined No adjustments to wall displacements
2	Apply surcharge no.1 at elevation 70.00 No analysis at this stage
3	Apply surcharge no.2 at elevation 68.40 No analysis at this stage
4	Apply surcharge no.3 at elevation 68.40 No analysis at this stage
5	Change EI of wall to 546566 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
6	Install strut or anchor no.2 at elevation 70.00
7	Excavate to elevation 65.00 on RIGHT side
8	Install strut or anchor no.5 at elevation 65.50
9	Apply water pressure profile no.1 No analysis at this stage
10	Excavate to elevation 62.65 on RIGHT side
11	Change EI of wall to 382596 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value
12	Install strut or anchor no.4 at elevation 63.45
13	Install strut or anchor no.1 at elevation 66.84
14	Remove strut or anchor no.5 at elevation 65.50
15	Remove strut or anchor no.2 at elevation 70.00
16	Install strut or anchor no.3 at elevation 70.85
17	Change EI of wall to 273283 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Change EI of wall to 1.0000E-04kN.m2/m	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 70.00	No	No	No
3	Apply surcharge no.2 at elev. 68.40	No	No	No
4	Apply surcharge no.3 at elev. 68.40	No	No	No
5	Change EI of wall to 546566kN.m2/m run	No	No	No
6	Install prop no.2 at elev. 70.00	Yes	Yes	Yes
7	Excav. to elev. 65.00 on RIGHT side	Yes	No	No
8	Install prop no.5 at elev. 65.50	No	No	No
9	Apply water pressure profile no.1	No	No	No
10	Excav. to elev. 62.65 on RIGHT side	Yes	No	No
11	Change EI of wall to 382596kN.m2/m run	No	No	No
12	Install prop no.4 at elev. 63.45	No	No	No
13	Install prop no.1 at elev. 66.84	No	No	No
14	Remove prop no.5 at elev. 65.50	No	No	No
15	Remove prop no.2 at elev. 70.00	Yes	Yes	Yes
16	Install prop no.3 at elev. 70.85	Yes	Yes	Yes
17	Change EI of wall to 273283kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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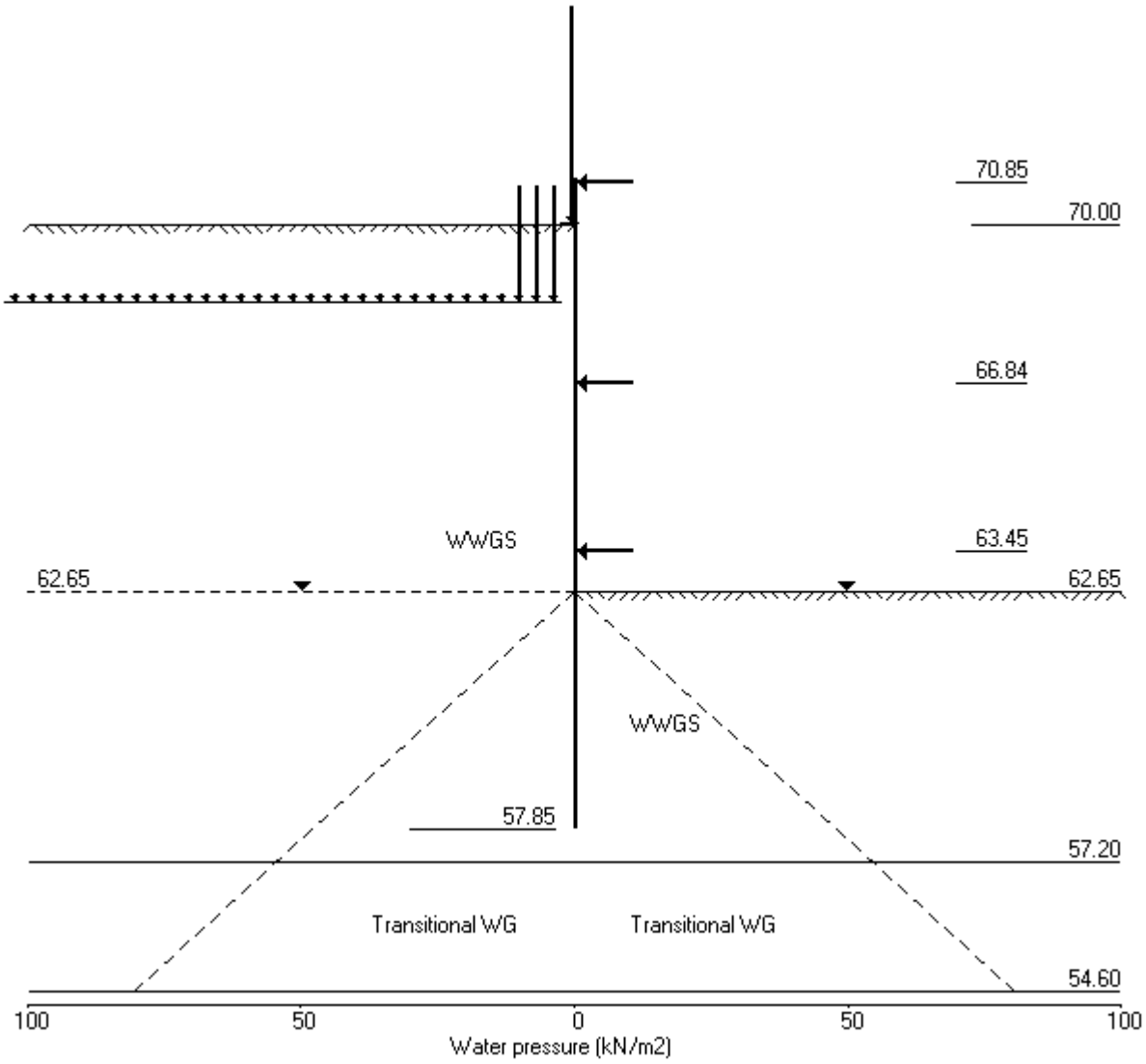
Units: kN,m

Stage No.17 Change EI of wall to 273283kN.m2/m run



Units: kN,m

Stage No. 1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

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. = 57.85 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
1	70.00	70.00	Cant.	Conditions not suitable for FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Node no.	Y coord	Nett pressure	Wall disp.	Wall rotation	Shear force	Bending moment	Prop forces	EI of wall
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	70.85	0.00	0.000	2.528E-21	0.0	0.0		0
2	70.43	0.00	0.000	2.528E-21	0.0	-0.0		0
3	70.00	0.00	-0.000	2.528E-21	0.0	0.0		0
4	69.20	0.00	0.000	-5.05E-21	0.0	0.0		0
5	68.40	0.00	-0.000	1.76E-20	0.0	-0.0		0
6	67.62	0.00	0.000	-6.49E-20	0.0	0.0		0
7	66.84	0.00	-0.000	2.42E-19	0.0	-0.0		0
8	66.17	0.00	0.000	-8.44E-19	0.0	0.0		0
9	65.50	0.00	-0.000	3.13E-18	0.0	-0.0		0
10	65.00	0.00	0.000	-1.03E-17	0.0	0.0		0
11	64.22	0.00	-0.000	4.77E-17	0.0	-0.0		0
12	63.45	0.00	0.000	-1.92E-15	0.0	0.0		0
13	62.65	0.00	0.000	1.01E-15	0.0	-0.0		0
14	62.13	0.00	0.000	2.25E-15	0.0	0.0		0
15	61.60	0.00	-0.000	9.07E-17	0.0	0.0		0
16	60.80	0.00	-0.000	-3.83E-17	0.0	-0.0		0
17	60.00	0.00	-0.000	6.24E-17	0.0	-0.0		0
18	59.20	0.00	-0.000	-2.11E-16	0.0	0.0		0
19	58.53	0.00	0.000	-1.60E-15	0.0	0.0		0
20	57.85	0.00	0.000	-2.69E-15	0.0	-0.0		---

		LEFT side						
			Effective stresses				Total	Coeff. of
Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	0.00	0.00a	102082
4	69.20	0.00	14.40	0.00	101.60	7.20	7.20	19504

(continued)

Stage No.1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

LEFT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
5	68.40	0.00	28.80	0.00	163.35	14.40	14.40	19902
6	67.62	0.00	42.84	3.55	223.55	21.42	21.42	21584
7	66.84	0.00	56.88	7.56	283.74	28.44	28.44	20289
8	66.17	0.00	68.94	11.00	335.45	34.47	34.47	25428
9	65.50	0.00	81.00	14.44	387.16	40.50	40.50	20139
10	65.00	0.00	90.00	17.00	425.75	45.00	45.00	42797
11	64.22	0.00	103.95	20.98	485.57	51.98	51.98	21584
12	63.45	0.00	117.90	24.96	545.38	58.95	58.95	10944
13	62.65	8.00	124.30	26.78	572.82	62.15	70.15	10944
14	62.13	13.25	128.50	27.98	590.83	64.25	77.50	10944
15	61.60	18.50	132.70	29.18	608.84	66.35	84.85	20239
16	60.80	26.50	139.10	31.01	636.28	69.55	96.05	96624
17	60.00	34.50	145.50	32.83	663.72	72.75	107.25	20239
18	59.20	42.50	151.90	34.66	691.16	75.95	118.45	20239
19	58.53	49.25	157.30	36.20	714.31	78.65	127.90	18462
20	57.85	56.00	162.70	37.74	737.47	81.35	137.35	18462

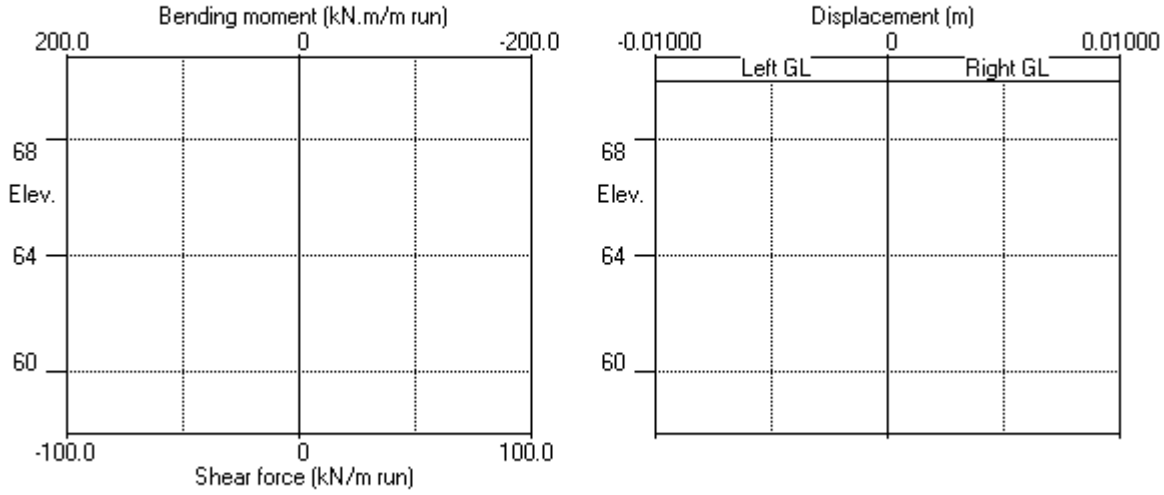
RIGHT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	0.00	0.00a	102082
4	69.20	0.00	14.40	0.00	101.60	7.20	7.20	19504
5	68.40	0.00	28.80	0.00	163.35	14.40	14.40	19902
6	67.62	0.00	42.84	3.55	223.55	21.42	21.42	21584
7	66.84	0.00	56.88	7.56	283.74	28.44	28.44	20289
8	66.17	0.00	68.94	11.00	335.45	34.47	34.47	25428
9	65.50	0.00	81.00	14.44	387.16	40.50	40.50	20139
10	65.00	0.00	90.00	17.00	425.75	45.00	45.00	42797
11	64.22	0.00	103.95	20.98	485.57	51.98	51.98	21584
12	63.45	0.00	117.90	24.96	545.38	58.95	58.95	10944
13	62.65	8.00	124.30	26.78	572.82	62.15	70.15	10944
14	62.13	13.25	128.50	27.98	590.83	64.25	77.50	10944
15	61.60	18.50	132.70	29.18	608.84	66.35	84.85	20239
16	60.80	26.50	139.10	31.01	636.28	69.55	96.05	96624
17	60.00	34.50	145.50	32.83	663.72	72.75	107.25	20239
18	59.20	42.50	151.90	34.66	691.16	75.95	118.45	20239
19	58.53	49.25	157.30	36.20	714.31	78.65	127.90	18462
20	57.85	56.00	162.70	37.74	737.47	81.35	137.35	18462

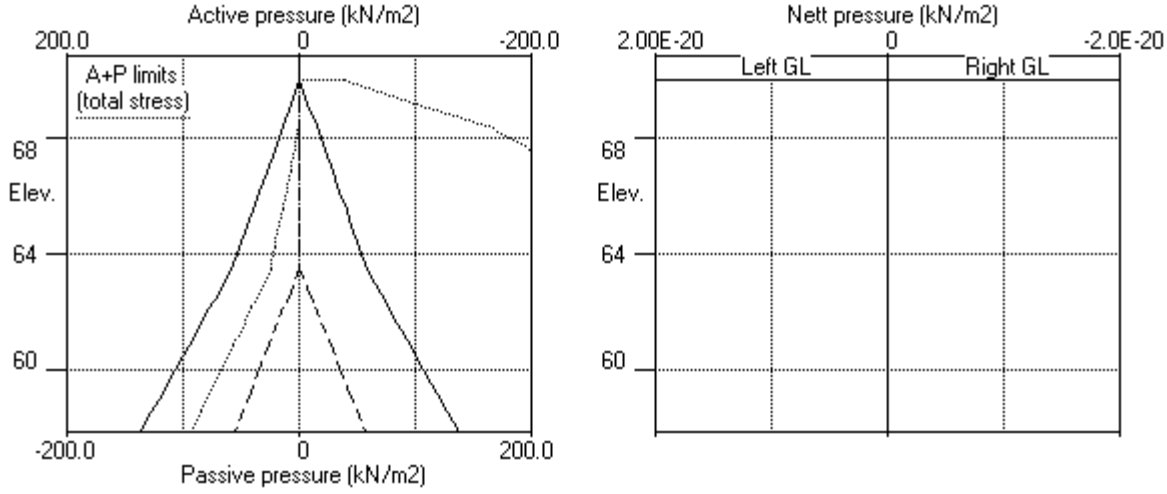
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Units: kN,m

Stage No. 5 Change EI of wall to 546566 kN.m2/m run
Yield moment not defined
Reset wall displacements to zero at this stage

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

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = 57.85 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
5	70.00	70.00	Cant.	Conditions not suitable for FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

*** Wall displacements reset to zero at stage 5

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	70.85	0.00	0.002	1.73E-04	0.0	0.0		546566
2	70.43	0.00	0.002	1.73E-04	0.0	-0.0		546566
3	70.00	0.00	0.002	1.73E-04	0.0	-0.0		546566
		7.70	0.002	1.73E-04	0.0	-0.0		
4	69.20	0.20	0.002	1.71E-04	3.2	1.6		546566
5	68.40	-3.97	0.002	1.68E-04	1.7	3.6		546566
6	67.62	0.10	0.002	1.62E-04	0.1	4.1		546566
7	66.84	0.68	0.001	1.56E-04	0.4	4.2		546566
8	66.17	0.18	0.001	1.51E-04	0.7	4.5		546566
9	65.50	-0.25	0.001	1.45E-04	0.7	5.0		546566
10	65.00	-0.45	0.001	1.40E-04	0.5	5.3		546566
11	64.22	-0.59	0.001	1.33E-04	0.1	5.5		546566
12	63.45	-0.59	0.001	1.25E-04	-0.3	5.4		546566
13	62.65	-0.49	0.001	1.17E-04	-0.8	4.9		546566
14	62.13	-0.39	0.001	1.13E-04	-1.0	4.4		546566
15	61.60	-0.27	0.001	1.09E-04	-1.2	3.8		546566
16	60.80	-0.05	0.001	1.04E-04	-1.3	2.8		546566
17	60.00	0.19	0.001	1.01E-04	-1.2	1.7		546566
18	59.20	0.46	0.000	9.95E-05	-1.0	0.8		546566
19	58.53	0.71	0.000	9.89E-05	-0.6	0.2		546566
20	57.85	0.97	0.000	9.87E-05	0.0	0.0		---

(continued)

Stage No.5 Change EI of wall to 546566 kN.m2/m run
Yield moment not defined
Reset wall displacements to zero at this stage

LEFT side

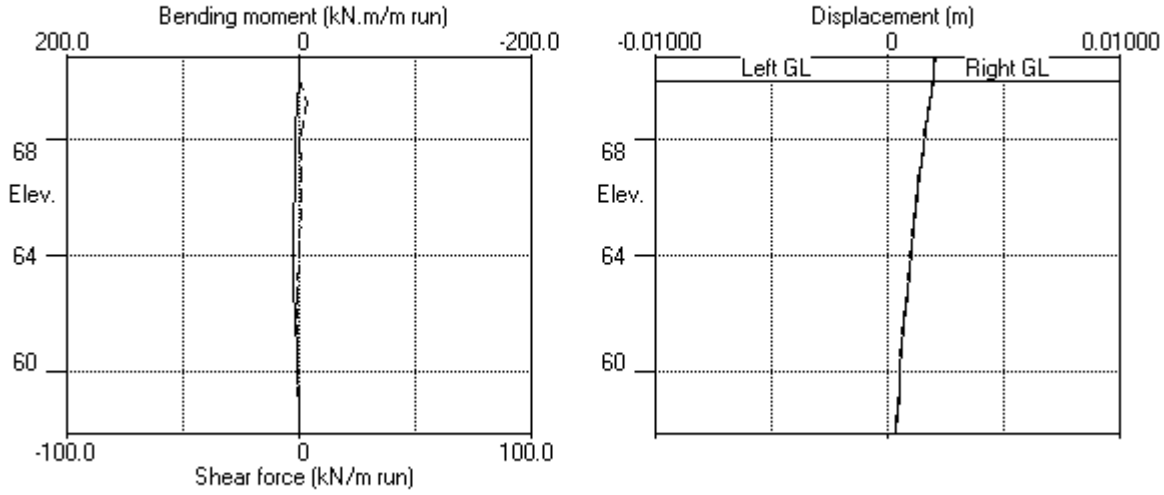
Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	77.00	13.29	370.01	13.48	13.48	2989
4	69.20	0.00	58.08	7.90	288.87	12.76	12.76	2989
5	68.40	0.00	52.56	6.32	265.22	15.39	15.39	2989
6	67.62	0.00	79.78	14.09	381.93	26.09	26.09	2989
7	66.84	0.00	93.17	17.91	439.36	33.32	33.32	2989
8	66.17	0.00	100.76	20.07	471.88	38.54	38.54	2989
9	65.50	0.00	108.73	22.34	506.05	43.84	43.84	2989
10	65.00	0.00	115.21	24.19	533.84	47.93	47.93	2989
11	64.22	0.00	110.07	22.73	511.81	54.44	54.44	2989
12	63.45	0.00	137.60	30.58	629.84	61.12	61.12	2989
13	62.65	8.00	131.27	28.77	602.73	64.13	72.13	2989
14	62.13	13.25	145.22	32.75	662.54	66.15	79.40	2989
15	61.60	18.50	142.36	31.94	650.26	68.19	86.69	2989
16	60.80	26.50	153.68	35.16	698.78	71.35	97.85	2989
17	60.00	34.50	154.50	35.40	702.29	74.55	109.05	2989
18	59.20	42.50	164.70	38.31	746.05	77.78	120.28	2989
19	58.53	49.25	168.21	39.31	761.11	80.53	129.78	2989
20	57.85	56.00	173.65	40.86	784.44	83.29	139.29	2989

RIGHT side

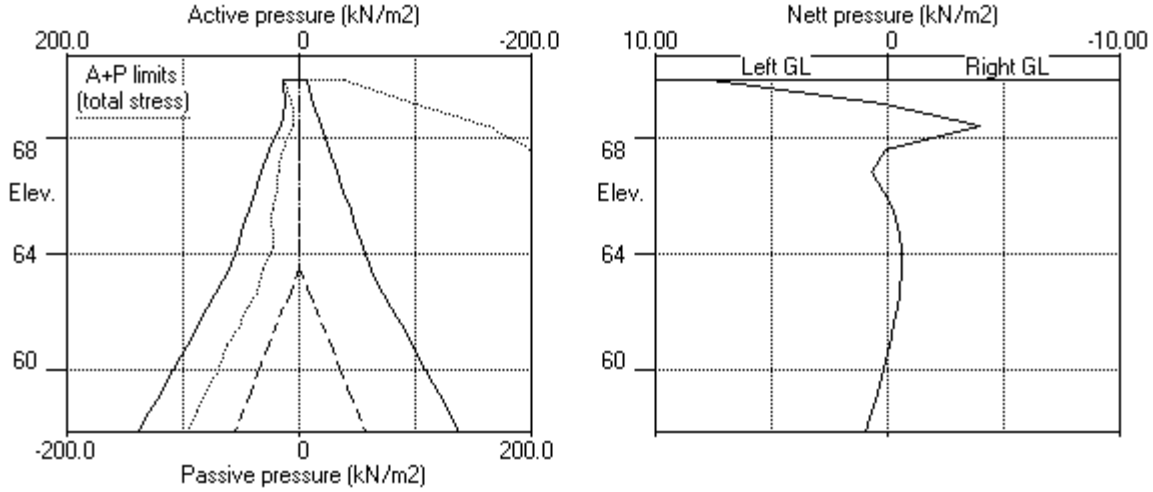
Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	5.77	5.77	2989
4	69.20	0.00	14.40	0.00	101.60	12.56	12.56	2989
5	68.40	0.00	28.80	0.00	163.35	19.35	19.35	2989
6	67.62	0.00	42.84	3.55	223.55	25.99	25.99	2989
7	66.84	0.00	56.88	7.56	283.74	32.64	32.64	2989
8	66.17	0.00	68.94	11.00	335.45	38.36	38.36	2989
9	65.50	0.00	81.00	14.44	387.16	44.09	44.09	2989
10	65.00	0.00	90.00	17.00	425.75	48.37	48.37	2989
11	64.22	0.00	103.95	20.98	485.57	55.03	55.03	2989
12	63.45	0.00	117.90	24.96	545.38	61.71	61.71	2989
13	62.65	8.00	124.30	26.78	572.82	64.62	72.62	2989
14	62.13	13.25	128.50	27.98	590.83	66.54	79.79	2989
15	61.60	18.50	132.70	29.18	608.84	68.46	86.96	2989
16	60.80	26.50	139.10	31.01	636.28	71.40	97.90	2989
17	60.00	34.50	145.50	32.83	663.72	74.36	108.86	2989
18	59.20	42.50	151.90	34.66	691.16	77.32	119.82	2989
19	58.53	49.25	157.30	36.20	714.31	79.82	129.07	2989
20	57.85	56.00	162.70	37.74	737.47	82.32	138.32	2989

Units: kN,m

Stage No.5 Change EI of wall to 546566kN.m2/m run



Stage No.5 Change EI of wall to 546566kN.m2/m run



Units: kN,m

Stage No. 7 Excavate to elevation 65.00 on RIGHT side

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. = 57.85** Factor of Safety	Moment equilib. at elev.	**Toe elev. for FoS = 1.500** Toe elev.	Wall Penetr -ation	Direction of failure
7	70.00	65.00	70.00	2.525	n/a	62.73	2.27	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

*** Wall displacements reset to zero at stage 5

Node no.	Y coord	Nett pressure	Wall disp.	Wall rotation	Shear force	Bending moment	Prop forces	EI of wall
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	70.85	0.00	0.001	-1.19E-03	0.0	-0.0		546566
2	70.43	0.00	0.001	-1.19E-03	0.0	-0.0		546566
3	70.00	0.00	0.002	-1.19E-03	0.0	-0.0	-63.3	546566
		13.31	0.002	-1.19E-03	-63.3	-0.0		
4	69.20	10.02	0.003	-1.16E-03	-54.0	-46.6		546566
5	68.40	10.21	0.004	-1.06E-03	-45.9	-86.4		546566
6	67.62	18.77	0.005	-9.21E-04	-34.6	-118.1		546566
7	66.84	24.17	0.005	-7.37E-04	-17.9	-138.7		546566
8	66.17	28.12	0.006	-5.63E-04	-0.3	-144.9		546566
9	65.50	32.43	0.006	-3.90E-04	19.9	-138.5		546566
10	65.00	35.96	0.006	-2.70E-04	37.0	-124.3		546566
		-3.90	0.006	-2.70E-04	37.0	-124.3		
11	64.22	-5.43	0.006	-1.14E-04	33.4	-95.4		546566
12	63.45	-6.16	0.006	3.79E-06	28.9	-71.2		546566
13	62.65	-6.36	0.006	9.25E-05	23.9	-50.1		546566
14	62.13	-6.27	0.006	1.35E-04	20.6	-38.4		546566
15	61.60	-6.06	0.006	1.67E-04	17.4	-28.5		546566
16	60.80	-5.56	0.006	2.00E-04	12.7	-16.6		546566
17	60.00	-4.93	0.006	2.18E-04	8.5	-8.2		546566
18	59.20	-4.23	0.006	2.26E-04	4.9	-3.0		546566
19	58.53	-3.61	0.006	2.28E-04	2.2	-0.7		546566
20	57.85	-2.99	0.005	2.29E-04	0.0	0.0		---

At elev. 70.00 Prop force = 63.3 kN/m run

(continued)

Stage No.7 Excavate to elevation 65.00 on RIGHT side

LEFT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	77.00	13.29	370.01	13.31	13.31	2363
4	69.20	0.00	58.08	7.90	288.87	10.02	10.02	2363
5	68.40	0.00	52.56	6.32	265.22	10.21	10.21	2363
6	67.62	0.00	79.78	14.09	381.93	18.77	18.77	2363
7	66.84	0.00	93.17	17.91	439.36	24.17	24.17	2363
8	66.17	0.00	100.76	20.07	471.88	28.12	28.12	2363
9	65.50	0.00	108.73	22.34	506.05	32.43	32.43	2363
10	65.00	0.00	115.21	24.19	533.84	35.96	35.96	2363
11	64.22	0.00	110.07	22.73	511.81	41.87	41.87	2363
12	63.45	0.00	137.60	30.58	629.84	48.22	48.22	2363
13	62.65	8.00	131.27	28.77	602.73	51.09	59.09	2363
14	62.13	13.25	145.22	32.75	662.54	53.11	66.36	2363
15	61.60	18.50	142.36	31.94	650.26	55.21	73.71	2363
16	60.80	26.50	153.68	35.16	698.78	58.52	85.02	2363
17	60.00	34.50	154.50	35.40	702.29	61.92	96.42	2363
18	59.20	42.50	164.70	38.31	746.05	65.38	107.88	2363
19	58.53	49.25	168.21	39.31	761.11	68.33	117.58	2363
20	57.85	56.00	173.65	40.86	784.44	71.30	127.30	2363

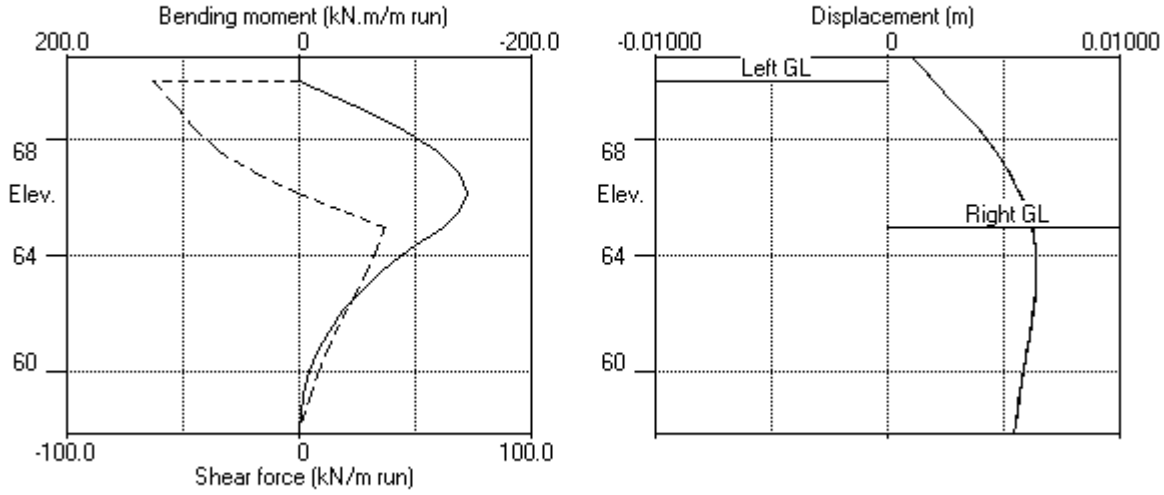
RIGHT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	2777
11	64.22	0.00	13.95	0.00	99.68	47.30	47.30	2777
12	63.45	0.00	27.92	0.00	159.56	54.37	54.37	2777
13	62.65	8.00	34.36	1.13	187.19	57.45	65.45	2777
14	62.13	13.25	38.61	2.35	205.41	59.38	72.63	2777
15	61.60	18.50	42.88	3.56	223.72	61.27	79.77	2777
16	60.80	26.50	49.44	5.43	251.83	64.08	90.58	2777
17	60.00	34.50	56.05	7.32	280.21	66.85	101.35	2777
18	59.20	42.50	62.75	9.23	308.89	69.61	112.11	2777
19	58.53	49.25	68.45	10.86	333.35	71.94	121.19	2777
20	57.85	56.00	74.21	12.50	358.05	74.29	130.29	2777

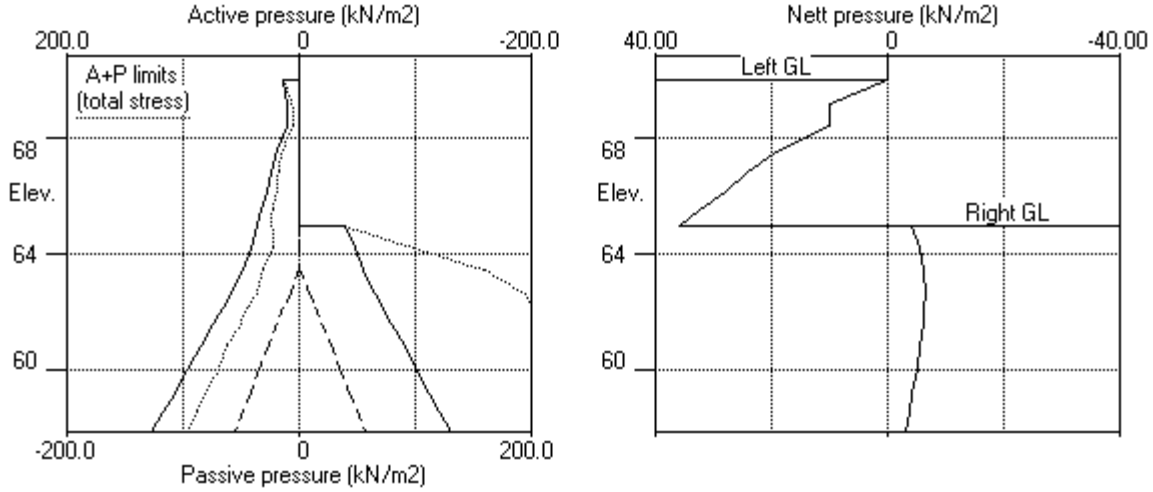
Note: 12.34a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.7 Excav. to elev. 65.00 on RIGHT side



Stage No.7 Excav. to elev. 65.00 on RIGHT side



Units: kN,m

Stage No. 10 Excavate to elevation 62.65 on RIGHT side

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

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	**FoS for toe elev. = 57.85** Factor of Safety	Moment equilib. at elev.	**Toe elev. for FoS = 1.500** Toe elev.	Wall Penetr -ation	Direction of failure
10	70.00	62.65		More than one prop. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

*** Wall displacements reset to zero at stage 5

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	70.85	0.00	0.001	-1.06E-03	0.0	-0.0		546566
2	70.43	0.00	0.002	-1.06E-03	0.0	-0.0		546566
3	70.00	0.00	0.002	-1.06E-03	0.0	-0.0	-38.9	546566
		13.44	0.002	-1.06E-03	-38.9	-0.0		
4	69.20	10.62	0.003	-1.04E-03	-29.2	-27.0		546566
5	68.40	11.17	0.004	-9.91E-04	-20.5	-46.8		546566
6	67.62	19.88	0.004	-9.16E-04	-8.4	-58.4		546566
7	66.84	25.13	0.005	-8.33E-04	9.1	-58.2		546566
8	66.17	28.62	0.006	-7.69E-04	27.2	-46.1		546566
9	65.50	32.19	0.006	-7.28E-04	47.5	-21.1	-129.4	546566
		32.19	0.006	-7.28E-04	-81.9	-21.1		
10	65.00	35.06	0.006	-6.92E-04	-65.1	-57.9		546566
11	64.22	39.77	0.007	-5.83E-04	-36.1	-95.7		546566
12	63.45	44.90	0.007	-4.36E-04	-3.2	-111.0		546566
13	62.65	48.65	0.008	-2.83E-04	34.2	-98.8		546566
		8.79	0.008	-2.83E-04	34.2	-98.8		
14	62.13	-5.87	0.008	-1.97E-04	34.9	-80.1		546566
15	61.60	-6.77	0.008	-1.28E-04	31.6	-62.5		546566
16	60.80	-7.75	0.008	-5.41E-05	25.8	-39.4		546566
17	60.00	-8.40	0.008	-9.72E-06	19.4	-21.3		546566
18	59.20	-8.88	0.008	1.20E-05	12.4	-8.5		546566
19	58.53	-9.22	0.008	1.86E-05	6.3	-2.2		546566
20	57.85	-9.54	0.008	2.00E-05	0.0	0.0		---
At elev. 70.00			Prop force =		38.9 kN/m run			
At elev. 65.50			Prop force =		129.4 kN/m run			

(continued)

Stage No.10 Excavate to elevation 62.65 on RIGHT side

LEFT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	77.00	13.29	370.01	13.44	13.44	4605
4	69.20	0.00	58.08	7.90	288.87	10.62	10.62	4605
5	68.40	0.00	52.56	6.32	265.22	11.17	11.17	4605
6	67.62	0.00	79.78	14.09	381.93	19.88	19.88	4605
7	66.84	0.00	93.17	17.91	439.36	25.13	25.13	4605
8	66.17	0.00	100.76	20.07	471.88	28.62	28.62	4605
9	65.50	0.00	108.73	22.34	506.05	32.19	32.19	3419
10	65.00	0.00	115.21	24.19	533.84	35.06	35.06	3419
11	64.22	0.00	110.07	22.73	511.81	39.77	39.77	3419
12	63.45	0.00	137.60	30.58	629.84	44.90	44.90	3419
13	62.65	0.00	139.27	31.06	637.03	48.65	48.65	3419
14	62.13	5.25	153.22	35.03	696.84	50.04	55.29	3419
15	61.60	10.50	150.36	34.22	684.56	51.57	62.07	3419
16	60.80	18.50	161.68	37.44	733.08	54.13	72.63	3419
17	60.00	26.50	162.50	37.68	736.59	56.88	83.38	3419
18	59.20	34.50	172.70	40.59	780.35	59.74	94.24	3419
19	58.53	41.25	176.21	41.59	795.42	62.20	103.45	3419
20	57.85	48.00	181.65	43.14	818.74	64.68	112.68	3419

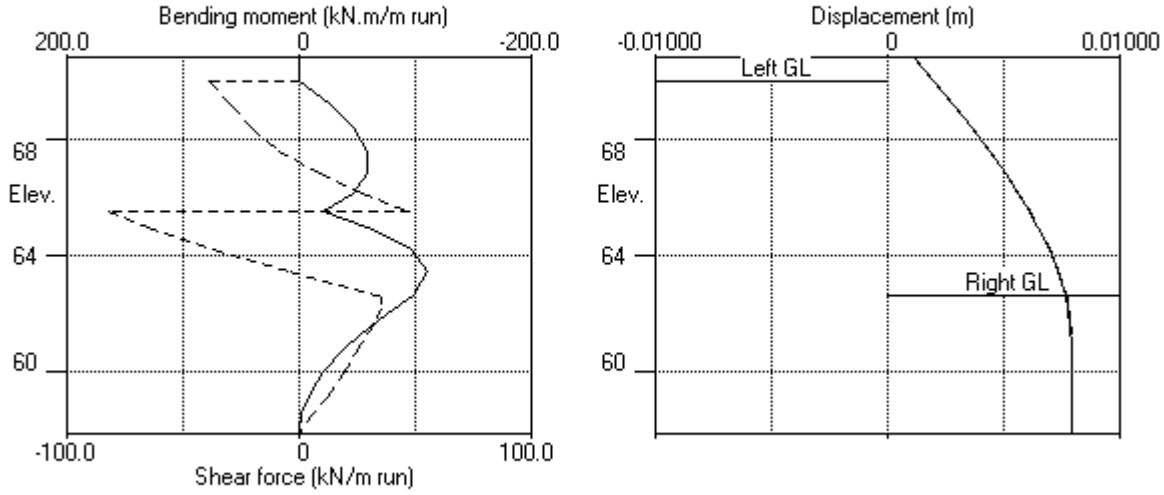
RIGHT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.22	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	63.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	3456
14	62.13	5.25	4.20	0.00	57.87	55.91	61.16	3456
15	61.60	10.50	8.41	0.00	75.91	58.35	68.85	3456
16	60.80	18.50	14.84	0.00	103.51	61.88	80.38	3456
17	60.00	26.50	21.33	0.00	131.31	65.28	91.78	3456
18	59.20	34.50	27.88	0.00	159.39	68.62	103.12	3456
19	58.53	41.25	33.47	0.88	183.36	71.42	112.67	3456
20	57.85	48.00	39.13	2.49	207.62	74.23	122.23	3456

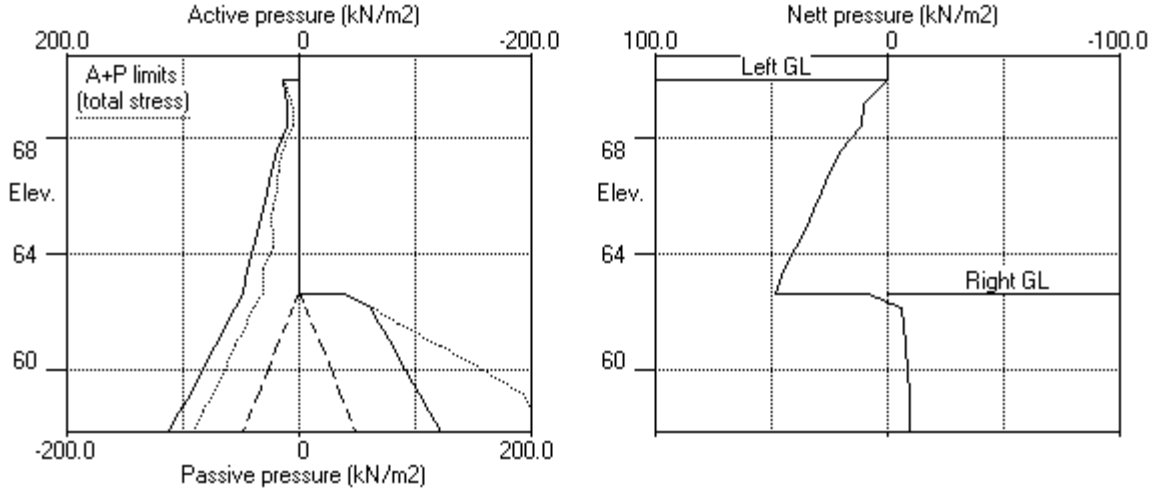
Note: 12.34a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.10 Excav. to elev. 62.65 on RIGHT side



Stage No.10 Excav. to elev. 62.65 on RIGHT side



Units: kN,m

Stage No. 11 Change EI of wall to 382596 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

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

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = 57.85 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
11	70.00	62.65		More than one prop.		No FoS calc.		

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

*** Wall displacements reset to zero at stage 5

Node no.	Y coord	Nett pressure	Wall disp.	Wall rotation	Shear force	Bending moment	Prop forces	EI of wall
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	70.85	0.00	0.001	-1.08E-03	0.0	-0.0		382596
2	70.43	0.00	0.002	-1.08E-03	0.0	-0.0		382596
3	70.00	0.00	0.002	-1.08E-03	0.0	-0.0	-33.3	382596
		13.65	0.002	-1.08E-03	-33.3	-0.0		
4	69.20	10.59	0.003	-1.05E-03	-23.6	-23.5		382596
5	68.40	11.11	0.004	-9.95E-04	-14.9	-39.8		382596
6	67.62	19.83	0.004	-9.10E-04	-2.9	-48.1		382596
7	66.84	25.11	0.005	-8.23E-04	14.7	-44.7		382596
8	66.17	28.62	0.006	-7.66E-04	32.6	-29.7		382596
9	65.50	32.16	0.006	-7.48E-04	53.0	-1.9	-137.8	382596
		32.16	0.006	-7.48E-04	-84.8	-1.9		
10	65.00	34.97	0.006	-7.28E-04	-68.0	-39.8		382596
11	64.22	39.54	0.007	-6.17E-04	-39.1	-79.4		382596
12	63.45	44.58	0.007	-4.48E-04	-6.5	-96.7		382596
13	62.65	48.35	0.008	-2.65E-04	30.6	-86.5		382596
		8.49	0.008	-2.65E-04	30.6	-86.5		
14	62.13	-6.64	0.008	-1.63E-04	31.1	-69.2		382596
15	61.60	-7.23	0.008	-8.35E-05	27.5	-53.3		382596
16	60.80	-7.60	0.008	1.67E-06	21.5	-32.9		382596
17	60.00	-7.57	0.008	5.09E-05	15.5	-17.4		382596
18	59.20	-7.33	0.008	7.44E-05	9.5	-6.8		382596
19	58.53	-7.05	0.008	8.13E-05	4.7	-1.7		382596
20	57.85	-6.76	0.008	8.26E-05	0.0	0.0		---
At elev. 70.00			Prop force =		33.3 kN/m run			
At elev. 65.50			Prop force =		137.8 kN/m run			

(continued)

Stage No.11 Change EI of wall to 382596 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

LEFT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	77.00	13.29	370.01	13.65	13.65	35408
4	69.20	0.00	58.08	7.90	288.87	10.59	10.59	4711
5	68.40	0.00	52.56	6.32	265.22	11.11	11.11	4711
6	67.62	0.00	79.78	14.09	381.93	19.83	19.83	4711
7	66.84	0.00	93.17	17.91	439.36	25.11	25.11	4711
8	66.17	0.00	100.76	20.07	471.88	28.62	28.62	4711
9	65.50	0.00	108.73	22.34	506.05	32.16	32.16	4711
10	65.00	0.00	115.21	24.19	533.84	34.97	34.97	4711
11	64.22	0.00	110.07	22.73	511.81	39.54	39.54	4711
12	63.45	0.00	137.60	30.58	629.84	44.58	44.58	4711
13	62.65	0.00	139.27	31.06	637.03	48.35	48.35	4711
14	62.13	5.25	153.22	35.03	696.84	49.80	55.05	4711
15	61.60	10.50	150.36	34.22	684.56	51.43	61.93	4711
16	60.80	18.50	161.68	37.44	733.08	54.21	72.71	7282
17	60.00	26.50	162.50	37.68	736.59	57.29	83.79	7282
18	59.20	34.50	172.70	40.59	780.35	60.51	95.01	7282
19	58.53	41.25	176.21	41.59	795.42	63.28	104.53	7282
20	57.85	48.00	181.65	43.14	818.74	66.08	114.08	7282

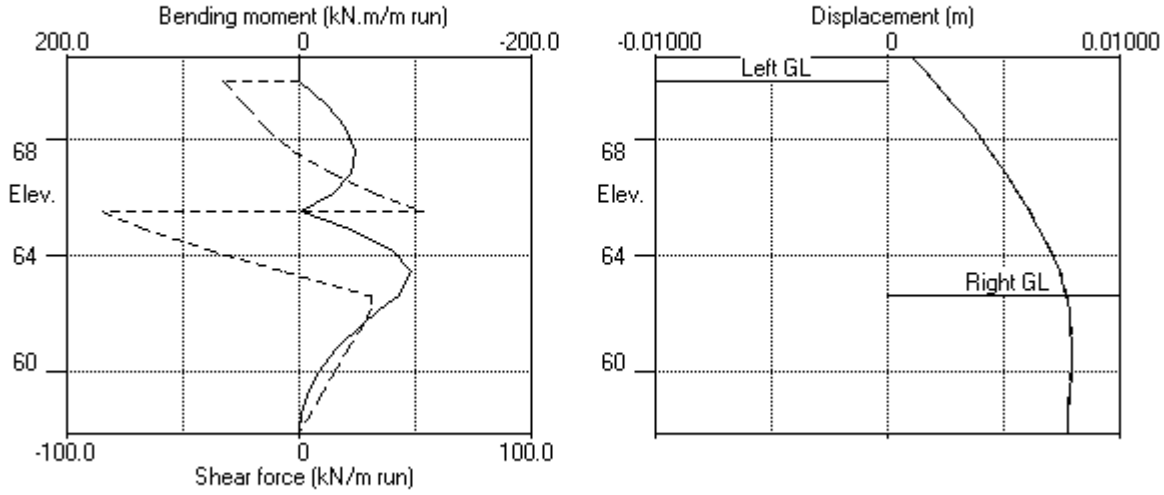
RIGHT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.22	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	63.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	10175
14	62.13	5.25	4.20	0.00	57.87	56.43	61.68	10175
15	61.60	10.50	8.41	0.00	75.91	58.66	69.16	10175
16	60.80	18.50	14.84	0.00	103.51	61.81	80.31	7282
17	60.00	26.50	21.33	0.00	131.31	64.87	91.37	7282
18	59.20	34.50	27.88	0.00	159.39	67.84	102.34	7282
19	58.53	41.25	33.47	0.88	183.36	70.33	111.58	7282
20	57.85	48.00	39.13	2.49	207.62	72.83	120.83	7282

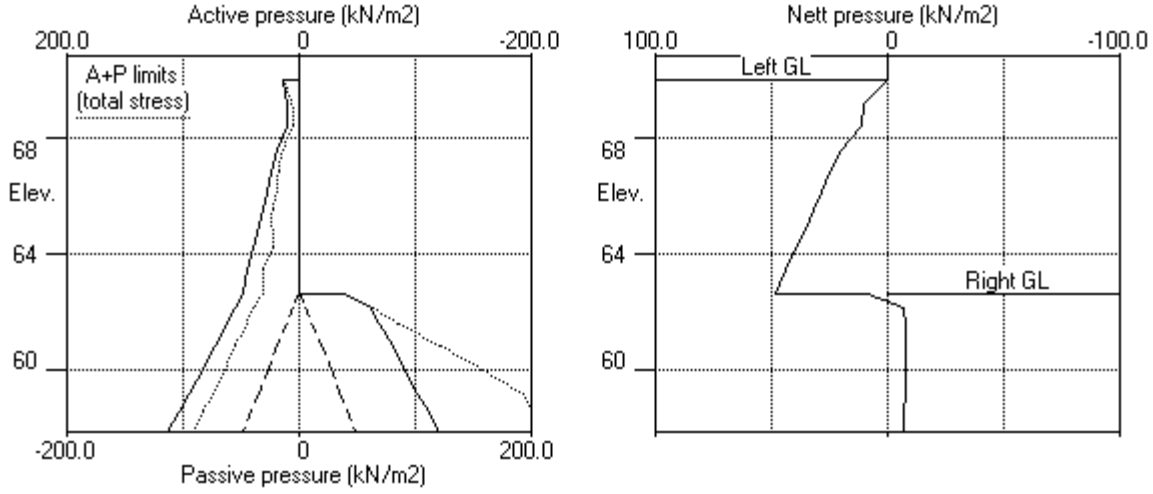
Note: 12.34a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.11 Change EI of wall to 382596kN.m2/m run



Stage No.11 Change EI of wall to 382596kN.m2/m run



Units: kN,m

Stage No. 17 Change EI of wall to 273283 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

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

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = 57.85 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
17	70.00	62.65		More than one prop.		No FoS calc.		

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

*** Wall displacements reset to zero at stage 5

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	70.85	0.00	0.003	-6.06E-04	-1.3	0.0	-1.3	273283
2	70.43	0.00	0.003	-6.05E-04	-1.3	-0.4		273283
3	70.00	0.00	0.003	-6.04E-04	-1.3	-0.8		273283
		13.30	0.003	-6.04E-04	-1.3	-0.8		
4	69.20	7.93	0.004	-6.05E-04	7.2	1.4		273283
5	68.40	7.16	0.004	-6.23E-04	13.3	9.7		273283
6	67.62	17.88	0.005	-6.73E-04	23.0	22.6		273283
7	66.84	24.31	0.005	-7.76E-04	39.5	46.1	-122.7	273283
		24.31	0.005	-7.76E-04	-83.2	46.1		
8	66.17	27.88	0.006	-8.33E-04	-65.7	-5.7		273283
9	65.50	31.23	0.006	-7.83E-04	-45.9	-44.9		273283
10	65.00	34.03	0.007	-6.94E-04	-29.6	-64.4		273283
11	64.22	38.87	0.007	-5.15E-04	-1.3	-76.0		273283
12	63.45	44.33	0.007	-3.36E-04	30.9	-65.6	-46.5	273283
		44.33	0.007	-3.36E-04	-15.6	-65.6		
13	62.65	48.47	0.008	-1.71E-04	21.6	-61.9		273283
		8.74	0.008	-1.71E-04	21.6	-61.9		
14	62.13	-5.96	0.008	-7.74E-05	22.3	-48.8		273283
15	61.60	-6.15	0.008	-5.21E-06	19.1	-36.9		273283
16	60.80	-5.98	0.008	6.94E-05	14.3	-22.1		273283
17	60.00	-5.46	0.008	1.10E-04	9.7	-11.3		273283
18	59.20	-4.77	0.008	1.29E-04	5.6	-4.3		273283
19	58.53	-4.14	0.007	1.34E-04	2.6	-1.0		273283
20	57.85	-3.49	0.007	1.35E-04	0.0	0.0		---
At elev. 70.85			Prop force =		1.3 kN/m run			
At elev. 66.84			Prop force =		122.7 kN/m run			
At elev. 63.45			Prop force =		46.5 kN/m run			

(continued)

Stage No.17 Change EI of wall to 273283 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

LEFT side

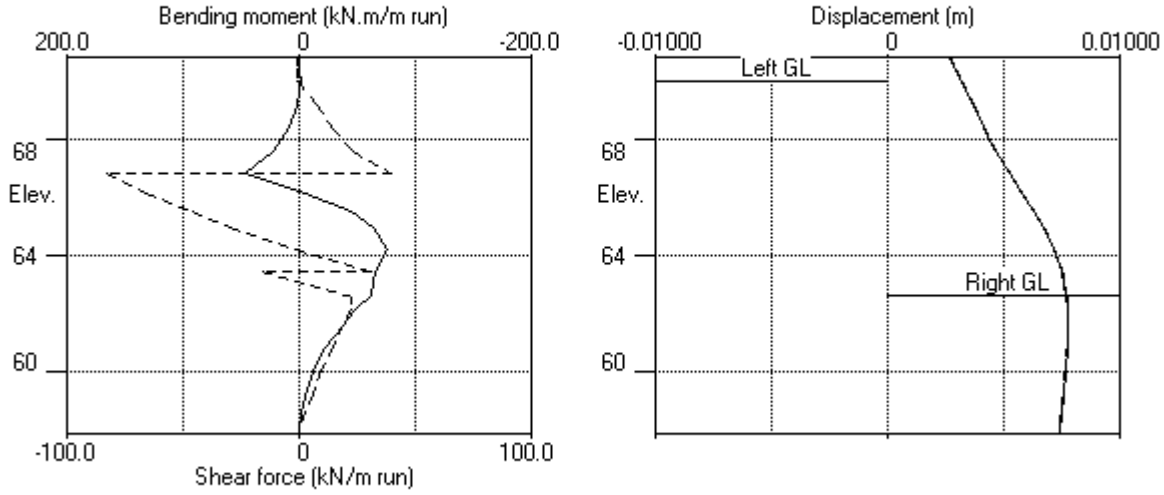
Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	77.00	13.29	370.01	13.30	13.30	5708
4	69.20	0.00	58.08	7.90	288.87	7.93	7.93	5708
5	68.40	0.00	52.56	6.32	265.22	7.16	7.16	5708
6	67.62	0.00	79.78	14.09	381.93	17.88	17.88	5708
7	66.84	0.00	93.17	17.91	439.36	24.31	24.31	5708
8	66.17	0.00	100.76	20.07	471.88	27.88	27.88	5607
9	65.50	0.00	108.73	22.34	506.05	31.23	31.23	5607
10	65.00	0.00	115.21	24.19	533.84	34.03	34.03	5607
11	64.22	0.00	110.07	22.73	511.81	38.87	38.87	5607
12	63.45	0.00	137.60	30.58	629.84	44.33	44.33	5607
13	62.65	0.00	139.27	31.06	637.03	48.47	48.47	5174
14	62.13	5.25	153.22	35.03	696.84	50.14	55.39	5174
15	61.60	10.50	150.36	34.22	684.56	51.97	62.47	5174
16	60.80	18.50	161.68	37.44	733.08	55.02	73.52	5174
17	60.00	26.50	162.50	37.68	736.59	58.35	84.85	5174
18	59.20	34.50	172.70	40.59	780.35	61.79	96.29	5174
19	58.53	41.25	176.21	41.59	795.42	64.74	105.99	5174
20	57.85	48.00	181.65	43.14	818.74	67.71	115.71	5174

RIGHT side

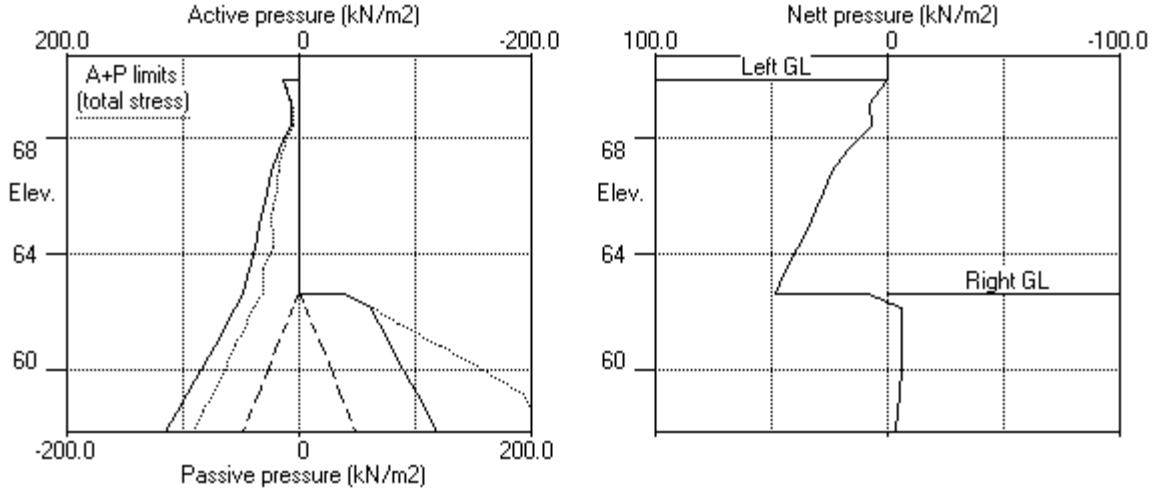
Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.43	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.22	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	63.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.73	39.73	5174
14	62.13	5.25	4.20	0.00	57.87	56.09	61.34	5174
15	61.60	10.50	8.41	0.00	75.91	58.12	68.62	5174
16	60.80	18.50	14.84	0.00	103.51	61.00	79.50	5174
17	60.00	26.50	21.33	0.00	131.31	63.81	90.31	5174
18	59.20	34.50	27.88	0.00	159.39	66.56	101.06	5174
19	58.53	41.25	33.47	0.88	183.36	68.88	110.13	5174
20	57.85	48.00	39.13	2.49	207.62	71.20	119.20	5174

Units: kN,m

Stage No.17 Change EI of wall to 273283kN.m2/m run



Stage No.17 Change EI of wall to 273283kN.m2/m run



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 Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = 57.85 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
1	70.00	70.00	Cant.	Conditions not suitable for FoS calc.				
2	70.00	70.00		No analysis at this stage				
3	70.00	70.00		No analysis at this stage				
4	70.00	70.00		No analysis at this stage				
5	70.00	70.00	Cant.	Conditions not suitable for FoS calc.				
6	70.00	70.00		No analysis at this stage				
7	70.00	65.00	70.00	2.525	n/a	62.73	2.27	L to R
8	70.00	65.00		No analysis at this stage				

All remaining stages have more than one prop - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	70.85	0.003	0.000	0.0	-0.0	0.0	-1.3
2	70.43	0.003	0.000	0.0	-0.4	0.0	-1.3
3	70.00	0.003	0.000	0.0	-0.8	0.0	-63.3
4	69.20	0.004	0.000	2.8	-46.6	8.5	-54.0
5	68.40	0.004	0.000	11.6	-86.4	14.5	-45.9
6	67.62	0.005	0.000	25.0	-118.1	24.2	-34.6
7	66.84	0.005	0.000	48.9	-138.7	40.6	-91.2
8	66.17	0.006	0.000	4.5	-144.9	32.6	-73.7
9	65.50	0.006	0.000	5.0	-138.5	53.0	-84.8
10	65.00	0.007	0.000	5.3	-124.3	37.0	-68.0
11	64.22	0.007	0.000	5.5	-97.4	33.4	-39.1
12	63.45	0.007	0.000	5.4	-111.0	43.3	-15.6
13	62.65	0.008	0.000	4.9	-98.8	34.2	-0.8
14	62.13	0.008	0.000	4.4	-80.1	34.9	-1.0
15	61.60	0.008	0.000	3.8	-62.5	31.6	-1.2
16	60.80	0.008	0.000	2.8	-39.4	25.8	-1.3
17	60.00	0.008	0.000	1.7	-21.3	19.4	-1.2
18	59.20	0.008	0.000	0.8	-8.5	12.4	-1.0
19	58.53	0.008	0.000	0.2	-2.2	6.3	-0.6
20	57.85	0.008	0.000	0.0	-0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum	Bending moment elev.	Bending moment minimum	Bending moment elev.	Shear force maximum	Shear force elev.	Shear force minimum	Shear force elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	0.0	62.13	-0.0	62.65	0.0	69.20	0.0	70.85
2	No calculation at this stage							
3	No calculation at this stage							
4	No calculation at this stage							
5	5.5	64.22	-0.0	70.00	3.2	69.20	-1.3	60.80
6	No calculation at this stage							
7	0.0	57.85	-144.9	66.17	37.0	65.00	-63.3	70.00
8	No calculation at this stage							
9	No calculation at this stage							
10	0.0	57.85	-111.0	63.45	47.5	65.50	-81.9	65.50
11	0.0	57.85	-96.7	63.45	53.0	65.50	-84.8	65.50
12	No calculation at this stage							
13	No calculation at this stage							
14	0.0	57.85	-97.4	64.22	43.3	63.45	-70.2	66.84
15	48.9	66.84	-89.4	64.22	40.6	66.84	-91.2	66.84
16	No calculation at this stage							
17	46.1	66.84	-76.0	64.22	39.5	66.84	-83.2	66.84

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum (m)	elev.	minimum (m)	elev.	Stage description
1	0.000	57.85	-0.000	61.60	Change EI of wall to 1.0000E-04kN.m2/m run
2	No calculation at this stage				Apply surcharge no.1 at elev. 70.00
3	No calculation at this stage				Apply surcharge no.2 at elev. 68.40
4	No calculation at this stage				Apply surcharge no.3 at elev. 68.40
5	0.002	70.85	0.000	70.85	Change EI of wall to 546566kN.m2/m run
6	No calculation at this stage				Install prop no.2 at elev. 70.00
7	0.006	63.45	0.000	70.85	Excav. to elev. 65.00 on RIGHT side
8	No calculation at this stage				Install prop no.5 at elev. 65.50
9	No calculation at this stage				Apply water pressure profile no.1
10	0.008	60.00	0.000	70.85	Excav. to elev. 62.65 on RIGHT side
11	0.008	60.80	0.000	70.85	Change EI of wall to 382596kN.m2/m run
12	No calculation at this stage				Install prop no.4 at elev. 63.45
13	No calculation at this stage				Install prop no.1 at elev. 66.84
14	0.008	61.60	0.000	70.85	Remove prop no.5 at elev. 65.50
15	0.008	60.80	0.000	70.85	Remove prop no.2 at elev. 70.00
16	No calculation at this stage				Install prop no.3 at elev. 70.85
17	0.008	61.60	0.000	70.85	Change EI of wall to 273283kN.m2/m run

Summary of results (continued)

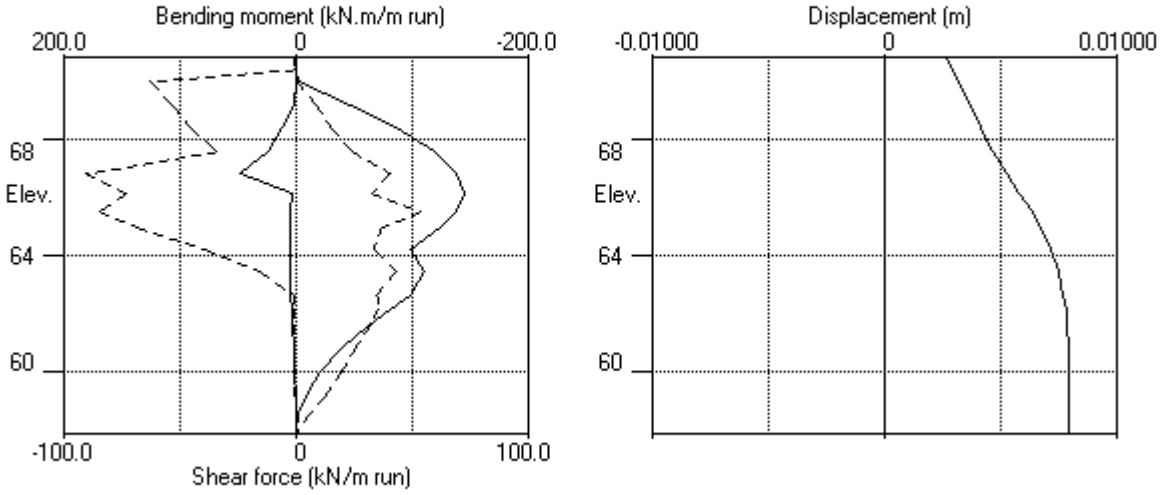
Prop forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 66.84		Strut no. 2 at elev. 70.00		Strut no. 3 at elev. 70.85	
	kN/m run	kN/prop	kN/m run	kN/prop	kN/m run	kN/prop
7	---	---	63.34	63.34	---	---
10	---	---	38.86	38.86	---	---
11	---	---	33.32	33.32	---	---
14	94.49	94.49	23.47	23.47	---	---
15	131.73	131.73	---	---	---	---
17	122.66	122.66	---	---	1.25	1.25

Stage no.	Strut no. 4 at elev. 63.45		Strut no. 5 at elev. 65.50	
	kN/m run	kN/prop	kN/m run	kN/prop
10	---	---	129.39	129.39
11	---	---	137.81	137.81
14	55.40	55.40	---	---
15	33.41	33.41	---	---
17	46.47	46.47	---	---

Units: kN,m

Bending moment, shear force, displacement envelopes



Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	70.80	2 WWGS	2 WWGS
2	61.20	3 Transitional WG	3 Transitional WG
3	54.80	4 Waitemata Group Rock	4 Waitemata Group Rock

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Fill	18.00	9000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	5.000d
2	WWGS	18.00	24000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	7.000d
3	Transition-al WG	19.00	45000	0.470	OC (0.200)	0.262 (1.182)	4.845 (6.154)	12.00d
4	Waitemata Group Rock	19.00	150000	0.412	OC (0.200)	0.219 (1.075)	6.289 (7.279)	30.00d

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Fill	30.00	0.631	0.00	30.00	0.464	0.00
2	WWGS	30.00	0.631	0.00	30.00	0.464	0.00
3	Transitional WG	32.00	0.625	0.00	32.00	0.459	0.00
4	Waitemata Group Rock	36.00	0.613	0.00	36.00	0.447	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	64.00	64.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	62.65	62.65	0.0	1	62.65	62.65	0.0

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.75 m
Soldier Pile spacing = 1.50 m
Passive mobilisation factor = 3.00 m
Elevation of toe of wall = 56.40
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 3.1685E+07 kN/m2
Moment of inertia of wall I = 0.010350 m4/m run
E.I = 327940 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	66.84	1.00	0.150000	3.169E+07	0.10	0.00	0	Yes

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	70.80	0.00(A)	50.00	50.00	12.00	=	N/A	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Change EI of wall to 1.0000E-04 kN.m2/m run Yield moment not defined No adjustments to wall displacements
2	Apply surcharge no.1 at elevation 70.80 No analysis at this stage
3	Change EI of wall to 327940 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
4	Apply water pressure profile no.1 No analysis at this stage
5	Excavate to elevation 66.04 on PASSIVE side Toe of berm at elevation 62.65 Width of top of berm = 4.00 Width of toe of berm = 7.40
6	Change EI of wall to 229558 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value
7	Install strut or anchor no.1 at elevation 66.84
8	Excavate to elevation 62.65 on PASSIVE side
9	Change EI of wall to 163970 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Change EI of wall to 1.0000E-04kN.m2/m	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 70.80	No	No	No
3	Change EI of wall to 327940kN.m2/m run	No	No	No
4	Apply water pressure profile no.1	No	No	No
5	Excav. to elev. 66.04 on PASSIVE side	No	No	No
6	Change EI of wall to 229558kN.m2/m run	Yes	Yes	Yes
7	Install strut no.1 at elev. 66.84	Yes	Yes	Yes
8	Excav. to elev. 62.65 on PASSIVE side	Yes	Yes	Yes
9	Change EI of wall to 163970kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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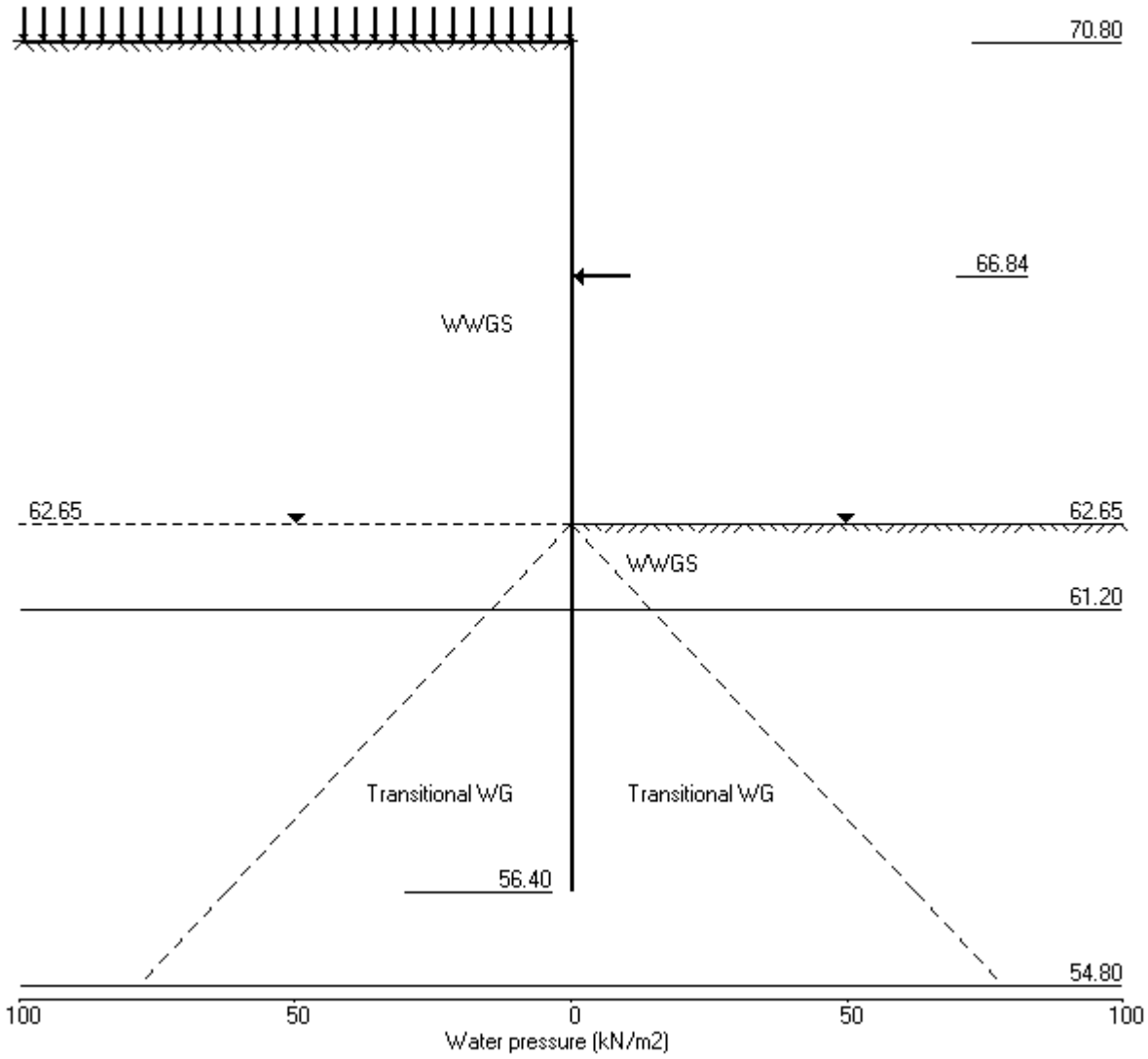
Units: kN,m

Stage No.9 Change EI of wall to 163970kN.m2/m run



Units: kN,m

Stage No. 1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.40 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
1	70.80	70.80	Cant.	Conditions not suitable for FoS calc.			

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall
Analysis options
Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	70.80	-0.00	0.000	-1.61E-21	0.0	0.0		0
2	70.20	0.00	-0.000	3.221E-21	-0.0	-0.0		0
3	69.60	0.00	0.000	-1.12E-20	-0.0	0.0		0
4	69.00	0.00	-0.000	4.18E-20	-0.0	-0.0		0
5	68.40	0.00	0.000	-1.56E-19	-0.0	0.0		0
6	67.62	0.00	-0.000	6.64E-19	-0.0	-0.0		0
7	66.84	0.00	0.000	-2.50E-18	-0.0	0.0		0
8	66.04	0.00	-0.000	9.44E-18	-0.0	-0.0		0
9	65.42	0.00	0.000	-3.16E-17	-0.0	0.0		0
10	64.80	0.00	-0.000	1.16E-16	-0.0	-0.0		0
11	64.00	0.00	0.000	-2.01E-15	-0.0	0.0		0
12	63.33	0.00	0.000	-1.81E-17	-0.0	-0.0		0
13	62.65	0.00	0.000	1.98E-15	-0.0	0.0		0
14	61.93	0.00	-0.000	-6.01E-17	-0.0	-0.0		0
15	61.20	0.00	0.000	1.58E-17	-0.0	0.0		0
16	60.60	0.00	0.000	-8.26E-18	-0.0	0.0		0
17	60.00	0.00	-0.000	1.71E-17	-0.0	-0.0		0
18	59.20	0.00	0.000	-6.92E-17	-0.0	0.0		0
19	58.40	0.00	-0.000	2.59E-16	-0.0	-0.0		0
20	57.60	0.00	0.000	-2.49E-15	-0.0	0.0		0
21	57.00	0.00	0.000	-2.43E-15	-0.0	-0.0		0
22	56.40	-0.00	0.000	3.08E-17	-0.0	0.0		---

(continued)

Stage No.1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

Node no.	Y coord	ACTIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.80	0.00	0.00	0.00	39.86	0.00	0.00a	133915
2	70.20	0.00	10.80	0.00	86.17	5.40	5.40	24289
3	69.60	0.00	21.60	0.00	132.48	10.80	10.80	25490
4	69.00	0.00	32.40	0.57	178.78	16.20	16.20	23626
5	68.40	0.00	43.20	3.65	225.09	21.60	21.60	25936
6	67.62	0.00	57.24	7.66	285.29	28.62	28.62	20445
7	66.84	0.00	71.28	11.66	345.49	35.64	35.64	22166
8	66.04	0.00	85.68	15.77	407.23	42.84	42.84	19918
9	65.42	0.00	96.84	18.95	455.08	48.42	48.42	25329
10	64.80	0.00	108.00	22.14	502.93	54.00	54.00	29406
11	64.00	0.00	122.40	26.24	564.67	61.20	61.20	10979
12	63.33	6.75	127.80	27.78	587.83	63.90	70.65	10979
13	62.65	13.50	133.20	29.32	610.98	66.60	80.10	10979
14	61.93	20.75	139.00	30.98	635.85	69.50	90.25	22827
15	61.20	28.00	144.80	32.63	660.72	72.40	100.40	23812
		28.00	144.80	23.69	775.42	68.06	96.06	44647
16	60.60	34.00	150.20	25.10	801.58	70.59	104.59	44647
17	60.00	40.00	155.60	26.51	827.75	73.13	113.13	38636
18	59.20	48.00	162.80	28.39	862.63	76.52	124.52	41367
19	58.40	56.00	170.00	30.28	897.52	79.90	135.90	43380
20	57.60	64.00	177.20	32.16	932.40	83.28	147.28	20459
21	57.00	70.00	182.60	33.57	958.57	85.82	155.82	20459
22	56.40	76.00	188.00	34.98	984.73	88.36	164.36	20459

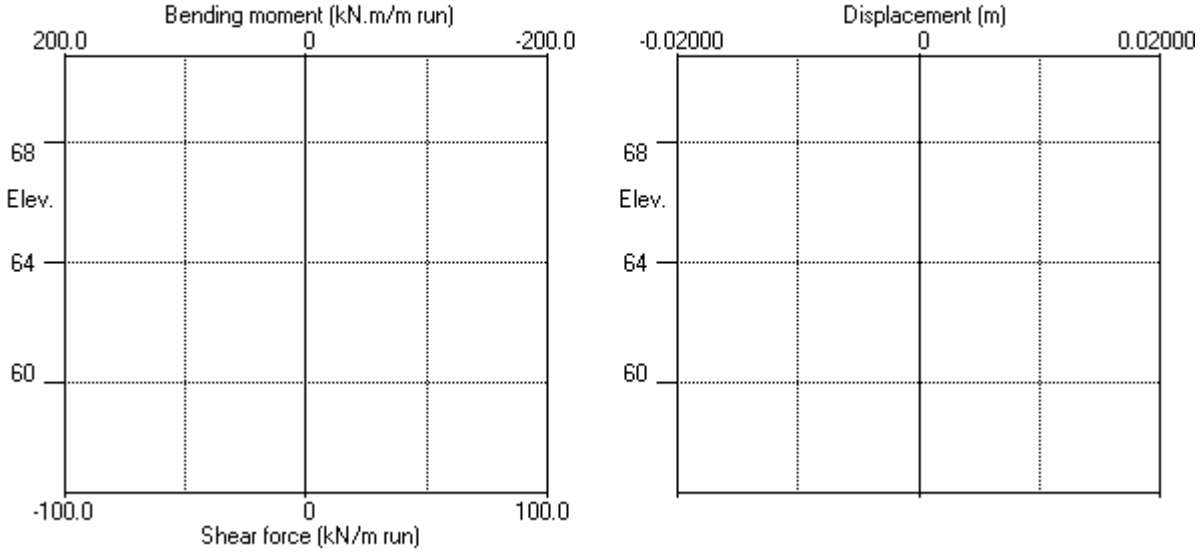
Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.80	0.00	0.00	0.00	39.86	0.00	0.00a	133915
2	70.20	0.00	10.80	0.00	86.17	5.40	5.40	24289
3	69.60	0.00	21.60	0.00	132.48	10.80	10.80	25490
4	69.00	0.00	32.40	0.57	178.78	16.20	16.20	23626
5	68.40	0.00	43.20	3.65	225.09	21.60	21.60	25936
6	67.62	0.00	57.24	7.66	285.29	28.62	28.62	20445
7	66.84	0.00	71.28	11.66	345.49	35.64	35.64	22166
8	66.04	0.00	85.68	15.77	407.23	42.84	42.84	19918
9	65.42	0.00	96.84	18.95	455.08	48.42	48.42	25329
10	64.80	0.00	108.00	22.14	502.93	54.00	54.00	29406
11	64.00	0.00	122.40	26.24	564.67	61.20	61.20	10979
12	63.33	6.75	127.80	27.78	587.83	63.90	70.65	10979
13	62.65	13.50	133.20	29.32	610.98	66.60	80.10	10979
14	61.93	20.75	139.00	30.98	635.85	69.50	90.25	22827
15	61.20	28.00	144.80	32.63	660.72	72.40	100.40	23812
		28.00	144.80	23.69	775.42	68.06	96.06	44647
16	60.60	34.00	150.20	25.10	801.58	70.59	104.59	44647
17	60.00	40.00	155.60	26.51	827.75	73.13	113.13	38636
18	59.20	48.00	162.80	28.39	862.63	76.52	124.52	41367
19	58.40	56.00	170.00	30.28	897.52	79.90	135.90	43380
20	57.60	64.00	177.20	32.16	932.40	83.28	147.28	20459
21	57.00	70.00	182.60	33.57	958.57	85.82	155.82	20459
22	56.40	76.00	188.00	34.98	984.73	88.36	164.36	20459

(continued)

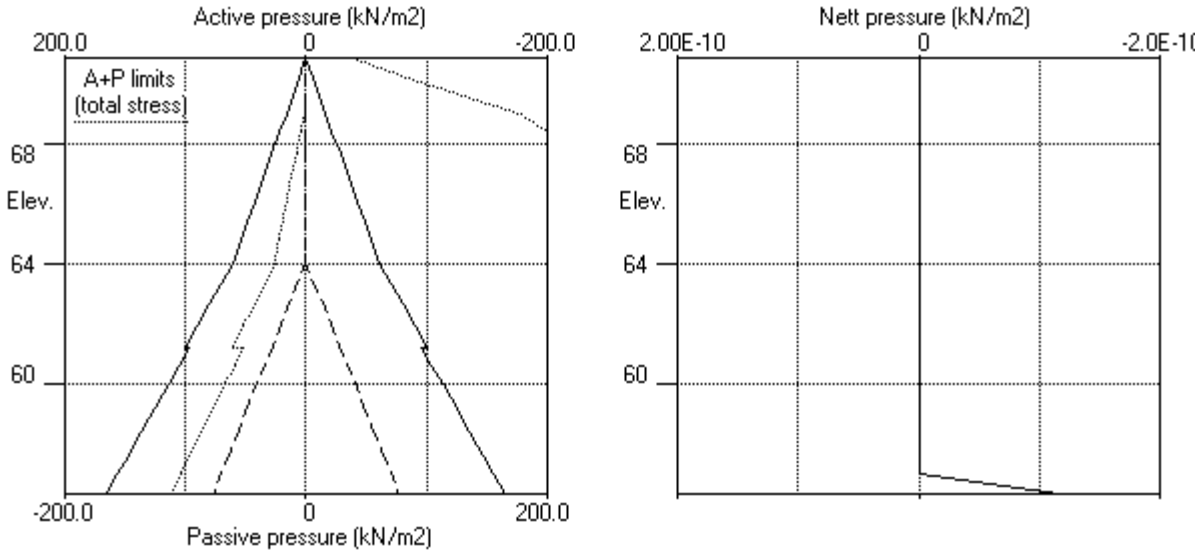
Stage No.1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 66.04 on PASSIVE side
Toe of berm at elevation 62.65
Width of top of berm = 4.00
Width of toe of berm = 7.40

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.40: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500: Toe elev.	Wall Penetr -ation
5	70.80	66.04	Cant.	1.533	57.01	56.88	9.16

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall
Analysis options
Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	70.80	0.00	0.015	1.69E-03	0.0	-0.0		327940
2	70.20	0.00	0.014	1.69E-03	0.0	0.0		327940
3	69.60	0.92	0.013	1.69E-03	0.3	0.1		327940
4	69.00	4.00	0.012	1.68E-03	1.7	0.6		327940
5	68.40	7.08	0.011	1.68E-03	5.1	2.5		327940
6	67.62	11.08	0.010	1.67E-03	12.2	9.0		327940
7	66.84	15.08	0.008	1.63E-03	22.4	22.3		327940
8	66.04	20.11	0.007	1.54E-03	36.4	48.3		327940
		-19.75	0.007	1.54E-03	36.4	48.3		
9	65.42	-27.61	0.006	1.43E-03	21.7	68.2		327940
10	64.80	-20.55	0.005	1.30E-03	6.8	76.4		327940
		-7.47	0.005	1.30E-03	6.8	76.4		
11	64.00	-12.54	0.004	1.11E-03	-1.2	80.8		327940
12	63.33	-6.79	0.004	9.48E-04	-7.7	77.2		327940
13	62.65	-1.94	0.003	7.96E-04	-10.7	70.4		327940
14	61.93	2.36	0.003	6.50E-04	-10.5	62.2		327940
15	61.20	5.82	0.002	5.20E-04	-7.5	55.2		327940
		-10.29	0.002	5.20E-04	-7.5	55.2		
16	60.60	-5.94	0.002	4.25E-04	-12.4	48.8		327940
17	60.00	-2.43	0.002	3.43E-04	-14.9	40.3		327940
18	59.20	1.19	0.001	2.61E-04	-15.4	27.5		327940
19	58.40	3.96	0.001	2.08E-04	-13.4	15.6		327940
20	57.60	6.22	0.001	1.82E-04	-9.3	6.1		327940
21	57.00	7.75	0.001	1.74E-04	-5.1	1.7		327940
22	56.40	9.24	0.001	1.73E-04	0.0	0.0		---

(continued)

Stage No.5 Excavate to elevation 66.04 on PASSIVE side
Toe of berm at elevation 62.65
Width of top of berm = 4.00
Width of toe of berm = 7.40

Node no.	Y coord	ACTIVE side						
			Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	70.80	0.00	12.00	0.00	91.31	0.00	0.00a	3576
2	70.20	0.00	22.80	0.00	137.62	0.00	0.00a	3576
3	69.60	0.00	33.60	0.92	183.92	0.92	0.92a	3576
4	69.00	0.00	44.40	4.00	230.23	4.00	4.00a	3576
5	68.40	0.00	55.20	7.08	276.52	7.08	7.08a	3576
6	67.62	0.00	69.23	11.08	336.69	11.08	11.08a	3576
7	66.84	0.00	83.26	15.08	396.85	15.08	15.08a	3576
8	66.04	0.00	97.64	19.18	458.53	20.11	20.11	3576
9	65.42	0.00	108.79	22.36	506.31	29.01	29.01	3576
10	64.80	0.00	119.93	25.54	554.08	37.62	37.62	3576
11	64.00	0.00	134.30	29.64	615.70	48.27	48.27	3576
12	63.33	0.00	146.42	33.09	667.66	55.14	55.14	3576
13	62.65	0.00	158.53	36.55	719.60	61.62	61.62	3576
14	61.93	7.25	164.29	38.19	744.28	66.38	73.63	3576
15	61.20	14.50	170.04	39.83	768.93	70.78	85.28	3576
		14.50	170.04	30.29	897.70	59.50	74.00	6706
16	60.60	20.50	175.39	31.69	923.64	63.92	84.42	6706
17	60.00	26.50	180.74	33.09	949.56	67.99	94.49	6706
18	59.20	34.50	187.87	34.95	984.09	72.96	107.46	6706
19	58.40	42.50	194.99	36.81	1018.59	77.58	120.08	6706
20	57.60	50.50	202.10	38.67	1053.05	81.98	132.48	6706
21	57.00	56.50	207.43	40.07	1078.88	85.21	141.71	6706
22	56.40	62.50	212.76	41.46	1104.69	88.43	150.93	6706

Node no.	Y coord	PASSIVE side						
			Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	70.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	69.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	4728
9	65.42	0.00	11.16	0.00	87.72	56.62	56.62	4728
		0.00	11.16	0.00	71.86b	56.62	56.62	4728
10	64.80	0.00	22.33	0.00	111.09b	58.17	58.17	4728
		0.00	22.33	0.00	45.09b	45.09	45.09p	4728
11	64.00	0.00	36.76	1.82	65.67b	60.81	60.81	4728
		0.00	36.76	1.82	63.99b	60.81	60.81	4728
12	63.33	0.00	48.96	5.30	80.94b	61.93	61.93	4728
		0.00	48.96	5.30	84.64b	61.93	61.93	4728
13	62.65	0.00	61.19	8.79	102.41b	63.56	63.56	4728
		0.00	61.19	8.79	92.67b	63.56	63.56	4728
14	61.93	7.25	67.12	10.48	100.47b	64.02	71.27	4728
		7.25	67.12	10.48	117.50b	64.02	71.27	4728
15	61.20	14.50	73.10	12.18	126.70b	64.96	79.46	4728
		14.50	73.10	4.94	286.23b	69.79	84.29	8865

(continued)

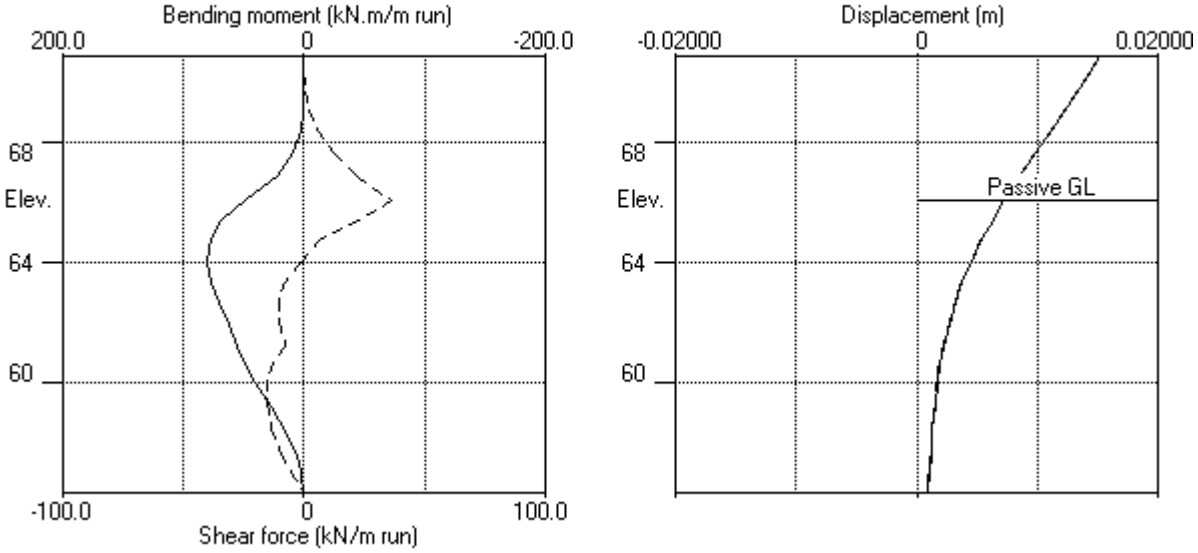
Stage No.5 Excavate to elevation 66.04 on PASSIVE side
Toe of berm at elevation 62.65
Width of top of berm = 4.00
Width of toe of berm = 7.40

Node no.	Y coord	PASSIVE side						
			Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
16	60.60	20.50	78.69	6.40	304.35b	69.86	90.36	8865
		20.50	78.69	6.40	217.98b	69.86	90.36	8865
17	60.00	26.50	84.32	7.87	231.05b	70.42	96.92	8865
		26.50	84.32	7.87	247.10b	70.42	96.92	8865
18	59.20	34.50	91.89	9.85	265.89b	71.77	106.27	8865
		34.50	91.89	9.85	283.25b	71.77	106.27	8865
19	58.40	42.50	99.54	11.85	303.47b	73.62	116.12	8865
		42.50	99.54	11.85	319.84b	73.62	116.12	8865
20	57.60	50.50	107.26	13.87	341.36b	75.76	126.26	8865
		50.50	107.26	13.87	354.99b	75.76	126.26	8865
21	57.00	56.50	113.10	15.40	371.92b	77.46	133.96	8865
		56.50	113.10	15.40	383.07b	77.46	133.96	8865
22	56.40	62.50	118.98	16.93	400.63b	79.19	141.69	8865

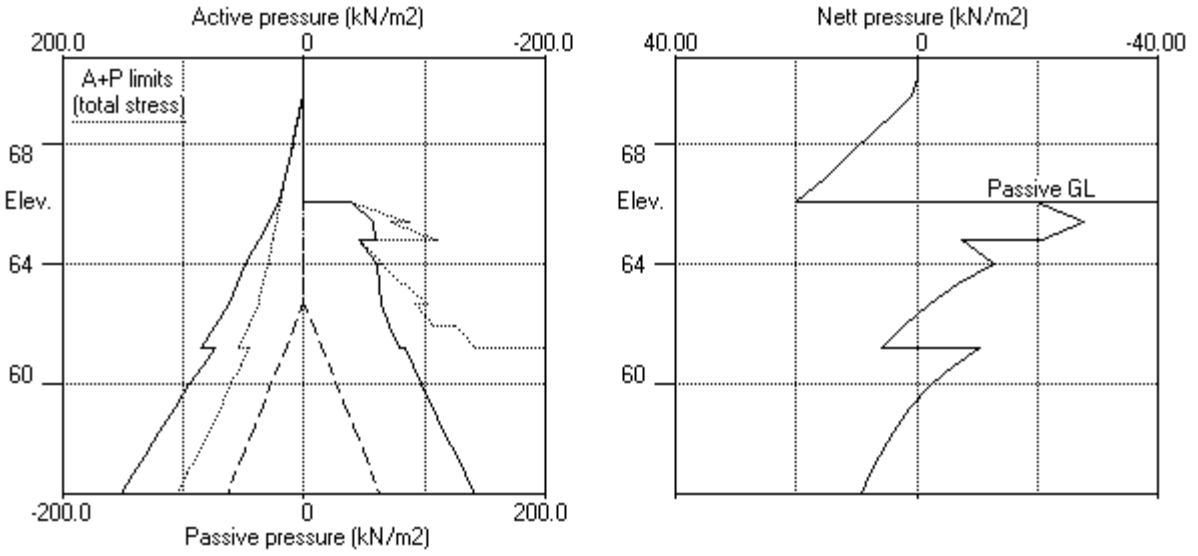
Note: 15.08a Soil pressure at active limit
45.09p Soil pressure at passive limit
400.63b Passive limit reduced because of berm

Units: kN,m

Stage No.5 Excav. to elev. 66.04 on PASSIVE side



Stage No.5 Excav. to elev. 66.04 on PASSIVE side



Units: kN,m

Stage No. 6 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 56.40 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
6	70.80	66.04	Cant.	1.533	57.01	56.88	9.16

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall
Analysis options
Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	70.80	0.00	0.017	2.04E-03	0.0	-0.0		229558
2	70.20	0.00	0.016	2.04E-03	0.0	0.0		229558
3	69.60	0.92	0.015	2.04E-03	0.3	0.1		229558
4	69.00	4.00	0.013	2.04E-03	1.7	0.6		229558
5	68.40	7.08	0.012	2.03E-03	5.1	2.5		229558
6	67.62	11.08	0.011	2.02E-03	12.2	9.0		229558
7	66.84	15.08	0.009	1.96E-03	22.4	22.3		229558
8	66.04	19.18	0.008	1.84E-03	36.1	48.2		229558
		-20.68	0.008	1.84E-03	36.1	48.2		
9	65.42	-31.24	0.006	1.68E-03	20.0	67.9		229558
10	64.80	-21.77	0.005	1.49E-03	3.5	74.7		229558
		-7.80	0.005	1.49E-03	3.5	74.7		
11	64.00	-12.11	0.004	1.23E-03	-4.4	77.0		229558
12	63.33	-5.87	0.004	1.01E-03	-10.5	71.7		229558
13	62.65	-0.77	0.003	8.26E-04	-12.8	63.7		229558
14	61.93	3.60	0.002	6.46E-04	-11.7	54.5		229558
15	61.20	6.97	0.002	4.93E-04	-7.9	47.1		229558
		-8.13	0.002	4.93E-04	-7.9	47.1		
16	60.60	-4.07	0.002	3.85E-04	-11.5	40.8		229558
17	60.00	-0.94	0.002	2.94E-04	-13.1	33.0		229558
18	59.20	2.09	0.001	2.06E-04	-12.6	21.7		229558
19	58.40	4.22	0.001	1.52E-04	-10.1	11.7		229558
20	57.60	5.13	0.001	1.27E-04	-6.3	4.4		229558
21	57.00	5.28	0.001	1.21E-04	-3.2	1.1		229558
22	56.40	5.40	0.001	1.20E-04	0.0	0.0		---

(continued)

Stage No.6 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	ACTIVE side						
			Effective stresses			Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	70.80	0.00	12.00	0.00	91.31	0.00	0.00a	4768
2	70.20	0.00	22.80	0.00	137.62	0.00	0.00a	4768
3	69.60	0.00	33.60	0.92	183.92	0.92	0.92a	4768
4	69.00	0.00	44.40	4.00	230.23	4.00	4.00a	4768
5	68.40	0.00	55.20	7.08	276.52	7.08	7.08a	4768
6	67.62	0.00	69.23	11.08	336.69	11.08	11.08a	4768
7	66.84	0.00	83.26	15.08	396.85	15.08	15.08a	4768
8	66.04	0.00	97.64	19.18	458.53	19.18	19.18a	4768
9	65.42	0.00	108.79	22.36	506.31	28.02	28.02	4768
10	64.80	0.00	119.93	25.54	554.08	37.29	37.29	4768
11	64.00	0.00	134.30	29.64	615.70	48.49	48.49	3768
12	63.33	0.00	146.42	33.09	667.66	55.60	55.60	3768
13	62.65	0.00	158.53	36.55	719.60	62.20	62.20	3768
14	61.93	7.25	164.29	38.19	744.28	67.00	74.25	3768
15	61.20	14.50	170.04	39.83	768.93	71.36	85.86	3768
		14.50	170.04	30.29	897.70	60.58	75.08	7066
16	60.60	20.50	175.39	31.69	923.64	64.86	85.36	7066
17	60.00	26.50	180.74	33.09	949.56	68.73	95.23	7066
18	59.20	34.50	187.87	34.95	984.09	73.41	107.91	7066
19	58.40	42.50	194.99	36.81	1018.59	77.71	120.21	7066
20	57.60	50.50	202.10	38.67	1053.05	81.43	131.93	21346
21	57.00	56.50	207.43	40.07	1078.88	83.98	140.48	21346
22	56.40	62.50	212.76	41.46	1104.69	86.51	149.01	21346

Node no.	Y coord	PASSIVE side						
			Effective stresses			Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	70.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	69.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	12846
9	65.42	0.00	11.16	0.00	87.72	59.26	59.26	12846
		0.00	11.16	0.00	71.86b	59.26	59.26	12846
10	64.80	0.00	22.33	0.00	111.09b	59.07	59.07	12846
		0.00	22.33	0.00	45.09b	45.09	45.09p	12846
11	64.00	0.00	36.76	1.82	65.67b	60.60	60.60	3768
		0.00	36.76	1.82	63.99b	60.60	60.60	3768
12	63.33	0.00	48.96	5.30	80.94b	61.47	61.47	3768
		0.00	48.96	5.30	84.64b	61.47	61.47	3768
13	62.65	0.00	61.19	8.79	102.41b	62.97	62.97	3768
		0.00	61.19	8.79	92.67b	62.97	62.97	3768
14	61.93	7.25	67.12	10.48	100.47b	63.40	70.65	3768
		7.25	67.12	10.48	117.50b	63.40	70.65	3768
15	61.20	14.50	73.10	12.18	126.70b	64.38	78.88	3768
		14.50	73.10	4.94	286.23b	68.71	83.21	7066

(continued)

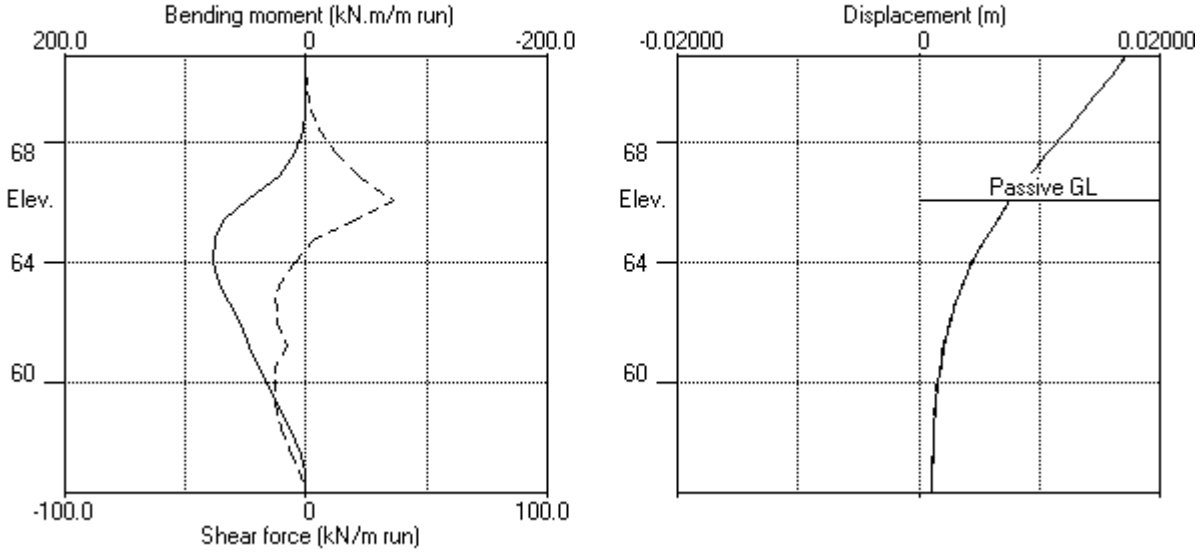
Stage No.6 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
16	60.60	20.50	78.69	6.40	304.35b	68.93	89.43	7066
		20.50	78.69	6.40	217.98b	68.93	89.43	7066
17	60.00	26.50	84.32	7.87	231.05b	69.68	96.18	7066
		26.50	84.32	7.87	247.10b	69.68	96.18	7066
18	59.20	34.50	91.89	9.85	265.89b	71.32	105.82	7066
		34.50	91.89	9.85	283.25b	71.32	105.82	7066
19	58.40	42.50	99.54	11.85	303.47b	73.49	115.99	7066
		42.50	99.54	11.85	319.84b	73.49	115.99	7066
20	57.60	50.50	107.26	13.87	341.36b	76.30	126.80	21346
		50.50	107.26	13.87	354.99b	76.30	126.80	21346
21	57.00	56.50	113.10	15.40	371.92b	78.70	135.20	21346
		56.50	113.10	15.40	383.07b	78.70	135.20	21346
22	56.40	62.50	118.98	16.93	400.63b	81.11	143.61	21346

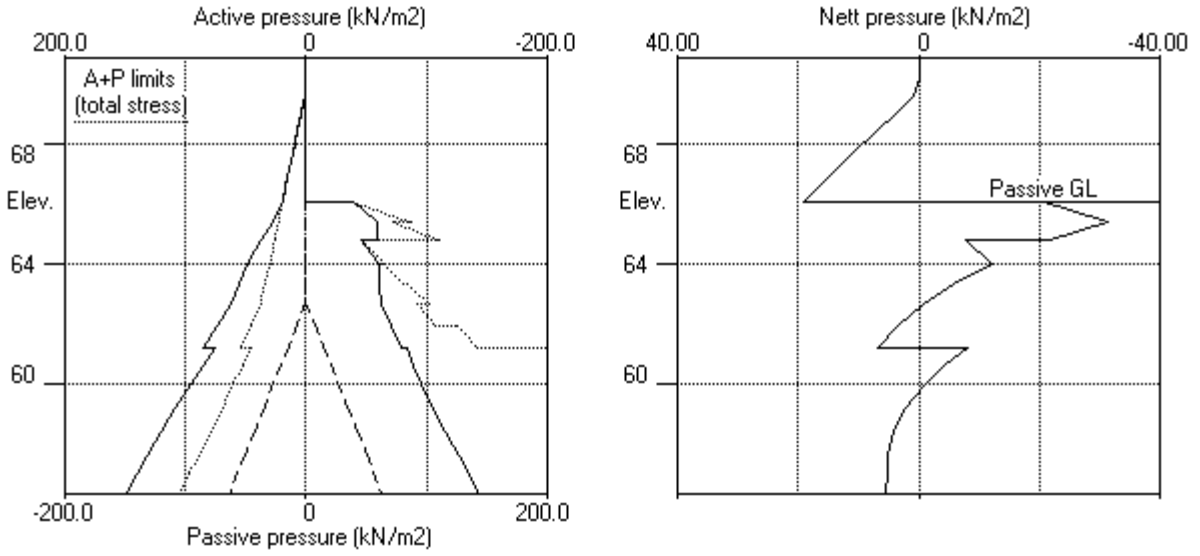
Note: 19.18a Soil pressure at active limit
45.09p Soil pressure at passive limit
400.63b Passive limit reduced because of berm

Units: kN,m

Stage No.6 Change EI of wall to 229558kN.m2/m run



Stage No.6 Change EI of wall to 229558kN.m2/m run



Units: kN,m

Stage No. 8 Excavate to elevation 62.65 on PASSIVE side

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.40 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
8	70.80	62.65	66.84	1.939	n/a	59.07	3.58

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	70.80	16.68	0.014	1.43E-03	0.0	-0.0		229558
2	70.20	14.67	0.013	1.42E-03	9.4	3.0		229558
3	69.60	13.56	0.012	1.40E-03	17.9	11.3		229558
4	69.00	14.50	0.012	1.36E-03	26.3	24.7		229558
5	68.40	15.23	0.011	1.27E-03	35.2	43.3		229558
6	67.62	15.63	0.010	1.07E-03	47.2	75.8		229558
7	66.84	15.08	0.009	7.41E-04	59.2	117.8	152.3	229558
		15.08	0.009	7.41E-04	-93.1	117.8		
8	66.04	19.18	0.009	4.47E-04	-79.4	51.3		229558
9	65.42	22.49	0.008	3.66E-04	-66.5	8.4		229558
10	64.80	29.58	0.008	3.94E-04	-50.3	-28.1		229558
11	64.00	38.69	0.008	5.42E-04	-23.0	-55.3		229558
12	63.33	44.83	0.007	7.17E-04	5.2	-61.4		229558
13	62.65	51.21	0.007	8.82E-04	37.6	-47.2		229558
		11.35	0.007	8.82E-04	37.6	-47.2		
14	61.93	-5.97	0.006	9.91E-04	39.6	-17.4		229558
15	61.20	-0.39	0.005	1.01E-03	37.2	9.9		229558
		-35.39	0.005	1.01E-03	37.2	9.9		
16	60.60	-27.04	0.005	9.70E-04	18.5	25.8		229558
17	60.00	-19.30	0.004	9.01E-04	4.6	31.8		229558
18	59.20	-10.07	0.004	8.02E-04	-7.1	28.9		229558
19	58.40	-1.94	0.003	7.23E-04	-11.9	19.4		229558
20	57.60	4.70	0.002	6.77E-04	-10.8	8.6		229558
21	57.00	9.04	0.002	6.63E-04	-6.7	2.6		229558
22	56.40	13.31	0.002	6.60E-04	0.0	0.0		---

At elev. 66.84 Strut force = 152.3 kN/strut = 152.3 kN/m run

(continued)

Stage No.8 Excavate to elevation 62.65 on PASSIVE side

Node no.	Y coord	ACTIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.80	0.00	12.00	0.00	91.31	16.68	16.68	5428
2	70.20	0.00	22.80	0.00	137.62	14.67	14.67	5428
3	69.60	0.00	33.60	0.92	183.92	13.56	13.56	5428
4	69.00	0.00	44.40	4.00	230.23	14.50	14.50	5428
5	68.40	0.00	55.20	7.08	276.52	15.23	15.23	5428
6	67.62	0.00	69.23	11.08	336.69	15.63	15.63	5428
7	66.84	0.00	83.26	15.08	396.85	15.08	15.08a	2876
8	66.04	0.00	97.64	19.18	458.53	19.18	19.18a	2876
9	65.42	0.00	108.79	22.36	506.31	22.49	22.49	2876
10	64.80	0.00	119.93	25.54	554.08	29.58	29.58	2876
11	64.00	0.00	134.30	29.64	615.70	38.69	38.69	2876
12	63.33	0.00	146.42	33.09	667.66	44.83	44.83	2876
13	62.65	0.00	158.53	36.55	719.60	51.21	51.21	2876
14	61.93	7.25	164.29	38.19	744.28	56.45	63.70	2876
15	61.20	14.50	170.04	39.83	768.93	61.73	76.23	2876
		14.50	170.04	30.29	897.70	42.52	57.02	5393
16	60.60	20.50	175.39	31.69	923.64	48.60	69.10	5393
17	60.00	26.50	180.74	33.09	949.56	54.42	80.92	5393
18	59.20	34.50	187.87	34.95	984.09	61.70	96.20	5393
19	58.40	42.50	194.99	36.81	1018.59	68.51	111.01	5393
20	57.60	50.50	202.10	38.67	1053.05	74.65	125.15	5393
21	57.00	56.50	207.43	40.07	1078.88	78.96	135.46	5393
22	56.40	62.50	212.76	41.46	1104.69	83.25	145.75	5393

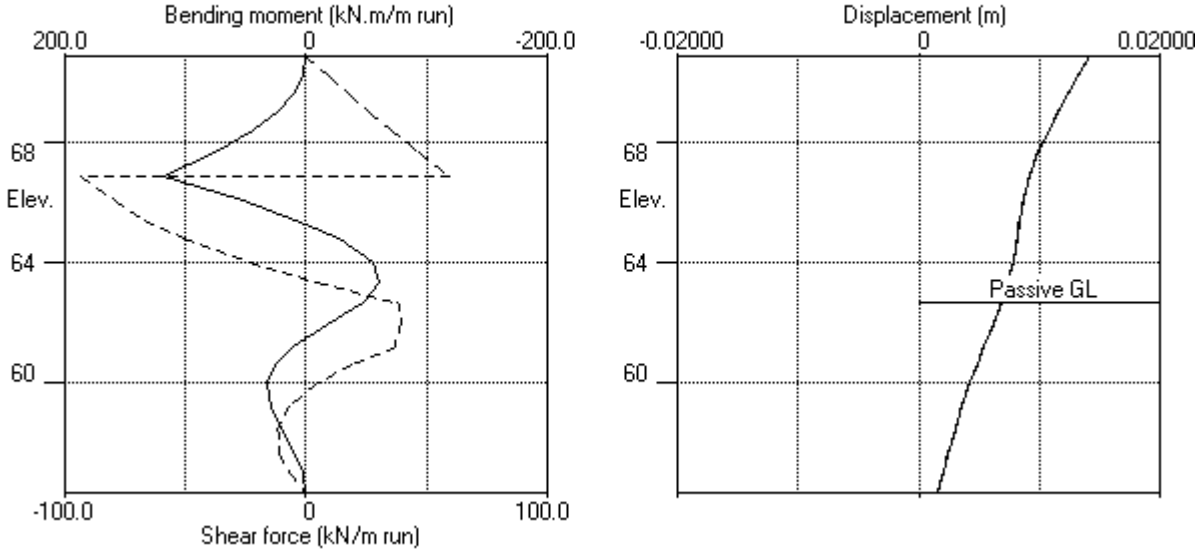
Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	70.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	69.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.42	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	64.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	63.33	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	3914
14	61.93	7.25	5.80	0.00	64.74	62.42	69.67	3914
15	61.20	14.50	11.62	0.00	89.70	62.12	76.62	3914
		14.50	11.62	0.00	130.16	77.91	92.41	7338
16	60.60	20.50	17.07	0.00	156.53	75.64	96.14	7338
17	60.00	26.50	22.54	0.00	183.06	73.71	100.21	7338
18	59.20	34.50	29.91	0.00	218.75	71.76	106.26	7338
19	58.40	42.50	37.37	0.00	254.89	70.45	112.95	7338
20	57.60	50.50	44.93	0.00	291.54	69.95	120.45	7338
21	57.00	56.50	50.68	0.00	319.39	69.92	126.42	7338
22	56.40	62.50	56.50	0.59	347.59	69.94	132.44	7338

(continued)

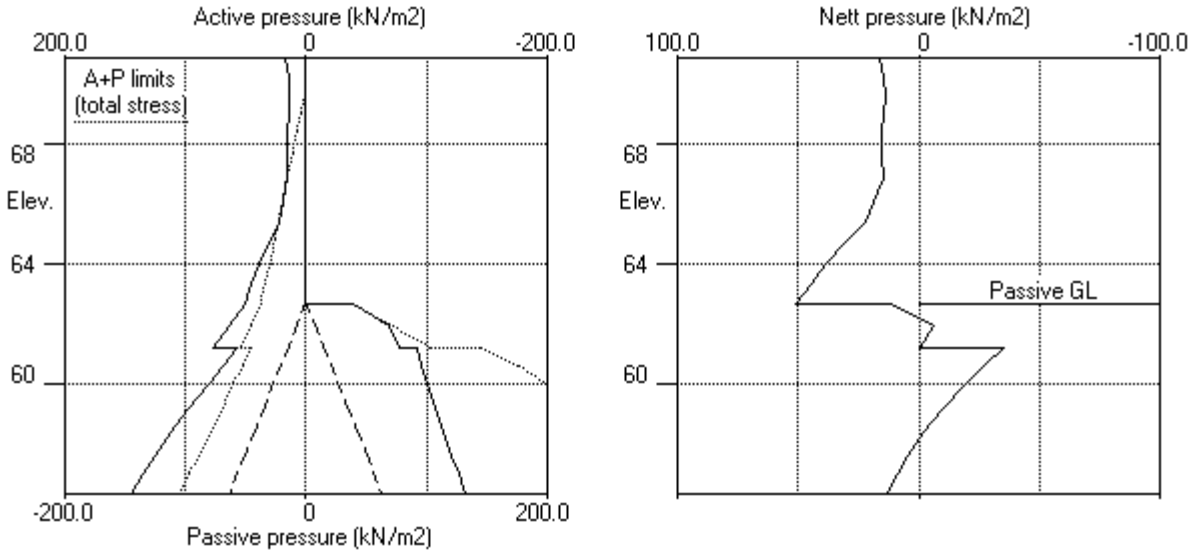
Stage No.8 Excavate to elevation 62.65 on PASSIVE side
Note: 19.18a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.8 Excav. to elev. 62.65 on PASSIVE side



Stage No.8 Excav. to elev. 62.65 on PASSIVE side



Units: kN,m

Stage No. 9 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.40 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
9	70.80	62.65	66.84	1.939	n/a	59.07	3.58

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	70.80	14.11	0.014	1.55E-03	0.0	-0.0		163970
2	70.20	12.69	0.013	1.54E-03	8.0	2.6		163970
3	69.60	12.15	0.013	1.52E-03	15.5	10.1		163970
4	69.00	13.63	0.012	1.46E-03	23.2	22.1		163970
5	68.40	14.83	0.011	1.35E-03	31.8	39.1		163970
6	67.62	15.65	0.010	1.10E-03	43.7	69.4		163970
7	66.84	15.27	0.009	6.93E-04	55.7	109.3	144.8	163970
		15.27	0.009	6.93E-04	-89.1	109.3		
8	66.04	19.18	0.009	3.26E-04	-75.4	45.3		163970
9	65.42	22.36	0.009	2.38E-04	-62.5	4.3		163970
10	64.80	28.68	0.008	2.91E-04	-46.7	-30.4		163970
11	64.00	37.56	0.008	5.06E-04	-20.2	-55.6		163970
12	63.33	43.70	0.008	7.49E-04	7.3	-60.6		163970
13	62.65	50.25	0.007	9.71E-04	39.0	-45.6		163970
		10.39	0.007	9.71E-04	39.0	-45.6		
14	61.93	-8.17	0.006	1.11E-03	39.8	-15.2		163970
15	61.20	-1.44	0.005	1.12E-03	36.3	11.7		163970
		-37.35	0.005	1.12E-03	36.3	11.7		
16	60.60	-27.49	0.005	1.05E-03	16.8	26.9		163970
17	60.00	-18.80	0.004	9.55E-04	3.0	32.1		163970
18	59.20	-9.05	0.004	8.14E-04	-8.2	28.4		163970
19	58.40	-0.99	0.003	7.06E-04	-12.2	18.6		163970
20	57.60	5.24	0.002	6.45E-04	-10.5	8.0		163970
21	57.00	9.17	0.002	6.27E-04	-6.2	2.3		163970
22	56.40	11.44	0.002	6.24E-04	0.0	0.0		---

At elev. 66.84 Strut force = 144.8 kN/strut = 144.8 kN/m run

(continued)

Stage No.9 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	ACTIVE side						
		Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	70.80	0.00	12.00	0.00	91.31	14.11	14.11	8048
2	70.20	0.00	22.80	0.00	137.62	12.69	12.69	8048
3	69.60	0.00	33.60	0.92	183.92	12.15	12.15	8048
4	69.00	0.00	44.40	4.00	230.23	13.63	13.63	8048
5	68.40	0.00	55.20	7.08	276.52	14.83	14.83	8048
6	67.62	0.00	69.23	11.08	336.69	15.65	15.65	15992
7	66.84	0.00	83.26	15.08	396.85	15.27	15.27	1200000
8	66.04	0.00	97.64	19.18	458.53	19.18	19.18a	4003
9	65.42	0.00	108.79	22.36	506.31	22.36	22.36a	4003
10	64.80	0.00	119.93	25.54	554.08	28.68	28.68	4003
11	64.00	0.00	134.30	29.64	615.70	37.56	37.56	4003
12	63.33	0.00	146.42	33.09	667.66	43.70	43.70	4003
13	62.65	0.00	158.53	36.55	719.60	50.25	50.25	4003
14	61.93	7.25	164.29	38.19	744.28	55.79	63.04	4003
15	61.20	14.50	170.04	39.83	768.93	61.41	75.91	4003
		14.50	170.04	30.29	897.70	41.93	56.43	7505
16	60.60	20.50	175.39	31.69	923.64	48.47	68.97	7505
17	60.00	26.50	180.74	33.09	949.56	54.66	81.16	10010
18	59.20	34.50	187.87	34.95	984.09	62.20	96.70	10010
19	58.40	42.50	194.99	36.81	1018.59	68.99	111.49	10010
20	57.60	50.50	202.10	38.67	1053.05	74.92	125.42	10010
21	57.00	56.50	207.43	40.07	1078.88	79.02	135.52	10010
22	56.40	62.50	212.76	41.46	1104.69	82.31	144.81	59899

Node no.	Y coord	PASSIVE side						
		Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	70.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	70.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	69.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	67.62	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	66.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.42	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	64.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	63.33	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	9373
14	61.93	7.25	5.80	0.00	64.74	63.96	71.21	9373
15	61.20	14.50	11.62	0.00	89.70	62.85	77.35	9373
		14.50	11.62	0.00	130.16	79.28	93.78	17574
16	60.60	20.50	17.07	0.00	156.53	75.95	96.45	17574
17	60.00	26.50	22.54	0.00	183.06	73.47	99.97	10010
18	59.20	34.50	29.91	0.00	218.75	71.26	105.76	10010
19	58.40	42.50	37.37	0.00	254.89	69.98	112.48	10010
20	57.60	50.50	44.93	0.00	291.54	69.68	120.18	10010
21	57.00	56.50	50.68	0.00	319.39	69.86	126.36	10010

(continued)

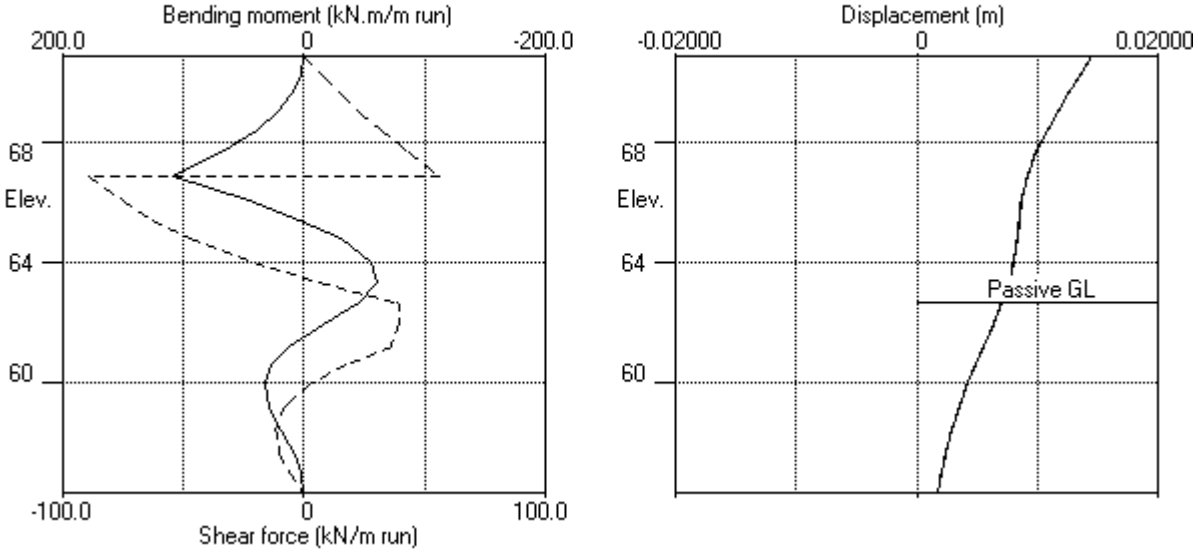
Stage No.9 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
22	56.40	62.50	56.50	0.59	347.59	70.87	133.37	59899

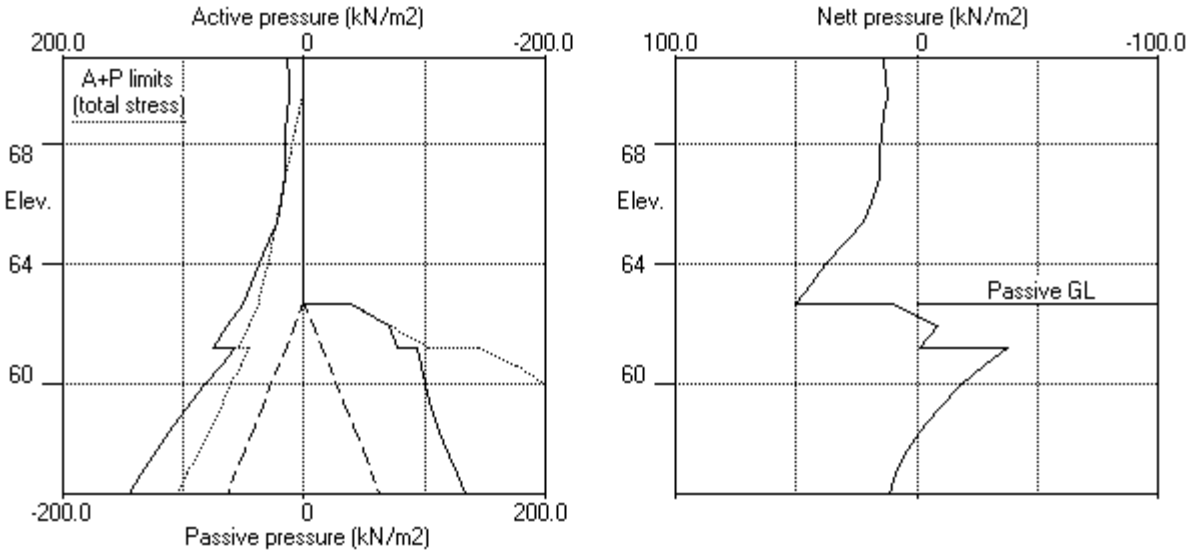
Note: 22.36a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.9 Change EI of wall to 163970kN.m2/m run



Stage No.9 Change EI of wall to 163970kN.m2/m run



Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 56.40: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500: Toe elev.	Wall Penetr-ation
1	70.80	70.80	Cant.	Conditions not suitable for FoS calc.			
2	70.80	70.80		No analysis at this stage			
3	70.80	70.80		No analysis at this stage			
4	70.80	70.80		No analysis at this stage			
5	70.80	66.04	Cant.	1.533	57.01	56.88	9.16
6	70.80	66.04	Cant.	1.533	57.01	56.88	9.16
7	70.80	66.04		No analysis at this stage			
8	70.80	62.65	66.84	1.939	n/a	59.07	3.58
9	70.80	62.65	66.84	1.939	n/a	59.07	3.58

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	70.80	0.017	0.000	0.0	-0.0	0.0	0.0
2	70.20	0.016	0.000	3.0	-0.0	9.4	-0.0
3	69.60	0.015	0.000	11.3	0.0	17.9	-0.0
4	69.00	0.013	0.000	24.7	-0.0	26.3	-0.0
5	68.40	0.012	0.000	43.3	0.0	35.2	-0.0
6	67.62	0.011	0.000	75.8	-0.0	47.2	-0.0
7	66.84	0.009	0.000	117.8	0.0	59.2	-93.1
8	66.04	0.009	0.000	51.3	-0.0	36.4	-79.4
9	65.42	0.009	0.000	68.2	0.0	21.7	-66.5
10	64.80	0.008	0.000	76.4	-30.4	6.8	-50.3
11	64.00	0.008	0.000	80.8	-55.6	0.0	-23.0
12	63.33	0.008	0.000	77.2	-61.4	7.3	-10.5
13	62.65	0.007	0.000	70.4	-47.2	39.0	-12.8
14	61.93	0.006	0.000	62.2	-17.4	39.8	-11.7
15	61.20	0.005	0.000	55.2	0.0	37.2	-7.9
16	60.60	0.005	0.000	48.8	0.0	18.5	-12.4
17	60.00	0.004	0.000	40.3	-0.0	4.6	-14.9
18	59.20	0.004	0.000	28.9	0.0	0.0	-15.4
19	58.40	0.003	0.000	19.4	-0.0	0.0	-13.4
20	57.60	0.002	0.000	8.6	0.0	0.0	-10.8
21	57.00	0.002	0.000	2.6	-0.0	0.0	-6.7
22	56.40	0.002	0.000	0.0	0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	Bending moment elev.	Bending moment minimum kN.m/m	Bending moment elev.	Shear force maximum kN/m	Shear force elev.	Shear force minimum kN/m	Shear force elev.
1	0.0	57.60	-0.0	63.33	0.0	70.80	-0.0	56.40
2	No calculation at this stage							
3	No calculation at this stage							
4	No calculation at this stage							
5	80.8	64.00	-0.0	70.80	36.4	66.04	-15.4	59.20
6	77.0	64.00	-0.0	70.80	36.1	66.04	-13.1	60.00
7	No calculation at this stage							
8	117.8	66.84	-61.4	63.33	59.2	66.84	-93.1	66.84
9	109.3	66.84	-60.6	63.33	55.7	66.84	-89.1	66.84

Summary of results (continued)

Maximum and minimum displacement at each stage

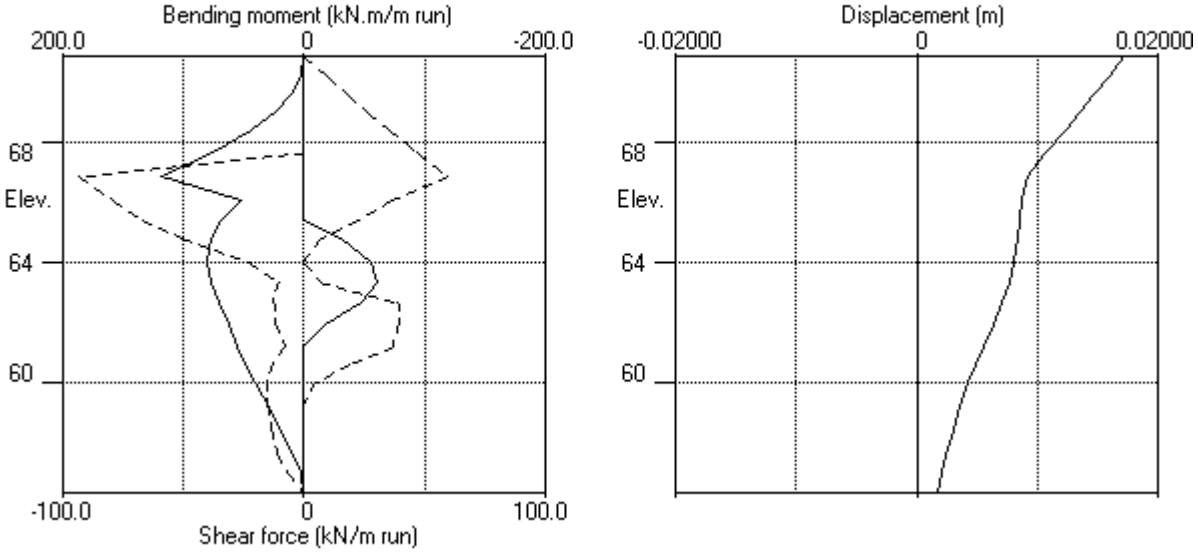
Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.000	56.40	-0.000	61.93	Change EI of wall to 1.0000E-04kN.m2/m run
2	No calculation at this stage				Apply surcharge no.1 at elev. 70.80
3	Wall displacements reset to zero				Change EI of wall to 327940kN.m2/m run
4	No calculation at this stage				Apply water pressure profile no.1
5	0.015	70.80	0.000	70.80	Excav. to elev. 66.04 on PASSIVE side
6	0.017	70.80	0.000	70.80	Change EI of wall to 229558kN.m2/m run
7	No calculation at this stage				Install strut no.1 at elev. 66.84
8	0.014	70.80	0.000	70.80	Excav. to elev. 62.65 on PASSIVE side
9	0.014	70.80	0.000	70.80	Change EI of wall to 163970kN.m2/m run

Strut forces at each stage (horizontal components)

Stage no.	--- Strut no. 1 --- at elev. 66.84 kN/m run	kN/strut
8	152.29	152.29
9	144.85	144.85

Units: kN,m

Bending moment, shear force, displacement envelopes



Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side		Soil types Passive side	
1	67.00	2	WWGS	2	WWGS
2	56.40	3	Transitional WG	3	Transitional WG
3	55.50	4	Waitemata Group Rock	4	Waitemata Group Rock

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Fill	18.00	9000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	5.000d
2	WWGS	18.00	24000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	7.000d
3	Transition-al WG	19.00	45000	0.470	OC (0.200)	0.262 (1.182)	4.845 (6.154)	12.00d
4	Waitemata Group Rock	19.00	150000	0.412	OC (0.200)	0.219 (1.075)	6.289 (7.279)	30.00d

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Fill	30.00	0.631	0.00	30.00	0.464	0.00
2	WWGS	30.00	0.631	0.00	30.00	0.464	0.00
3	Transitional WG	32.00	0.625	0.00	32.00	0.459	0.00
4	Waitemata Group Rock	36.00	0.613	0.00	36.00	0.447	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	63.10	63.10

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	62.65	62.65	0.0	1	62.65	62.65	0.0

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.75 m
Soldier Pile spacing = 1.50 m
Passive mobilisation factor = 3.00 m
Elevation of toe of wall = 56.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 3.1685E+07 kN/m2
Moment of inertia of wall I = 0.010350 m4/m run
E.I = 327940 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	66.84	1.00	0.150000	3.169E+07	0.10	0.00	0	Yes

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- kN/m2 ----- Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	67.00	0.00(A)	50.00	50.00	12.00	=	N/A	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Change EI of wall to 1.0000E-04 kN.m2/m run Yield moment not defined No adjustments to wall displacements
2	Apply surcharge no.1 at elevation 67.00 No analysis at this stage
3	Change EI of wall to 327940 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
4	Apply water pressure profile no.1 No analysis at this stage
5	Excavate to elevation 62.65 on PASSIVE side
6	Change EI of wall to 229558 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value
7	Install strut or anchor no.1 at elevation 66.84
8	Change EI of wall to 163970 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Change EI of wall to 1.0000E-04kN.m2/m	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 67.00	No	No	No
3	Change EI of wall to 327940kN.m2/m run	No	No	No
4	Apply water pressure profile no.1	No	No	No
5	Excav. to elev. 62.65 on PASSIVE side	Yes	Yes	Yes
6	Change EI of wall to 229558kN.m2/m run	Yes	Yes	Yes
7	Install strut no.1 at elev. 66.84	Yes	Yes	Yes
8	Change EI of wall to 163970kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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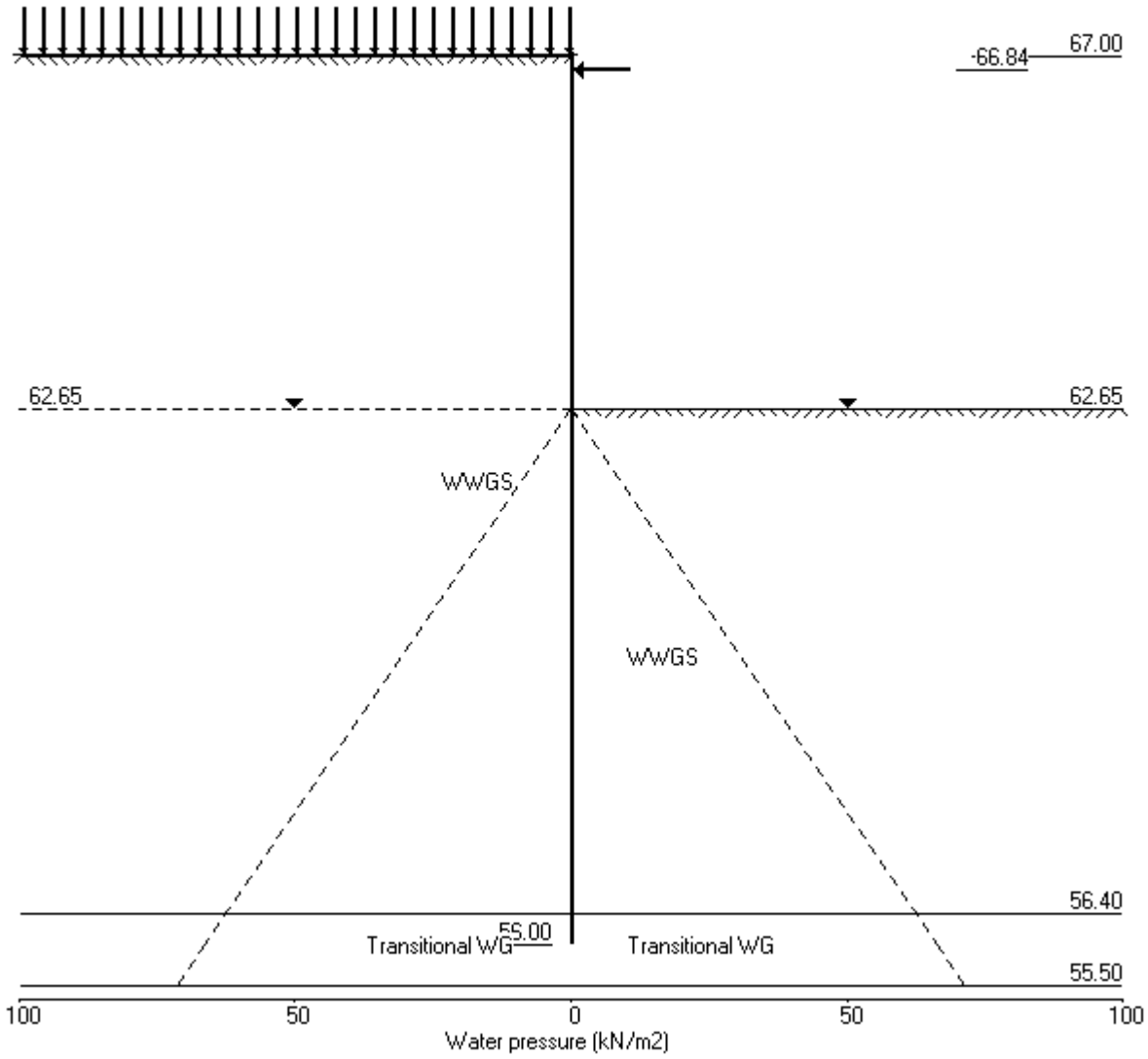
Units: kN,m

Stage No.8 Change EI of wall to 163970kN.m2/m run



Units: kN,m

Stage No. 1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
1	67.00	67.00	Cant.	Conditions not suitable for FoS calc.			

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall
Analysis options
Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	67.00	-0.00	0.000	-2.63E-21	0.0	0.0		0
2	66.84	0.00	-0.000	5.278E-21	-0.0	-0.0		0
3	66.42	0.00	0.000	-3.13E-20	-0.0	0.0		0
4	66.00	0.00	-0.000	1.20E-19	-0.0	-0.0		0
5	65.40	0.00	0.000	-5.38E-19	-0.0	0.0		0
6	64.80	0.00	-0.000	2.03E-18	-0.0	-0.0		0
7	64.20	0.00	0.000	-7.59E-18	-0.0	0.0		0
8	63.65	0.00	-0.000	2.72E-17	-0.0	-0.0		0
9	63.10	0.00	0.000	-1.01E-16	-0.0	0.0		0
10	62.65	0.00	-0.000	3.46E-16	-0.0	-0.0		0
11	62.23	0.00	0.000	-1.25E-15	-0.0	0.0		0
12	61.80	0.00	0.000	-7.76E-15	-0.0	0.0		0
13	61.20	0.00	0.000	4.09E-16	-0.0	-0.0		0
14	60.60	0.00	0.000	-1.09E-16	-0.0	0.0		0
15	60.00	0.00	0.000	2.69E-17	-0.0	-0.0		0
16	59.40	0.00	0.000	7.51E-15	-0.0	0.0		0
17	58.80	0.00	0.000	-7.55E-15	-0.0	0.0		0
18	58.20	0.00	0.000	-7.38E-15	-0.0	-0.0		0
19	57.60	-0.00	0.000	-4.95E-16	-0.0	0.0		0
20	57.00	0.00	0.000	1.84E-15	-0.0	-0.0		0
21	56.40	0.00	0.000	4.79E-15	-0.0	0.0		0
22	56.00	-0.00	0.000	4.62E-15	-0.0	-0.0		---

(continued)

Stage No.1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

Node no.	Y coord	ACTIVE side						
			Effective stresses				Total	Soil
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	stiffness coeff.
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	67.00	0.00	0.00	0.00	39.86	0.00	0.00a	109798
2	66.84	0.00	2.88	0.00	52.21	1.44	1.44	85195
3	66.42	0.00	10.44	0.00	84.62	5.22	5.22	30901
4	66.00	0.00	18.00	0.00	117.04	9.00	9.00	34275
5	65.40	0.00	28.80	0.00	163.35	14.40	14.40	25718
6	64.80	0.00	39.60	2.63	209.65	19.80	19.80	26098
7	64.20	0.00	50.40	5.71	255.96	25.20	25.20	25193
8	63.65	0.00	60.30	8.53	298.41	30.15	30.15	28695
9	63.10	0.00	70.20	11.36	340.86	35.10	35.10	28148
10	62.65	4.50	73.80	12.38	356.29	36.90	41.40	26639
11	62.23	8.75	77.20	13.35	370.87	38.60	47.35	3226
12	61.80	13.00	80.60	14.32	385.45	40.30	53.30	3226
13	61.20	19.00	85.40	15.69	406.03	42.70	61.70	3226
14	60.60	25.00	90.20	17.06	426.61	45.10	70.10	3226
15	60.00	31.00	95.00	18.43	447.19	47.50	78.50	3226
16	59.40	37.00	99.80	19.80	467.77	49.90	86.90	3226
17	58.80	43.00	104.60	21.17	488.35	52.30	95.30	3226
18	58.20	49.00	109.40	22.54	508.93	54.70	103.70	3226
19	57.60	55.00	114.20	23.90	529.52	57.10	112.10	3226
20	57.00	61.00	119.00	25.27	550.10	59.50	120.50	3226
21	56.40	67.00	123.80	26.64	570.68	61.90	128.90	3226
		67.00	123.80	18.19	673.67	58.19	125.19	6049
22	56.00	71.00	127.40	19.14	691.11	59.88	130.88	6049

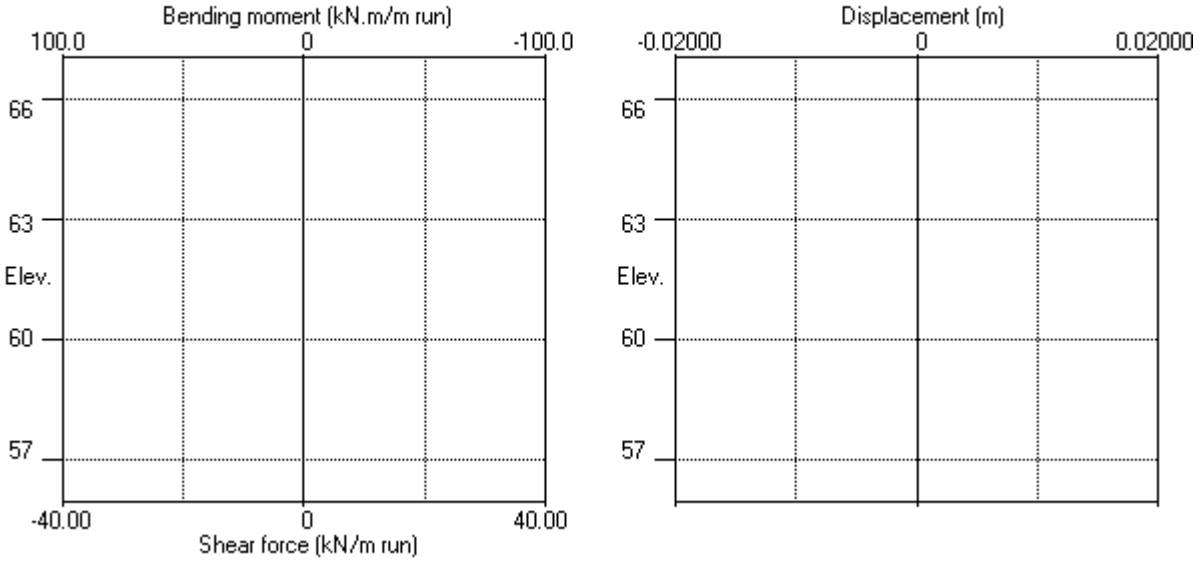
Node no.	Y coord	PASSIVE side						
			Effective stresses				Total	Soil
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	stiffness coeff.
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	67.00	0.00	0.00	0.00	39.86	0.00	0.00a	109798
2	66.84	0.00	2.88	0.00	52.21	1.44	1.44	85195
3	66.42	0.00	10.44	0.00	84.62	5.22	5.22	30901
4	66.00	0.00	18.00	0.00	117.04	9.00	9.00	34275
5	65.40	0.00	28.80	0.00	163.35	14.40	14.40	25718
6	64.80	0.00	39.60	2.63	209.65	19.80	19.80	26098
7	64.20	0.00	50.40	5.71	255.96	25.20	25.20	25193
8	63.65	0.00	60.30	8.53	298.41	30.15	30.15	28695
9	63.10	0.00	70.20	11.36	340.86	35.10	35.10	28148
10	62.65	4.50	73.80	12.38	356.29	36.90	41.40	26639
11	62.23	8.75	77.20	13.35	370.87	38.60	47.35	3226
12	61.80	13.00	80.60	14.32	385.45	40.30	53.30	3226
13	61.20	19.00	85.40	15.69	406.03	42.70	61.70	3226
14	60.60	25.00	90.20	17.06	426.61	45.10	70.10	3226
15	60.00	31.00	95.00	18.43	447.19	47.50	78.50	3226
16	59.40	37.00	99.80	19.80	467.77	49.90	86.90	3226
17	58.80	43.00	104.60	21.17	488.35	52.30	95.30	3226
18	58.20	49.00	109.40	22.54	508.93	54.70	103.70	3226
19	57.60	55.00	114.20	23.90	529.52	57.10	112.10	3226
20	57.00	61.00	119.00	25.27	550.10	59.50	120.50	3226
21	56.40	67.00	123.80	26.64	570.68	61.90	128.90	3226
		67.00	123.80	18.19	673.67	58.19	125.19	6049
22	56.00	71.00	127.40	19.14	691.11	59.88	130.88	6049

(continued)

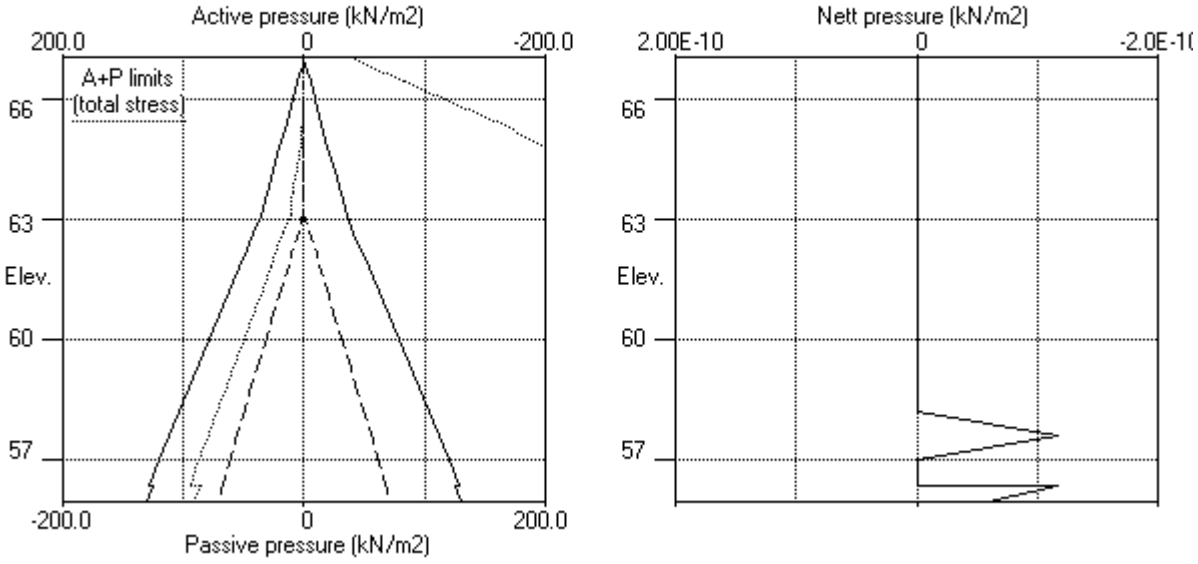
Stage No.1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 62.65 on PASSIVE side

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
5	67.00	62.65	Cant.	1.503	56.49	56.03	6.62

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	67.00	0.00	0.012	1.25E-03	0.0	0.0		327940
2	66.84	0.00	0.012	1.25E-03	0.0	-0.0		327940
3	66.42	0.00	0.011	1.25E-03	0.0	-0.0		327940
4	66.00	0.00	0.011	1.25E-03	0.0	-0.0		327940
5	65.40	2.97	0.010	1.25E-03	0.9	0.2		327940
6	64.80	6.05	0.009	1.25E-03	3.6	1.4		327940
7	64.20	9.13	0.008	1.25E-03	8.1	4.9		327940
8	63.65	11.95	0.008	1.23E-03	13.9	10.9		327940
9	63.10	14.77	0.007	1.21E-03	21.3	20.5		327940
10	62.65	18.92	0.006	1.17E-03	28.9	32.5		327940
		-20.94	0.006	1.17E-03	28.9	32.5		
11	62.23	-22.87	0.006	1.12E-03	19.6	43.5		327940
12	61.80	-19.26	0.005	1.06E-03	10.6	49.7		327940
13	61.20	-14.53	0.005	9.73E-04	0.5	52.6		327940
14	60.60	-10.24	0.004	8.78E-04	-7.0	50.3		327940
15	60.00	-6.38	0.004	7.92E-04	-11.9	44.3		327940
16	59.40	-2.90	0.003	7.19E-04	-14.7	36.0		327940
17	58.80	0.27	0.003	6.61E-04	-15.5	26.6		327940
18	58.20	3.20	0.002	6.21E-04	-14.5	17.3		327940
19	57.60	5.98	0.002	5.97E-04	-11.7	9.2		327940
20	57.00	8.66	0.002	5.85E-04	-7.3	3.3		327940
21	56.40	11.30	0.001	5.82E-04	-1.4	0.4		327940
		1.71	0.001	5.82E-04	-1.4	0.4		
22	56.00	5.04	0.001	5.82E-04	0.0	-0.0		---

(continued)

Stage No.5 Excavate to elevation 62.65 on PASSIVE side

Node no.	Y coord	ACTIVE side: Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	67.00	0.00	12.00	0.00	91.31	0.00	0.00a	3474
2	66.84	0.00	14.88	0.00	103.66	0.00	0.00a	3474
3	66.42	0.00	22.44	0.00	136.07	0.00	0.00a	3474
4	66.00	0.00	30.00	0.00	168.49	0.00	0.00a	3474
5	65.40	0.00	40.80	2.97	214.79	2.97	2.97a	3474
6	64.80	0.00	51.60	6.05	261.09	6.05	6.05a	3474
7	64.20	0.00	62.39	9.13	307.38	9.13	9.13a	3474
8	63.65	0.00	72.29	11.95	349.81	11.95	11.95a	3474
9	63.10	0.00	82.18	14.77	392.22	14.77	14.77a	3474
10	62.65	0.00	90.27	17.08	426.92	18.92	18.92	3474
11	62.23	4.25	93.66	18.05	441.46	22.32	26.57	3474
12	61.80	8.50	97.05	19.01	456.00	25.64	34.14	3474
13	61.20	14.50	101.84	20.38	476.50	30.16	44.66	3474
14	60.60	20.50	106.62	21.74	497.00	34.49	54.99	3474
15	60.00	26.50	111.39	23.10	517.47	38.62	65.12	3474
16	59.40	32.50	116.16	24.46	537.93	42.58	75.08	3474
17	58.80	38.50	120.93	25.82	558.37	46.41	84.91	3474
18	58.20	44.50	125.69	27.18	578.80	50.14	94.64	3474
19	57.60	50.50	130.45	28.54	599.20	53.80	104.30	3474
20	57.00	56.50	135.21	29.90	619.59	57.41	113.91	3474
21	56.40	62.50	139.96	31.25	639.96	61.02	123.52	3474
		62.50	139.96	22.42	751.97	53.00	115.50	6513
22	56.00	66.50	143.52	23.35	769.24	56.20	122.70	6513

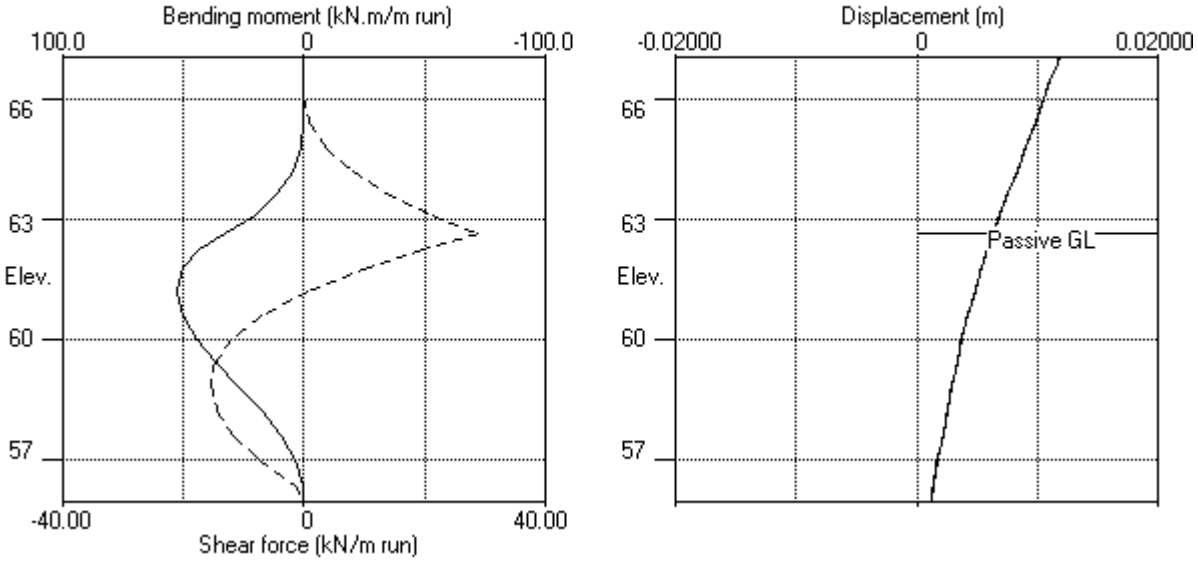
Node no.	Y coord	PASSIVE side: Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	67.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	66.42	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	66.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	65.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	64.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	64.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	63.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	63.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	4265
11	62.23	4.25	3.40	0.00	54.44	45.19	49.44	4265
12	61.80	8.50	6.80	0.00	69.03	44.90	53.40	4265
13	61.20	14.50	11.61	0.00	89.65	44.69	59.19	4265
14	60.60	20.50	16.44	0.00	110.33	44.73	65.23	4265
15	60.00	26.50	21.28	0.00	131.08	45.00	71.50	4265
16	59.40	32.50	26.14	0.00	151.93	45.49	77.99	4265
17	58.80	38.50	31.03	0.18	172.89	46.15	84.65	4265
18	58.20	44.50	35.95	1.59	193.98	46.94	91.44	4265
19	57.60	50.50	40.90	3.00	215.21	47.82	98.32	4265
20	57.00	56.50	45.88	4.42	236.59	48.76	105.26	4265
21	56.40	62.50	50.91	5.85	258.13	49.72	112.22	4265
		62.50	50.91	0.00	320.49	51.29	113.79	7996
22	56.00	66.50	54.68	0.12	338.76	51.16	117.66	7996

(continued)

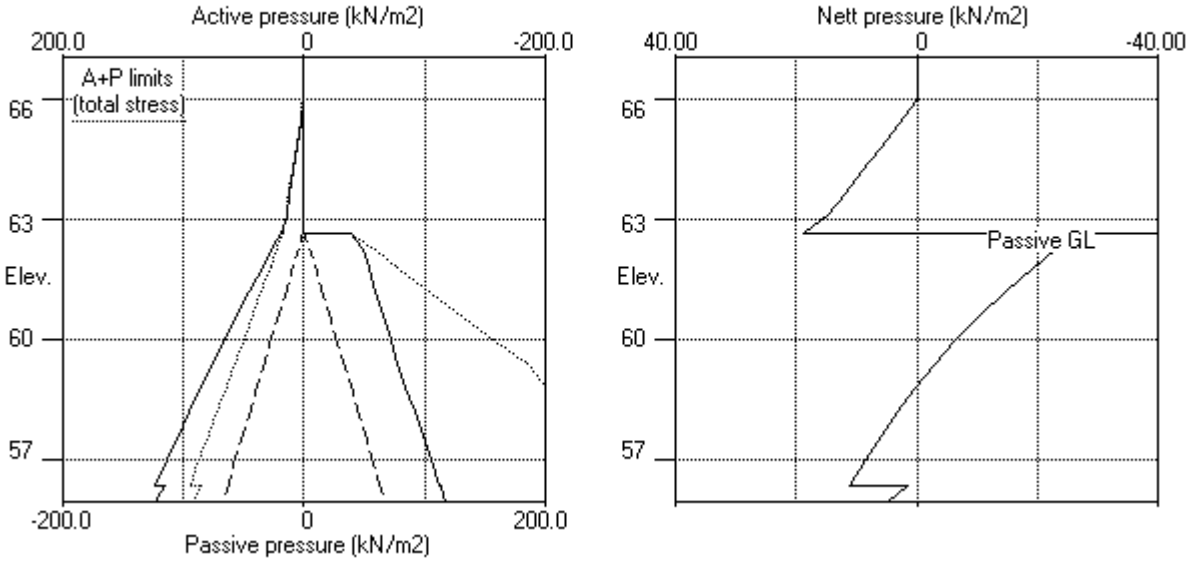
Stage No.5 Excavate to elevation 62.65 on PASSIVE side
Note: 14.77a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 62.65 on PASSIVE side



Stage No.5 Excav. to elev. 62.65 on PASSIVE side



Units: kN,m

Stage No. 6 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
6	67.00	62.65	Cant.	1.503	56.49	56.03	6.62

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	67.00	0.00	0.013	1.45E-03	0.0	0.0		229558
2	66.84	0.00	0.013	1.45E-03	0.0	-0.0		229558
3	66.42	0.00	0.012	1.45E-03	0.0	-0.0		229558
4	66.00	0.00	0.011	1.45E-03	0.0	-0.0		229558
5	65.40	2.97	0.010	1.45E-03	0.9	0.2		229558
6	64.80	6.05	0.010	1.45E-03	3.6	1.4		229558
7	64.20	9.13	0.009	1.44E-03	8.1	4.9		229558
8	63.65	11.95	0.008	1.42E-03	13.9	10.9		229558
9	63.10	14.77	0.007	1.39E-03	21.3	20.5		229558
10	62.65	18.17	0.007	1.34E-03	28.7	32.5		229558
		-21.69	0.007	1.34E-03	28.7	32.5		
11	62.23	-24.64	0.006	1.26E-03	18.9	43.4		229558
12	61.80	-19.78	0.005	1.18E-03	9.4	49.3		229558
13	61.20	-14.20	0.005	1.05E-03	-0.8	51.5		229558
14	60.60	-9.58	0.004	9.23E-04	-7.9	48.7		229558
15	60.00	-5.57	0.004	8.05E-04	-12.5	42.3		229558
16	59.40	-2.08	0.003	7.07E-04	-14.7	33.9		229558
17	58.80	0.97	0.003	6.32E-04	-15.1	24.6		229558
18	58.20	3.72	0.002	5.81E-04	-13.7	15.7		229558
19	57.60	6.26	0.002	5.51E-04	-10.7	8.0		229558
20	57.00	8.69	0.002	5.38E-04	-6.2	2.5		229558
21	56.40	10.44	0.001	5.35E-04	-0.5	0.2		229558
		0.09	0.001	5.35E-04	-0.5	0.2		
22	56.00	2.18	0.001	5.35E-04	0.0	-0.0		---

(continued)

Stage No.6 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	ACTIVE side						
			Effective stresses			Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	67.00	0.00	12.00	0.00	91.31	0.00	0.00a	5234
2	66.84	0.00	14.88	0.00	103.66	0.00	0.00a	5234
3	66.42	0.00	22.44	0.00	136.07	0.00	0.00a	5234
4	66.00	0.00	30.00	0.00	168.49	0.00	0.00a	5234
5	65.40	0.00	40.80	2.97	214.79	2.97	2.97a	5234
6	64.80	0.00	51.60	6.05	261.09	6.05	6.05a	5234
7	64.20	0.00	62.39	9.13	307.38	9.13	9.13a	5234
8	63.65	0.00	72.29	11.95	349.81	11.95	11.95a	5234
9	63.10	0.00	82.18	14.77	392.22	14.77	14.77a	5234
10	62.65	0.00	90.27	17.08	426.92	18.17	18.17	5234
11	62.23	4.25	93.66	18.05	441.46	21.91	26.16	5234
12	61.80	8.50	97.05	19.01	456.00	25.52	34.02	5234
13	61.20	14.50	101.84	20.38	476.50	30.33	44.83	4526
14	60.60	20.50	106.62	21.74	497.00	34.82	55.32	4526
15	60.00	26.50	111.39	23.10	517.47	39.03	65.53	4526
16	59.40	32.50	116.16	24.46	537.93	42.99	75.49	4526
17	58.80	38.50	120.93	25.82	558.37	46.77	85.27	4526
18	58.20	44.50	125.69	27.18	578.80	50.40	94.90	4526
19	57.60	50.50	130.45	28.54	599.20	53.94	104.44	4526
20	57.00	56.50	135.21	29.90	619.59	57.43	113.93	4526
21	56.40	62.50	139.96	31.25	639.96	60.59	123.09	17689
		62.50	139.96	22.42	751.97	52.19	114.69	33167
22	56.00	66.50	143.52	23.35	769.24	54.77	121.27	33167

Node no.	Y coord	PASSIVE side						
			Effective stresses			Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	67.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	66.42	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	66.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	65.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	64.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	64.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	63.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	63.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	17424
11	62.23	4.25	3.40	0.00	54.44	46.55	50.80	17424
12	61.80	8.50	6.80	0.00	69.03	45.30	53.80	17424
13	61.20	14.50	11.61	0.00	89.65	44.53	59.03	4526
14	60.60	20.50	16.44	0.00	110.33	44.40	64.90	4526
15	60.00	26.50	21.28	0.00	131.08	44.59	71.09	4526
16	59.40	32.50	26.14	0.00	151.93	45.08	77.58	4526
17	58.80	38.50	31.03	0.18	172.89	45.79	84.29	4526
18	58.20	44.50	35.95	1.59	193.98	46.68	91.18	4526
19	57.60	50.50	40.90	3.00	215.21	47.68	98.18	4526
20	57.00	56.50	45.88	4.42	236.59	48.74	105.24	4526
21	56.40	62.50	50.91	5.85	258.13	50.15	112.65	17689
		62.50	50.91	0.00	320.49	52.10	114.60	33167

(continued)

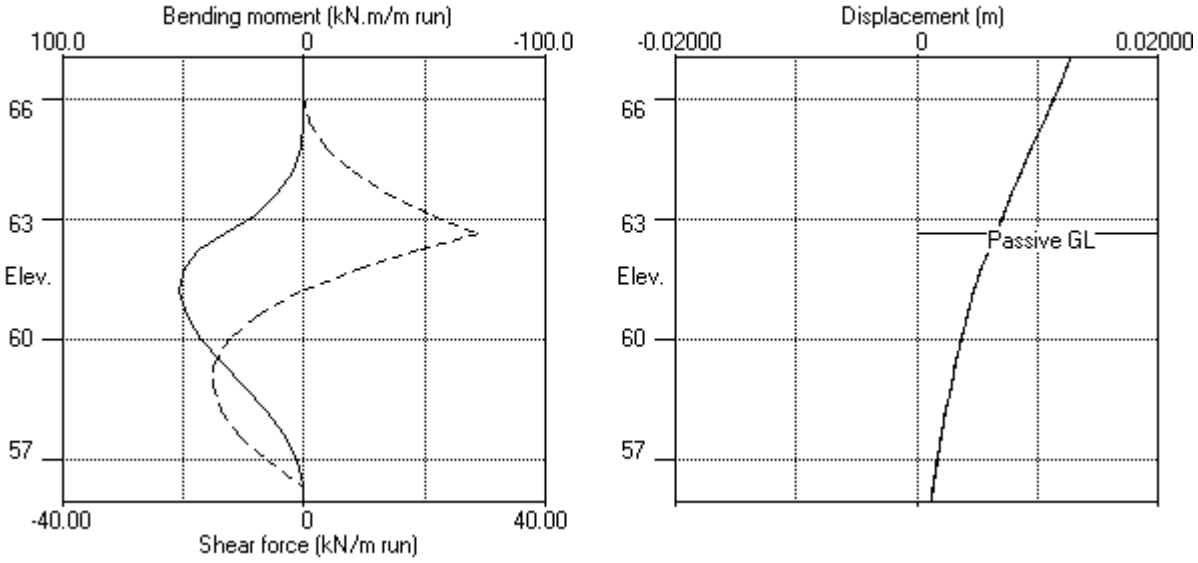
Stage No.6 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	PASSIVE side						
		Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
22	56.00	66.50	54.68	0.12	338.76	52.59	119.09	33167

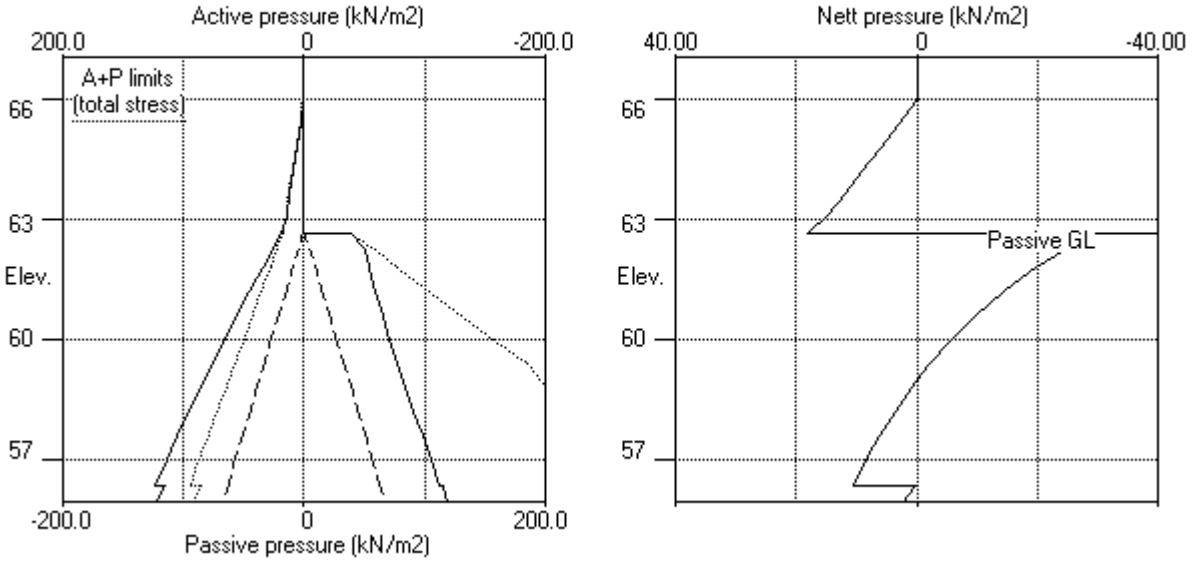
Note: 14.77a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.6 Change EI of wall to 229558kN.m2/m run



Stage No.6 Change EI of wall to 229558kN.m2/m run



Units: kN,m

Stage No. 8 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
8	67.00	62.65	66.84	2.348	n/a	60.13	2.52

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	67.00	0.01	0.013	1.45E-03	0.0	0.0		163970
2	66.84	0.00	0.013	1.45E-03	0.0	0.0	1.8	163970
		0.00	0.013	1.45E-03	-1.8	0.0		
3	66.42	0.00	0.012	1.45E-03	-1.8	-0.6		163970
4	66.00	0.00	0.011	1.46E-03	-1.8	-1.2		163970
5	65.40	2.98	0.010	1.46E-03	-0.9	-1.9		163970
6	64.80	6.10	0.010	1.47E-03	1.8	-1.5		163970
7	64.20	9.24	0.009	1.48E-03	6.4	1.1		163970
8	63.65	12.14	0.008	1.47E-03	12.3	6.4		163970
9	63.10	15.05	0.007	1.44E-03	19.7	15.3		163970
10	62.65	18.53	0.006	1.38E-03	27.3	26.8		163970
		-20.93	0.006	1.38E-03	27.3	26.8		
11	62.23	-23.74	0.006	1.30E-03	17.8	37.3		163970
12	61.80	-18.76	0.005	1.21E-03	8.8	42.8		163970
13	61.20	-13.11	0.005	1.05E-03	-0.8	44.9		163970
14	60.60	-8.52	0.004	9.05E-04	-7.3	42.2		163970
15	60.00	-4.63	0.004	7.70E-04	-11.2	36.2		163970
16	59.40	-1.34	0.003	6.59E-04	-13.0	28.5		163970
17	58.80	1.47	0.003	5.77E-04	-13.0	20.1		163970
18	58.20	3.95	0.002	5.23E-04	-11.4	12.3		163970
19	57.60	6.16	0.002	4.94E-04	-8.3	5.7		163970
20	57.00	7.84	0.002	4.84E-04	-4.1	1.4		163970
21	56.40	8.87	0.002	4.82E-04	0.9	-0.0		163970
		-2.85	0.002	4.82E-04	0.9	-0.0		
22	56.00	-1.64	0.001	4.83E-04	0.0	-0.0		---

At elev. 66.84 Strut force = 1.8 kN/strut = 1.8 kN/m run

(continued)

Stage No.8 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	ACTIVE side						
			Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	67.00	0.00	12.00	0.00	91.31	0.01	0.01	92922
2	66.84	0.00	14.88	0.00	103.66	0.00	0.00a	20298
3	66.42	0.00	22.44	0.00	136.07	0.00	0.00a	20298
4	66.00	0.00	30.00	0.00	168.49	0.00	0.00a	3682
5	65.40	0.00	40.80	2.97	214.79	2.98	2.98	3682
6	64.80	0.00	51.60	6.05	261.09	6.10	6.10	3682
7	64.20	0.00	62.39	9.13	307.38	9.24	9.24	3682
8	63.65	0.00	72.29	11.95	349.81	12.14	12.14	3682
9	63.10	0.00	82.18	14.77	392.22	15.05	15.05	3682
10	62.65	0.00	90.27	17.08	426.92	18.53	18.53	3682
11	62.23	4.25	93.66	18.05	441.46	22.34	26.59	3682
12	61.80	8.50	97.05	19.01	456.00	26.00	34.50	3682
13	61.20	14.50	101.84	20.38	476.50	30.85	45.35	3682
14	60.60	20.50	106.62	21.74	497.00	35.32	55.82	3682
15	60.00	26.50	111.39	23.10	517.47	39.47	65.97	3682
16	59.40	32.50	116.16	24.46	537.93	43.35	75.85	3682
17	58.80	38.50	120.93	25.82	558.37	47.00	85.50	3682
18	58.20	44.50	125.69	27.18	578.80	50.51	95.01	3682
19	57.60	50.50	130.45	28.54	599.20	53.89	104.39	11198
20	57.00	56.50	135.21	29.90	619.59	57.01	113.51	11198
21	56.40	62.50	139.96	31.25	639.96	59.80	122.30	11198
		62.50	139.96	22.42	751.97	50.72	113.22	20997
22	56.00	66.50	143.52	23.35	769.24	52.86	119.36	20997

Node no.	Y coord	PASSIVE side						
			Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	67.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	66.42	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	66.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	65.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	64.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	64.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	63.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	63.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.46	39.46	4023
11	62.23	4.25	3.40	0.00	54.44	46.08	50.33	4023
12	61.80	8.50	6.80	0.00	69.03	44.77	53.27	4023
13	61.20	14.50	11.61	0.00	89.65	43.96	58.46	4023
14	60.60	20.50	16.44	0.00	110.33	43.84	64.34	4023
15	60.00	26.50	21.28	0.00	131.08	44.11	70.61	4023
16	59.40	32.50	26.14	0.00	151.93	44.69	77.19	4023
17	58.80	38.50	31.03	0.18	172.89	45.53	84.03	4023
18	58.20	44.50	35.95	1.59	193.98	46.56	91.06	4023
19	57.60	50.50	40.90	3.00	215.21	47.73	98.23	11198
20	57.00	56.50	45.88	4.42	236.59	49.16	105.66	11198
21	56.40	62.50	50.91	5.85	258.13	50.93	113.43	11198
		62.50	50.91	0.00	320.49	53.57	116.07	20997

(continued)

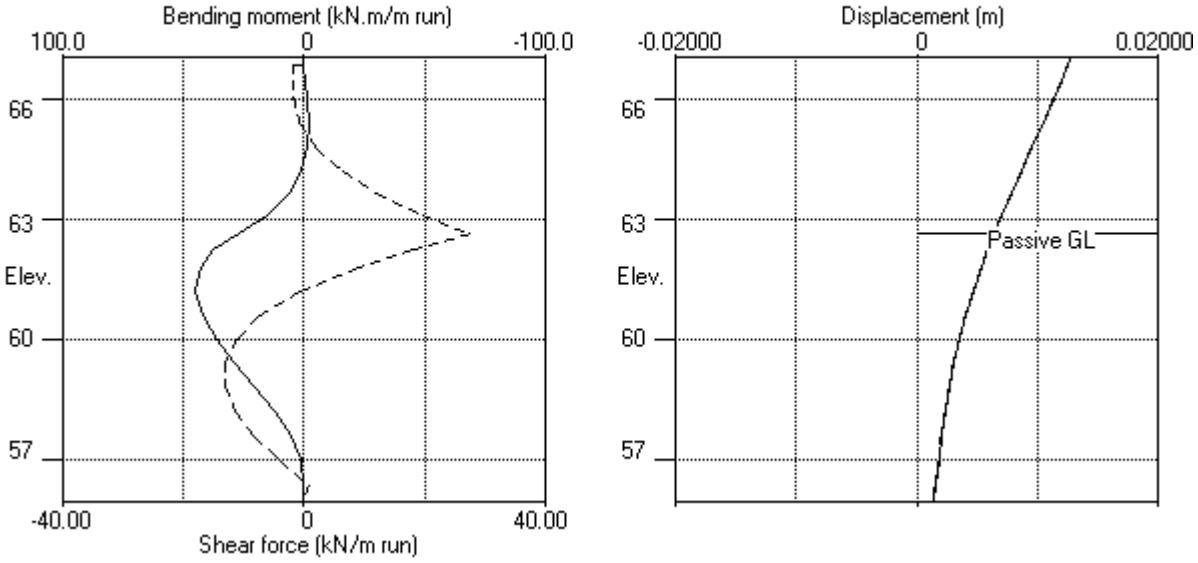
Stage No.8 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	PASSIVE side						
		Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
22	56.00	66.50	54.68	0.12	338.76	54.50	121.00	20997

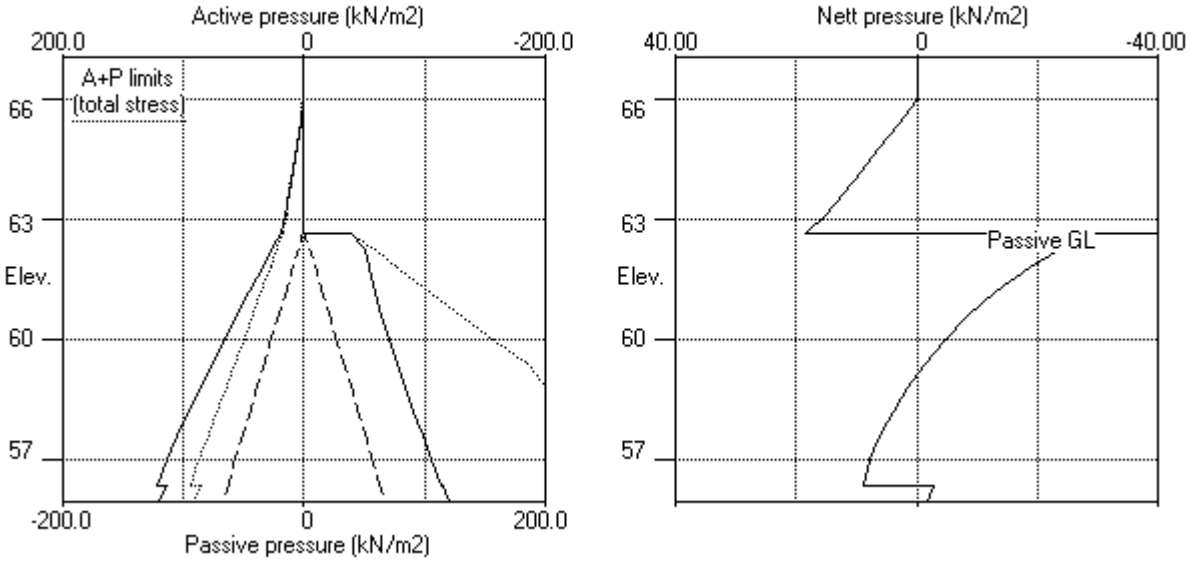
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.8 Change EI of wall to 163970kN.m2/m run



Stage No.8 Change EI of wall to 163970kN.m2/m run



Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 56.00: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500: Toe elev.	Wall Penetr -ation
1	67.00	67.00	Cant.	Conditions not suitable for FoS calc.			
2	67.00	67.00		No analysis at this stage			
3	67.00	67.00		No analysis at this stage			
4	67.00	67.00		No analysis at this stage			
5	67.00	62.65	Cant.	1.503	56.49	56.03	6.62
6	67.00	62.65	Cant.	1.503	56.49	56.03	6.62
7	67.00	62.65		No analysis at this stage			
8	67.00	62.65	66.84	2.348	n/a	60.13	2.52

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	67.00	0.013	0.000	0.0	0.0	0.0	0.0
2	66.84	0.013	0.000	0.0	-0.0	0.0	-1.8
3	66.42	0.012	0.000	0.0	-0.6	0.0	-1.8
4	66.00	0.011	0.000	0.0	-1.2	0.0	-1.8
5	65.40	0.010	0.000	0.2	-1.9	0.9	-0.9
6	64.80	0.010	0.000	1.4	-1.5	3.6	-0.0
7	64.20	0.009	0.000	4.9	0.0	8.1	-0.0
8	63.65	0.008	0.000	10.9	-0.0	13.9	-0.0
9	63.10	0.007	0.000	20.5	0.0	21.3	-0.0
10	62.65	0.007	0.000	32.5	-0.0	28.9	-0.0
11	62.23	0.006	0.000	43.5	0.0	19.6	-0.0
12	61.80	0.005	0.000	49.7	0.0	10.6	-0.0
13	61.20	0.005	0.000	52.6	-0.0	0.5	-0.8
14	60.60	0.004	0.000	50.3	0.0	0.0	-7.9
15	60.00	0.004	0.000	44.3	-0.0	0.0	-12.5
16	59.40	0.003	0.000	36.0	0.0	0.0	-14.7
17	58.80	0.003	0.000	26.6	0.0	0.0	-15.5
18	58.20	0.002	0.000	17.3	-0.0	0.0	-14.5
19	57.60	0.002	0.000	9.2	0.0	0.0	-11.7
20	57.00	0.002	0.000	3.3	-0.0	0.0	-7.3
21	56.40	0.002	0.000	0.4	-0.0	0.9	-1.4
22	56.00	0.001	0.000	0.0	-0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	Bending moment elev.	Bending moment minimum kN.m/m	Bending moment elev.	Shear force maximum kN/m	Shear force elev.	Shear force minimum kN/m	Shear force elev.
1	0.0	60.60	-0.0	60.00	0.0	67.00	-0.0	56.00
2	No calculation at this stage							
3	No calculation at this stage							
4	No calculation at this stage							
5	52.6	61.20	-0.0	66.00	28.9	62.65	-15.5	58.80
6	51.5	61.20	-0.0	66.00	28.7	62.65	-15.1	58.80
7	No calculation at this stage							
8	44.9	61.20	-1.9	65.40	27.3	62.65	-13.0	59.40

Summary of results (continued)

Maximum and minimum displacement at each stage

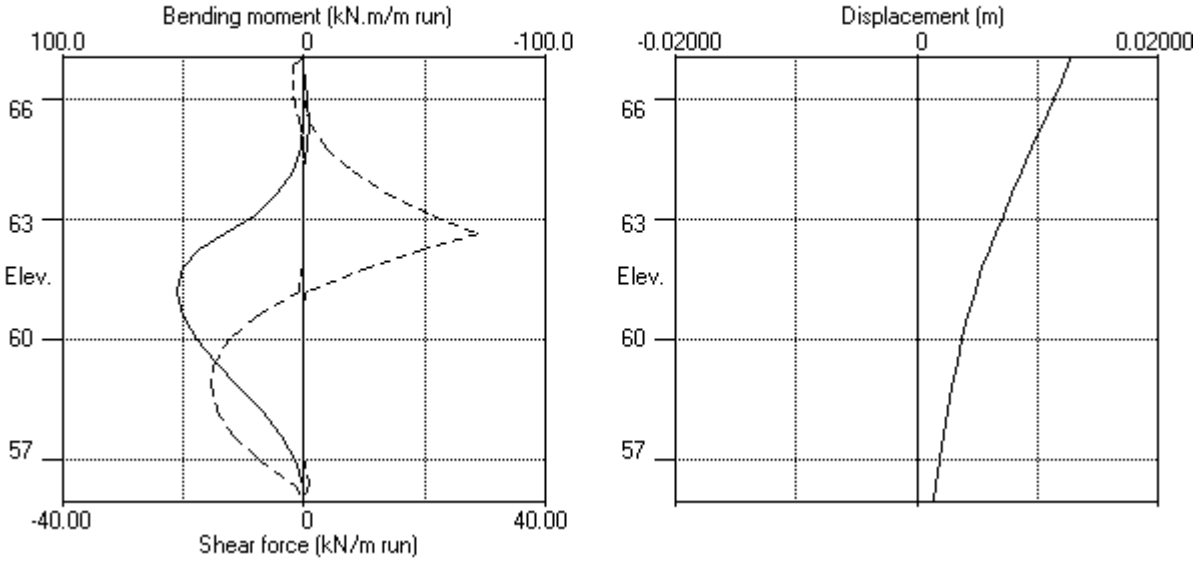
Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.000	57.60	-0.000	62.65	Change EI of wall to 1.0000E-04kN.m2/m run
2	No calculation at this stage				Apply surcharge no.1 at elev. 67.00
3	Wall displacements reset to zero				Change EI of wall to 327940kN.m2/m run
4	No calculation at this stage				Apply water pressure profile no.1
5	0.012	67.00	0.000	67.00	Excav. to elev. 62.65 on PASSIVE side
6	0.013	67.00	0.000	67.00	Change EI of wall to 229558kN.m2/m run
7	No calculation at this stage				Install strut no.1 at elev. 66.84
8	0.013	67.00	0.000	67.00	Change EI of wall to 163970kN.m2/m run

Strut forces at each stage (horizontal components)

Stage no.	--- Strut no. 1 --- at elev. 66.84 kN/m run	kN/strut
8	1.83	1.83

Units: kN,m

Bending moment, shear force, displacement envelopes



Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side		Passive side	
1	68.70	2	WWGS	2	WWGS
2	57.60	3	Transitional WG	3	Transitional WG
3	55.60	4	Waitemata Group Rock	4	Waitemata Group Rock

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Fill	18.00	9000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	5.000d
2	WWGS	18.00	24000	0.500	OC (0.200)	0.285 (1.238)	4.288 (5.694)	7.000d
3	Transition-al WG	19.00	45000	0.470	OC (0.200)	0.262 (1.182)	4.845 (6.154)	12.00d
4	Waitemata Group Rock	19.00	150000	0.412	OC (0.200)	0.219 (1.075)	6.289 (7.279)	30.00d

Additional soil parameters associated with Ka and Kp

		--- parameters for Ka ---			--- parameters for Kp ---		
------- Soil type ------- No.	Description	Soil friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Fill	30.00	0.631	0.00	30.00	0.464	0.00
2	WWGS	30.00	0.631	0.00	30.00	0.464	0.00
3	Transitional WG	32.00	0.625	0.00	32.00	0.459	0.00
4	Waitemata Group Rock	36.00	0.613	0.00	36.00	0.447	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	64.50	64.50

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	62.65	62.65	0.0	1	62.65	62.65	0.0

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.75 m
Soldier Pile spacing = 1.50 m
Passive mobilisation factor = 3.00 m
Elevation of toe of wall = 57.70
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 3.1685E+07 kN/m2
Moment of inertia of wall I = 0.010350 m4/m run
E.I = 327940 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	65.50	1.00	0.036100	2.000E+08	8.00	0.00	0	No
2	66.84	1.00	0.125000	3.169E+07	4.00	0.00	0	Yes
3	Not defined							
4	63.45	1.00	0.125000	3.169E+07	0.10	0.00	0	No

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor/ Category
1	63.80	6.400	0	0	N/A

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	68.70	0.00(A)	50.00	10.00	15.60	=	N/A	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Change EI of wall to 1.0000E-04 kN.m2/m run Yield moment not defined No adjustments to wall displacements
2	Apply surcharge no.1 at elevation 68.70 No analysis at this stage
3	Change EI of wall to 327940 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
4	Apply water pressure profile no.1
5	Excavate to elevation 65.00 on PASSIVE side
6	Install strut or anchor no.1 at elevation 65.50
7	Change EI of wall to 229558 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value
8	Excavate to elevation 62.65 on PASSIVE side
9	Install strut or anchor no.2 at elevation 66.84
10	Remove strut or anchor no.1 at elevation 65.50
11	Change EI of wall to 163970 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Change EI of wall to 1.0000E-04kN.m2/m	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 68.70	No	No	No
3	Change EI of wall to 327940kN.m2/m run	No	No	No
4	Apply water pressure profile no.1	Yes	Yes	Yes
5	Excav. to elev. 65.00 on PASSIVE side	Yes	Yes	Yes
6	Install strut no.1 at elev. 65.50	No	No	No
7	Change EI of wall to 229558kN.m2/m run	Yes	Yes	Yes
8	Excav. to elev. 62.65 on PASSIVE side	No	No	No
9	Install strut no.2 at elev. 66.84	No	No	No
10	Remove strut no.1 at elev. 65.50	Yes	Yes	Yes
11	Change EI of wall to 163970kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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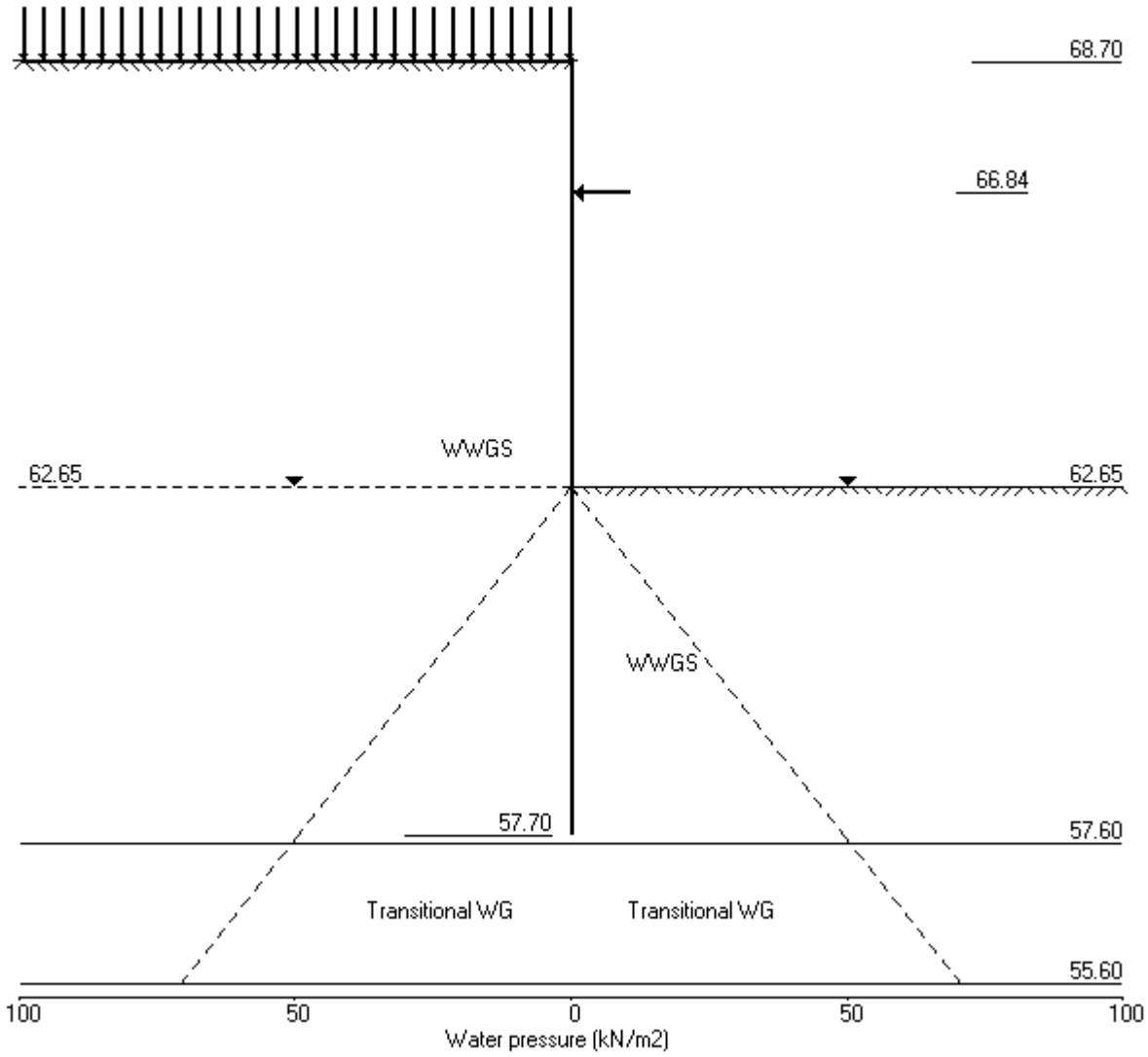
Units: kN,m

Stage No.11 Change EI of wall to 163970kN.m2/m run



Units: kN,m

Stage No. 1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 57.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
1	68.70	68.70	Cant.	Conditions not suitable for FoS calc.			

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall
Analysis options
Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	68.70	0.00	-0.000	3.940E-24	0.0	0.0		0
2	68.40	0.00	0.000	-7.88E-24	0.0	0.0		0
3	67.80	0.00	-0.000	3.940E-23	0.0	-0.0		0
4	67.32	0.00	0.000	-1.35E-22	0.0	0.0		0
5	66.84	0.00	-0.000	5.028E-22	0.0	-0.0		0
6	66.51	0.00	0.000	-1.61E-21	0.0	0.0		0
7	66.17	0.00	-0.000	5.949E-21	0.0	-0.0		0
8	65.84	0.00	0.000	-2.21E-20	0.0	0.0		0
9	65.50	0.00	-0.000	8.27E-20	0.0	-0.0		0
10	65.00	0.00	0.000	-3.79E-19	0.0	0.0		0
11	64.50	0.00	-0.000	1.43E-18	0.0	-0.0		0
12	64.05	0.00	0.000	-5.11E-18	0.0	0.0		0
13	63.60	0.00	-0.000	1.90E-17	0.0	-0.0		0
14	63.13	0.00	0.000	-7.27E-17	0.0	0.0		0
15	62.65	0.00	-0.000	2.72E-16	0.0	-0.0		0
16	62.23	0.00	0.000	-9.66E-16	0.0	0.0		0
17	61.80	0.00	0.000	-5.98E-15	0.0	0.0		0
18	61.20	0.00	0.000	-5.48E-15	0.0	-0.0		0
19	60.60	-0.00	0.000	-5.80E-17	-0.0	-0.0		0
20	60.00	0.00	0.000	5.71E-15	-0.0	-0.0		0
21	59.40	0.00	0.000	6.15E-15	-0.0	0.0		0
22	58.80	0.00	0.000	-6.92E-15	-0.0	0.0		0
23	58.25	0.00	0.000	-1.07E-14	-0.0	-0.0		0
24	57.70	0.00	0.000	-7.26E-15	-0.0	-0.0		---

(continued)

Stage No.1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

Node no.	Y coord	ACTIVE side						
			Effective stresses				Total	Soil
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	stiffness coeff.
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	0.00	0.00	39.86	0.00	0.00a	69695
2	68.40	0.00	5.40	0.00	63.01	2.70	2.70	63564
3	67.80	0.00	16.20	0.00	109.32	8.10	8.10	24471
4	67.32	0.00	24.84	0.00	146.37	12.42	12.42	33364
5	66.84	0.00	33.48	0.88	183.41	16.74	16.74	29986
6	66.51	0.00	39.51	2.60	209.27	19.75	19.75	40770
7	66.17	0.00	45.54	4.32	235.12	22.77	22.77	41817
8	65.84	0.00	51.57	6.04	260.98	25.78	25.78	36321
9	65.50	0.00	57.60	7.76	286.83	28.80	28.80	41353
10	65.00	0.00	66.60	10.33	325.42	33.30	33.30	30838
11	64.50	0.00	75.60	12.90	364.01	37.80	37.80	29326
12	64.05	4.50	79.20	13.92	379.45	39.60	44.10	31690
13	63.60	9.00	82.80	14.95	394.88	41.40	50.40	31956
14	63.13	13.75	86.60	16.03	411.17	43.30	57.05	33135
15	62.65	18.50	90.40	17.12	427.47	45.20	63.70	24471
16	62.23	22.75	93.80	18.09	442.05	46.90	69.65	4187
17	61.80	27.00	97.20	19.06	456.62	48.60	75.60	4187
18	61.20	33.00	102.00	20.42	477.21	51.00	84.00	4187
19	60.60	39.00	106.80	21.79	497.79	53.40	92.40	4187
20	60.00	45.00	111.60	23.16	518.37	55.80	100.80	4187
21	59.40	51.00	116.40	24.53	538.95	58.20	109.20	4187
22	58.80	57.00	121.20	25.90	559.53	60.60	117.60	4187
23	58.25	62.50	125.60	27.16	578.39	62.80	125.30	4187
24	57.70	68.00	130.00	28.41	597.26	65.00	133.00	4187

Node no.	Y coord	PASSIVE side						
			Effective stresses				Total	Soil
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	stiffness coeff.
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	0.00	0.00	39.86	0.00	0.00a	69695
2	68.40	0.00	5.40	0.00	63.01	2.70	2.70	63564
3	67.80	0.00	16.20	0.00	109.32	8.10	8.10	24471
4	67.32	0.00	24.84	0.00	146.37	12.42	12.42	33364
5	66.84	0.00	33.48	0.88	183.41	16.74	16.74	29986
6	66.51	0.00	39.51	2.60	209.27	19.75	19.75	40770
7	66.17	0.00	45.54	4.32	235.12	22.77	22.77	41817
8	65.84	0.00	51.57	6.04	260.98	25.78	25.78	36321
9	65.50	0.00	57.60	7.76	286.83	28.80	28.80	41353
10	65.00	0.00	66.60	10.33	325.42	33.30	33.30	30838
11	64.50	0.00	75.60	12.90	364.01	37.80	37.80	29326
12	64.05	4.50	79.20	13.92	379.45	39.60	44.10	31690
13	63.60	9.00	82.80	14.95	394.88	41.40	50.40	31956
14	63.13	13.75	86.60	16.03	411.17	43.30	57.05	33135
15	62.65	18.50	90.40	17.12	427.47	45.20	63.70	24471
16	62.23	22.75	93.80	18.09	442.05	46.90	69.65	4187
17	61.80	27.00	97.20	19.06	456.62	48.60	75.60	4187
18	61.20	33.00	102.00	20.42	477.21	51.00	84.00	4187
19	60.60	39.00	106.80	21.79	497.79	53.40	92.40	4187
20	60.00	45.00	111.60	23.16	518.37	55.80	100.80	4187
21	59.40	51.00	116.40	24.53	538.95	58.20	109.20	4187
22	58.80	57.00	121.20	25.90	559.53	60.60	117.60	4187

(continued)

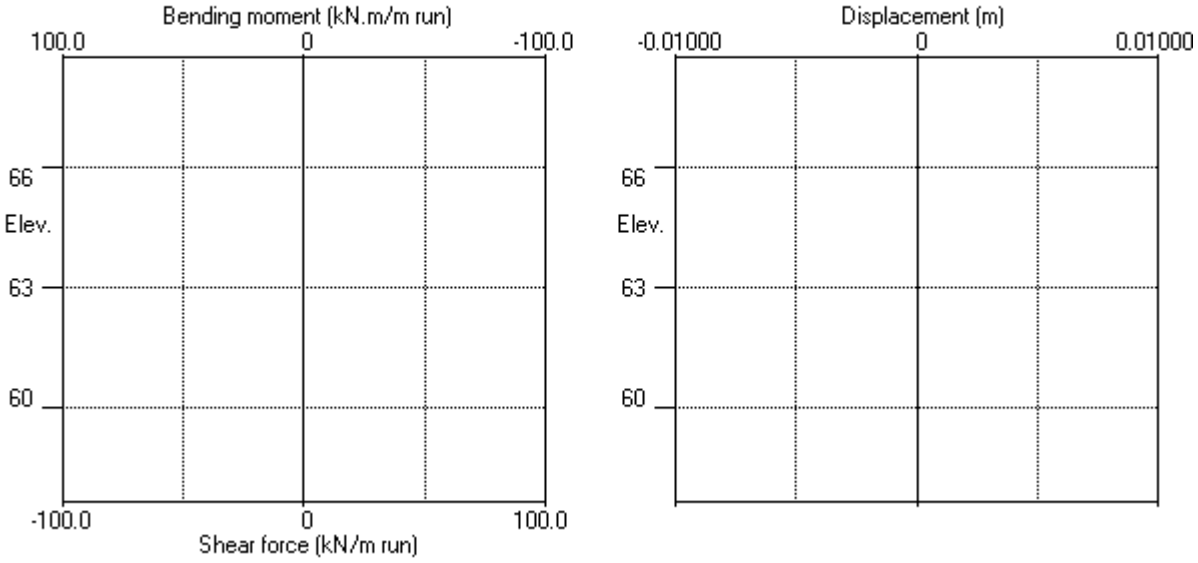
Stage No.1 Change EI of wall to 1.0000E-04 kN.m2/m run
Yield moment not defined
No adjustments to wall displacements

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
23	58.25	62.50	125.60	27.16	578.39	62.80	125.30	4187
24	57.70	68.00	130.00	28.41	597.26	65.00	133.00	4187

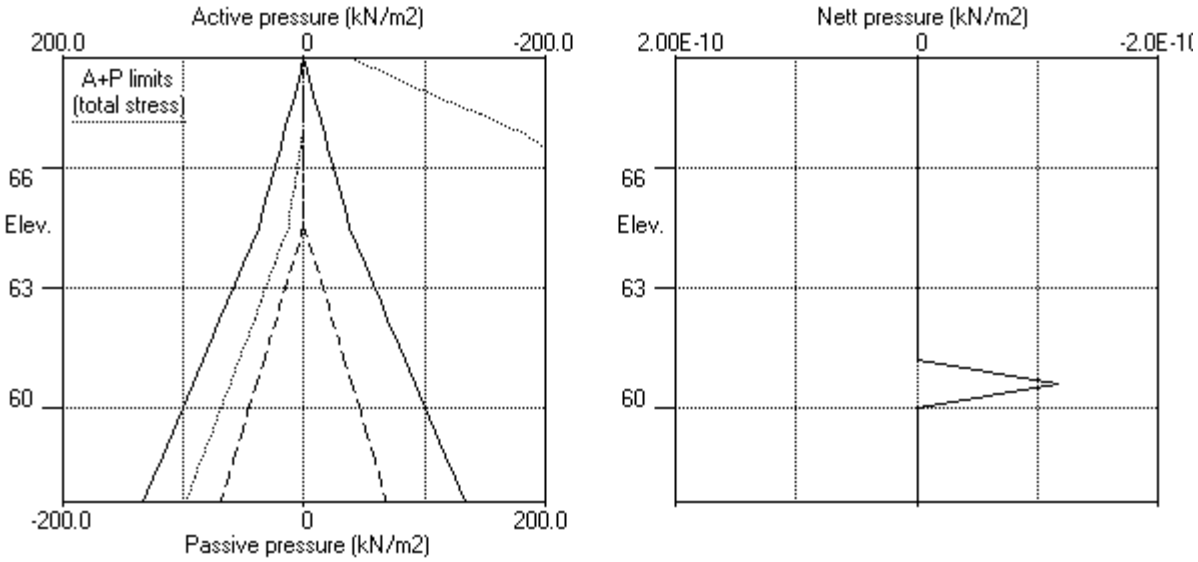
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Stage No.1 Change EI of wall to 1.0000E-04kN.m2/m run



Units: kN,m

Stage No. 4 Apply water pressure profile no.1

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 57.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
4	68.70	68.70	Cant.	Conditions not suitable for FoS calc.			

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	68.70	-0.13	0.001	1.43E-05	0.0	0.0		327940
2	68.40	-0.11	0.001	1.43E-05	-0.0	-0.0		327940
3	67.80	-0.07	0.001	1.43E-05	-0.1	-0.0		327940
4	67.32	-0.04	0.001	1.44E-05	-0.1	-0.1		327940
5	66.84	-0.01	0.001	1.46E-05	-0.1	-0.2		327940
6	66.51	0.00	0.001	1.48E-05	-0.1	-0.2		327940
7	66.17	0.02	0.001	1.50E-05	-0.1	-0.2		327940
8	65.84	0.03	0.001	1.53E-05	-0.1	-0.3		327940
9	65.50	0.04	0.001	1.56E-05	-0.1	-0.3		327940
10	65.00	0.05	0.001	1.61E-05	-0.1	-0.4		327940
11	64.50	0.06	0.001	1.67E-05	-0.1	-0.4		327940
12	64.05	0.06	0.001	1.72E-05	-0.0	-0.4		327940
13	63.60	0.06	0.001	1.78E-05	-0.0	-0.4		327940
14	63.13	0.06	0.001	1.84E-05	0.0	-0.4		327940
15	62.65	0.05	0.001	1.90E-05	0.1	-0.4		327940
16	62.23	0.05	0.001	1.95E-05	0.1	-0.4		327940
17	61.80	0.04	0.001	2.00E-05	0.1	-0.3		327940
18	61.20	0.02	0.001	2.06E-05	0.1	-0.3		327940
19	60.60	0.01	0.001	2.11E-05	0.1	-0.2		327940
20	60.00	-0.01	0.001	2.14E-05	0.1	-0.2		327940
21	59.40	-0.03	0.001	2.16E-05	0.1	-0.1		327940
22	58.80	-0.05	0.001	2.18E-05	0.1	-0.0		327940
23	58.25	-0.07	0.001	2.18E-05	0.0	-0.0		327940
24	57.70	-0.09	0.001	2.18E-05	0.0	0.0		---

(continued)

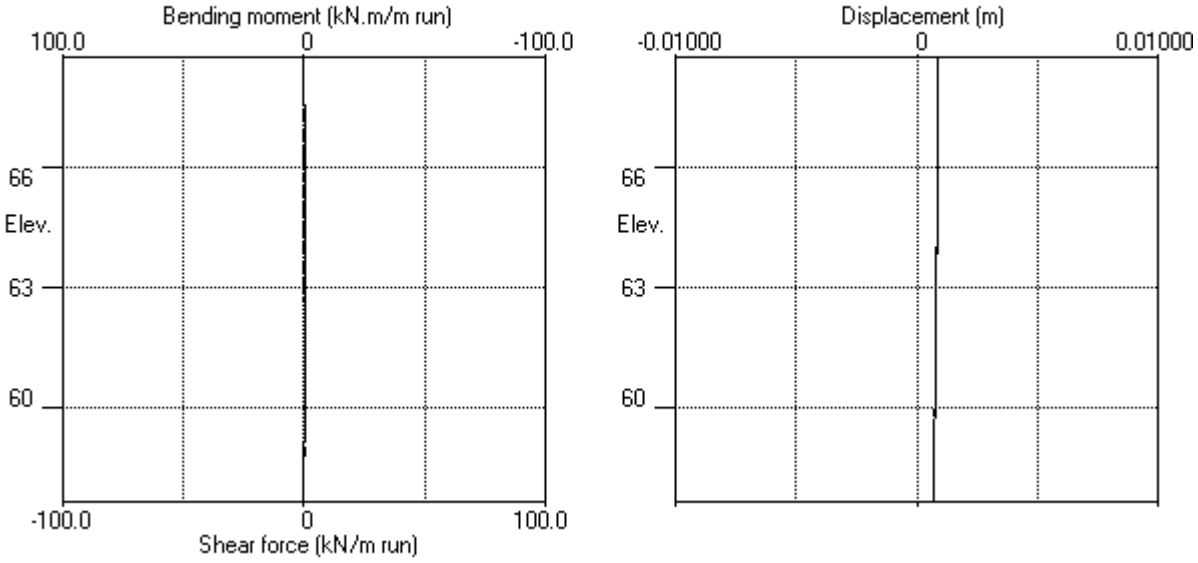
Stage No.4 Apply water pressure profile no.1

Node no.	Y coord	ACTIVE side: Water press. kN/m2	Effective stresses: Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	68.70	0.00	15.60	0.00	106.75	1.89	1.89	2276
2	68.40	0.00	21.00	0.00	129.90	4.60	4.60	2276
3	67.80	0.00	31.79	0.40	176.19	10.02	10.02	2276
4	67.32	0.00	40.42	2.86	213.18	14.35	14.35	2276
5	66.84	0.00	49.04	5.32	250.12	18.68	18.68	2276
6	66.51	0.00	55.04	7.03	275.86	21.70	21.70	2276
7	66.17	0.00	61.04	8.74	301.57	24.72	24.72	2276
8	65.84	0.00	67.02	10.45	327.24	27.73	27.73	2276
9	65.50	0.00	73.00	12.15	352.87	30.74	30.74	2276
10	65.00	0.00	81.90	14.69	391.04	35.24	35.24	2276
11	64.50	0.00	90.78	17.23	429.12	39.73	39.73	2276
12	64.05	0.00	98.76	19.50	463.30	42.64	42.64	2276
13	63.60	0.00	106.71	21.77	497.42	45.54	45.54	2276
14	63.13	0.00	115.09	24.16	533.35	48.61	48.61	2276
15	62.65	0.00	123.46	26.54	569.22	51.67	51.67	2276
16	62.23	4.25	126.68	27.46	583.03	53.35	57.60	2276
17	61.80	8.50	129.89	28.38	596.80	55.02	63.52	2276
18	61.20	14.50	134.41	29.67	616.18	57.38	71.88	2276
19	60.60	20.50	138.92	30.95	635.49	59.73	80.23	2276
20	60.00	26.50	143.41	32.24	654.76	62.08	88.58	2276
21	59.40	32.50	147.90	33.51	674.00	64.43	96.93	2276
22	58.80	38.50	152.38	34.79	693.22	66.78	105.28	2276
23	58.25	44.00	156.49	35.96	710.83	68.94	112.94	2276
24	57.70	49.50	160.59	37.14	728.44	71.09	120.59	2276

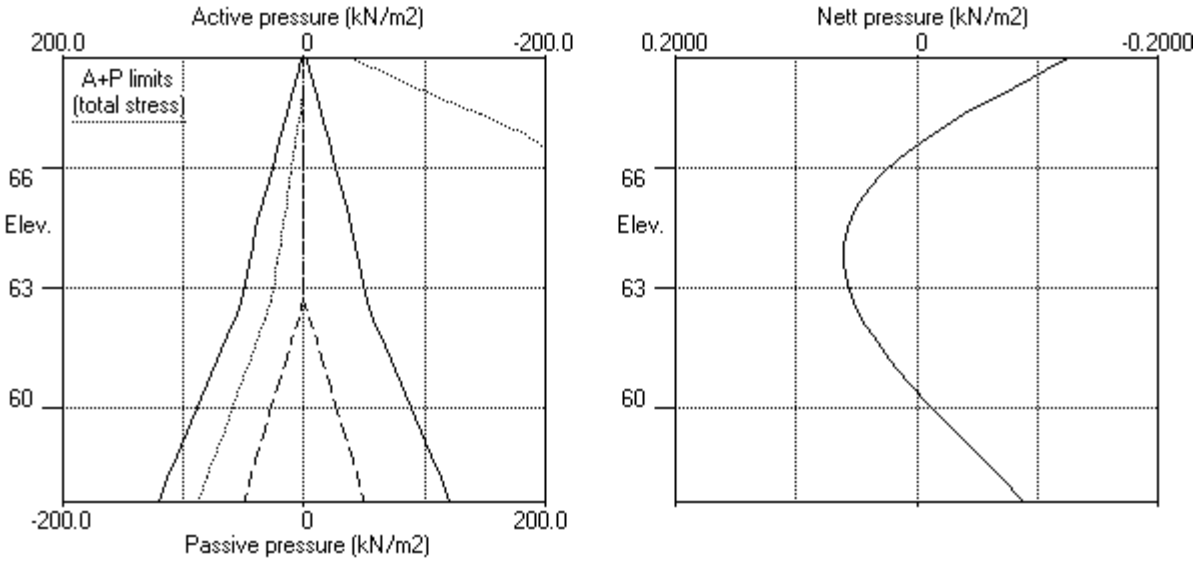
Node no.	Y coord	PASSIVE side: Water press. kN/m2	Effective stresses: Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	68.70	0.00	0.00	0.00	39.86	2.01	2.01	2276
2	68.40	0.00	5.40	0.00	63.01	4.70	4.70	2276
3	67.80	0.00	16.20	0.00	109.32	10.08	10.08	2276
4	67.32	0.00	24.84	0.00	146.37	14.39	14.39	2276
5	66.84	0.00	33.48	0.88	183.41	18.69	18.69	2276
6	66.51	0.00	39.51	2.60	209.27	21.70	21.70	2276
7	66.17	0.00	45.54	4.32	235.12	24.70	24.70	2276
8	65.84	0.00	51.57	6.04	260.98	27.70	27.70	2276
9	65.50	0.00	57.60	7.76	286.83	30.71	30.71	2276
10	65.00	0.00	66.60	10.33	325.42	35.19	35.19	2276
11	64.50	0.00	75.60	12.90	364.01	39.67	39.67	2276
12	64.05	0.00	83.70	15.21	398.74	42.58	42.58	2276
13	63.60	0.00	91.80	17.52	433.47	45.48	45.48	2276
14	63.13	0.00	100.35	19.95	470.13	48.55	48.55	2276
15	62.65	0.00	108.90	22.39	506.79	51.62	51.62	2276
16	62.23	4.25	112.30	23.36	521.37	53.30	57.55	2276
17	61.80	8.50	115.70	24.33	535.95	54.98	63.48	2276
18	61.20	14.50	120.50	25.70	556.53	57.35	71.85	2276
19	60.60	20.50	125.30	27.07	577.11	59.72	80.22	2276
20	60.00	26.50	130.10	28.44	597.69	62.10	88.60	2276
21	59.40	32.50	134.90	29.81	618.27	64.47	96.97	2276
22	58.80	38.50	139.70	31.18	638.85	66.84	105.34	2276
23	58.25	44.00	144.10	32.43	657.72	69.01	113.01	2276
24	57.70	49.50	148.50	33.69	676.58	71.18	120.68	2276

Units: kN,m

Stage No.4 Apply water pressure profile no.1



Stage No.4 Apply water pressure profile no.1



Units: kN,m

Stage No. 5 Excavate to elevation 65.00 on PASSIVE side

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 57.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
5	68.70	65.00	Cant.	2.038	58.45	61.09	3.91

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	68.70	0.00	0.009	8.54E-04	0.0	-0.0		327940
2	68.40	0.00	0.008	8.54E-04	0.0	-0.0		327940
3	67.80	0.40	0.008	8.54E-04	0.1	0.0		327940
4	67.32	2.86	0.008	8.53E-04	0.9	0.2		327940
5	66.84	5.32	0.007	8.53E-04	2.9	1.1		327940
6	66.51	7.03	0.007	8.51E-04	4.9	2.4		327940
7	66.17	8.74	0.007	8.47E-04	7.6	4.4		327940
8	65.84	10.45	0.006	8.41E-04	10.8	7.5		327940
9	65.50	13.02	0.006	8.31E-04	14.7	12.1		327940
10	65.00	18.90	0.006	8.06E-04	22.7	21.3		327940
		-17.68	0.006	8.06E-04	22.7	21.3		
11	64.50	-14.88	0.005	7.66E-04	14.6	30.4		327940
12	64.05	-12.50	0.005	7.21E-04	8.4	35.5		327940
13	63.60	-10.29	0.005	6.71E-04	3.3	38.0		327940
14	63.13	-8.14	0.004	6.16E-04	-1.1	38.4		327940
15	62.65	-6.19	0.004	5.61E-04	-4.5	36.9		327940
16	62.23	-4.60	0.004	5.15E-04	-6.8	34.5		327940
17	61.80	-3.16	0.004	4.72E-04	-8.4	31.1		327940
18	61.20	-1.34	0.003	4.20E-04	-9.8	25.5		327940
19	60.60	0.26	0.003	3.79E-04	-10.1	19.4		327940
20	60.00	1.70	0.003	3.49E-04	-9.5	13.4		327940
21	59.40	3.03	0.003	3.30E-04	-8.1	7.9		327940
22	58.80	4.28	0.002	3.19E-04	-5.9	3.6		327940
23	58.25	5.39	0.002	3.16E-04	-3.3	1.0		327940
24	57.70	6.48	0.002	3.15E-04	-0.0	0.0		---

(continued)

Stage No.5 Excavate to elevation 65.00 on PASSIVE side

Node no.	Y coord	ACTIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	15.60	0.00	106.75	0.00	0.00a	3445
2	68.40	0.00	21.00	0.00	129.90	0.00	0.00a	3445
3	67.80	0.00	31.79	0.40	176.19	0.40	0.40a	3445
4	67.32	0.00	40.42	2.86	213.18	2.86	2.86a	3445
5	66.84	0.00	49.04	5.32	250.12	5.32	5.32a	3445
6	66.51	0.00	55.04	7.03	275.86	7.03	7.03a	3445
7	66.17	0.00	61.04	8.74	301.57	8.74	8.74a	3445
8	65.84	0.00	67.02	10.45	327.24	10.45	10.45a	3445
9	65.50	0.00	73.00	12.15	352.87	13.02	13.02	3445
10	65.00	0.00	81.90	14.69	391.04	18.90	18.90	3445
11	64.50	0.00	90.78	17.23	429.12	24.72	24.72	3445
12	64.05	0.00	98.76	19.50	463.30	28.76	28.76	3445
13	63.60	0.00	106.71	21.77	497.42	32.72	32.72	3445
14	63.13	0.00	115.09	24.16	533.35	36.81	36.81	3445
15	62.65	0.00	123.46	26.54	569.22	40.80	40.80	3445
16	62.23	4.25	126.68	27.46	583.03	43.23	47.48	3445
17	61.80	8.50	129.89	28.38	596.80	45.60	54.10	3445
18	61.20	14.50	134.41	29.67	616.18	48.84	63.34	3445
19	60.60	20.50	138.92	30.95	635.49	51.97	72.47	3445
20	60.00	26.50	143.41	32.24	654.76	55.04	81.54	3445
21	59.40	32.50	147.90	33.51	674.00	58.04	90.54	3445
22	58.80	38.50	152.38	34.79	693.22	61.02	99.52	3445
23	58.25	44.00	156.49	35.96	710.83	63.73	107.73	3445
24	57.70	49.50	160.59	37.14	728.44	66.44	115.94	3445

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	67.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	67.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	66.51	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	65.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	36.58	36.58	3805
11	64.50	0.00	9.00	0.00	78.45	39.60	39.60	3805
12	64.05	0.00	17.10	0.00	113.19	41.26	41.26	3805
13	63.60	0.00	25.21	0.00	147.95	43.00	43.00	3805
14	63.13	0.00	33.77	0.97	184.67	44.95	44.95	3805
15	62.65	0.00	42.35	3.41	221.42	46.99	46.99	3805
16	62.23	4.25	45.77	4.39	236.12	47.84	52.09	3805
17	61.80	8.50	49.21	5.37	250.87	48.76	57.26	3805
18	61.20	14.50	54.09	6.76	271.76	50.18	64.68	3805
19	60.60	20.50	58.98	8.16	292.77	51.71	72.21	3805
20	60.00	26.50	63.91	9.56	313.89	53.33	79.83	3805
21	59.40	32.50	68.87	10.97	335.14	55.02	87.52	3805
22	58.80	38.50	73.85	12.40	356.52	56.74	95.24	3805
23	58.25	44.00	78.45	13.71	376.25	58.35	102.35	3805

(continued)

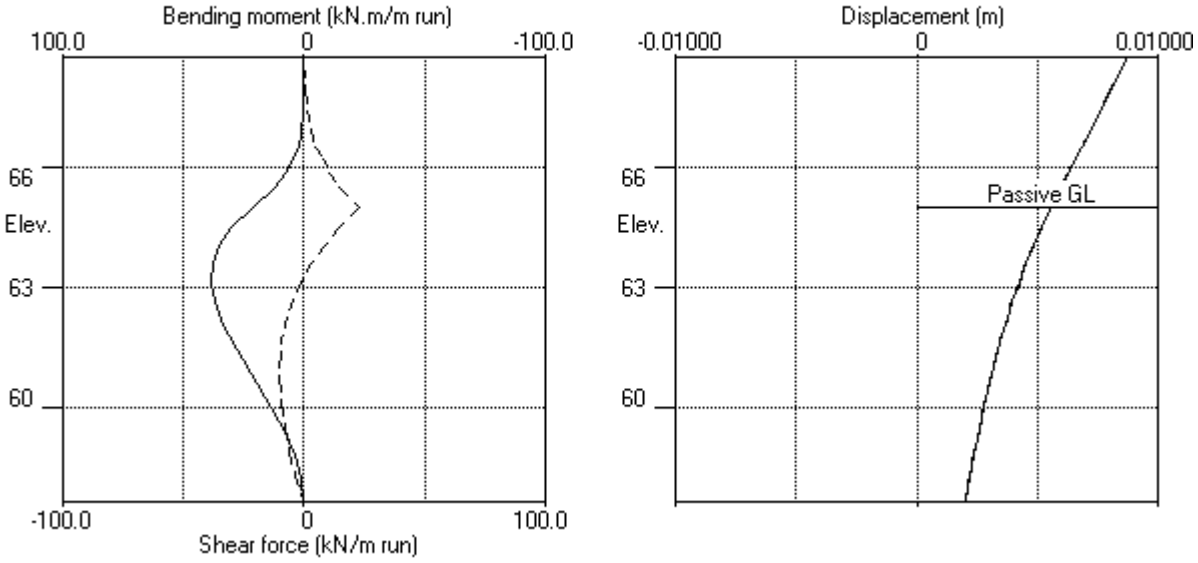
Stage No.5 Excavate to elevation 65.00 on PASSIVE side

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
24	57.70	49.50	83.08	15.03	396.09	59.96	109.46	3805

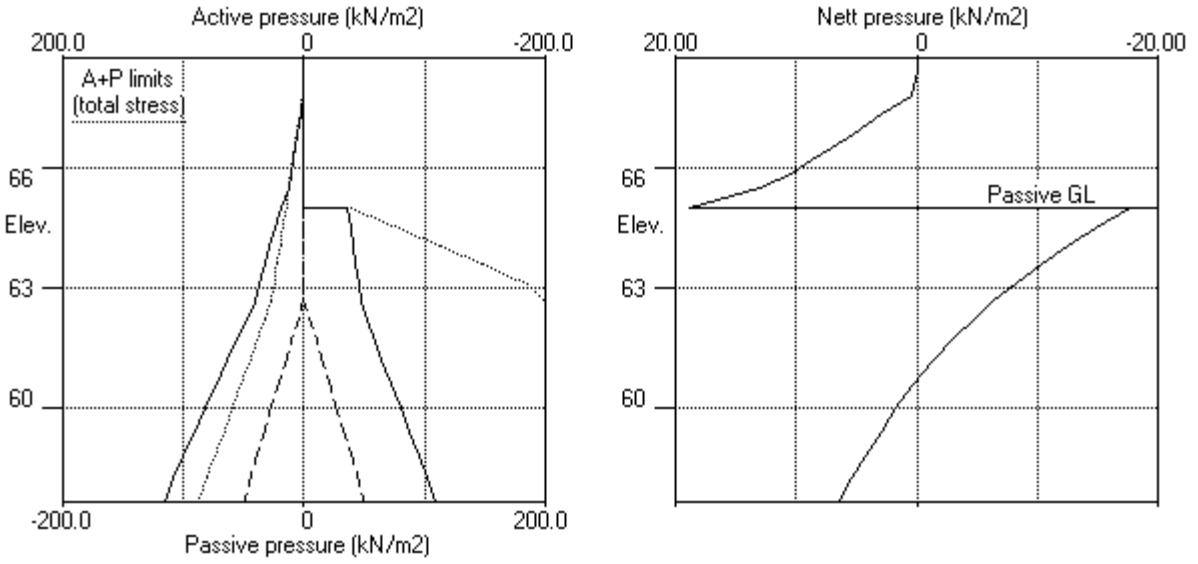
Note: 10.45a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 65.00 on PASSIVE side



Stage No.5 Excav. to elev. 65.00 on PASSIVE side



Units: kN,m

Stage No. 7 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 57.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
7	68.70	65.00	65.50	Conditions not suitable for FoS calc.			

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	68.70	0.00	0.009	9.45E-04	0.0	-0.0		229558
2	68.40	0.00	0.009	9.45E-04	0.0	-0.0		229558
3	67.80	0.40	0.008	9.45E-04	0.1	0.0		229558
4	67.32	2.86	0.008	9.44E-04	0.9	0.2		229558
5	66.84	5.32	0.007	9.43E-04	2.9	1.1		229558
6	66.51	7.03	0.007	9.41E-04	4.9	2.4		229558
7	66.17	8.74	0.007	9.36E-04	7.6	4.4		229558
8	65.84	10.45	0.006	9.27E-04	10.8	7.5		229558
9	65.50	13.01	0.006	9.13E-04	14.7	12.1	2.1	229558
		13.01	0.006	9.13E-04	12.6	12.1		
10	65.00	19.04	0.006	8.77E-04	20.6	20.5		229558
		-17.41	0.006	8.77E-04	20.6	20.5		
11	64.50	-14.36	0.005	8.25E-04	12.7	28.8		229558
12	64.05	-11.81	0.005	7.65E-04	6.8	33.3		229558
13	63.60	-9.47	0.004	6.99E-04	2.0	35.3		229558
14	63.13	-7.25	0.004	6.28E-04	-2.0	35.3		229558
15	62.65	-5.28	0.004	5.59E-04	-4.9	33.6		229558
16	62.23	-3.73	0.004	5.01E-04	-6.8	31.1		229558
17	61.80	-2.35	0.003	4.48E-04	-8.1	27.8		229558
18	61.20	-0.67	0.003	3.85E-04	-9.0	22.4		229558
19	60.60	0.76	0.003	3.36E-04	-9.0	16.7		229558
20	60.00	1.99	0.003	3.01E-04	-8.2	11.3		229558
21	59.40	3.12	0.003	2.79E-04	-6.7	6.5		229558
22	58.80	3.74	0.002	2.68E-04	-4.6	2.9		229558
23	58.25	4.18	0.002	2.64E-04	-2.4	0.8		229558
24	57.70	4.60	0.002	2.63E-04	-0.0	0.0		---

At elev. 65.50 Strut force = 2.1 kN/strut = 2.1 kN/m run

(continued)

Stage No.7 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	ACTIVE side						
		Effective stresses				Earth pressure	Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit			
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	15.60	0.00	106.75	0.00	0.00a	7137
2	68.40	0.00	21.00	0.00	129.90	0.00	0.00a	7137
3	67.80	0.00	31.79	0.40	176.19	0.40	0.40a	7137
4	67.32	0.00	40.42	2.86	213.18	2.86	2.86a	7137
5	66.84	0.00	49.04	5.32	250.12	5.32	5.32a	7137
6	66.51	0.00	55.04	7.03	275.86	7.03	7.03a	7137
7	66.17	0.00	61.04	8.74	301.57	8.74	8.74a	7137
8	65.84	0.00	67.02	10.45	327.24	10.45	10.45a	7137
9	65.50	0.00	73.00	12.15	352.87	13.01	13.01	7137
10	65.00	0.00	81.90	14.69	391.04	19.04	19.04	3782
11	64.50	0.00	90.78	17.23	429.12	24.98	24.98	3782
12	64.05	0.00	98.76	19.50	463.30	29.11	29.11	3782
13	63.60	0.00	106.71	21.77	497.42	33.13	33.13	3782
14	63.13	0.00	115.09	24.16	533.35	37.25	37.25	3782
15	62.65	0.00	123.46	26.54	569.22	41.25	41.25	3782
16	62.23	4.25	126.68	27.46	583.03	43.67	47.92	3782
17	61.80	8.50	129.89	28.38	596.80	46.01	54.51	3782
18	61.20	14.50	134.41	29.67	616.18	49.18	63.68	3782
19	60.60	20.50	138.92	30.95	635.49	52.22	72.72	3782
20	60.00	26.50	143.41	32.24	654.76	55.18	81.68	3782
21	59.40	32.50	147.90	33.51	674.00	58.09	90.59	5501
22	58.80	38.50	152.38	34.79	693.22	60.75	99.25	11830
23	58.25	44.00	156.49	35.96	710.83	63.13	107.13	11830
24	57.70	49.50	160.59	37.14	728.44	65.50	115.00	11830

Node no.	Y coord	PASSIVE side						
		Effective stresses				Earth pressure	Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit			
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	67.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	67.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	66.51	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	65.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	36.45	36.45	3782
11	64.50	0.00	9.00	0.00	78.45	39.34	39.34	3782
12	64.05	0.00	17.10	0.00	113.19	40.91	40.91	3782
13	63.60	0.00	25.21	0.00	147.95	42.60	42.60	3782
14	63.13	0.00	33.77	0.97	184.67	44.50	44.50	3782
15	62.65	0.00	42.35	3.41	221.42	46.54	46.54	3782
16	62.23	4.25	45.77	4.39	236.12	47.40	51.65	3782
17	61.80	8.50	49.21	5.37	250.87	48.35	56.85	3782
18	61.20	14.50	54.09	6.76	271.76	49.84	64.34	3782
19	60.60	20.50	58.98	8.16	292.77	51.46	71.96	3782
20	60.00	26.50	63.91	9.56	313.89	53.19	79.69	3782
21	59.40	32.50	68.87	10.97	335.14	54.97	87.47	5501

(continued)

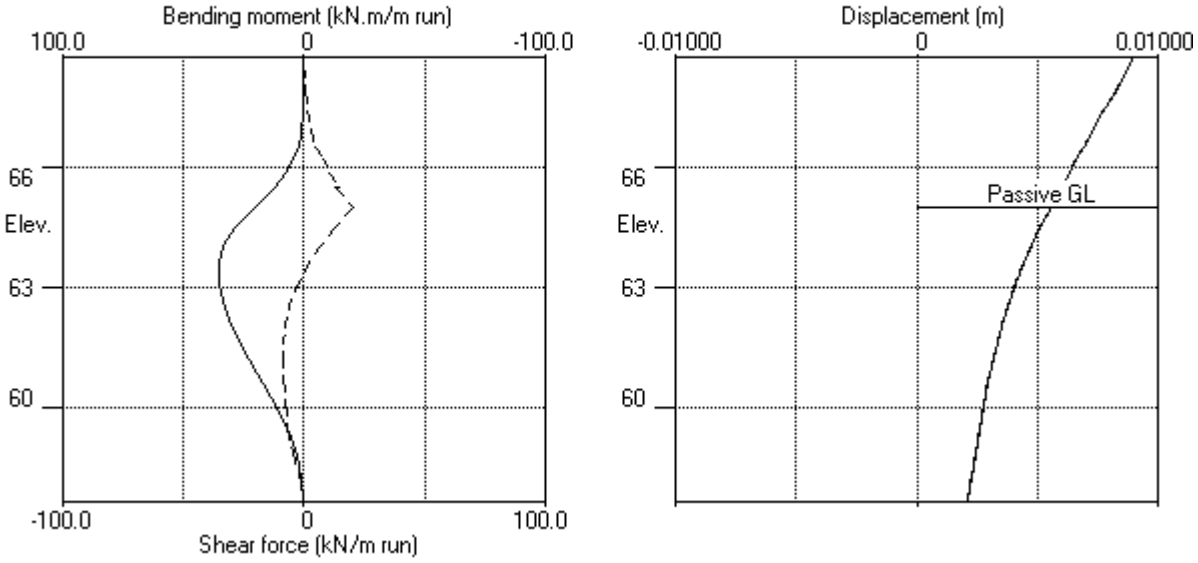
Stage No.7 Change EI of wall to 229558 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
22	58.80	38.50	73.85	12.40	356.52	57.01	95.51	11830
23	58.25	44.00	78.45	13.71	376.25	58.95	102.95	11830
24	57.70	49.50	83.08	15.03	396.09	60.90	110.40	11830

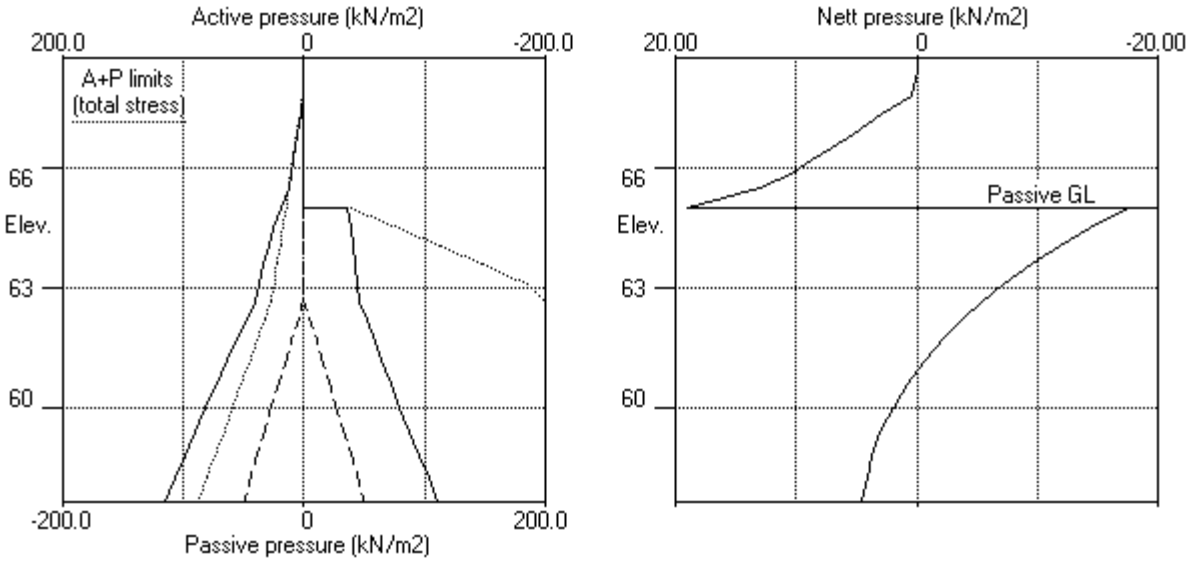
Note: 10.45a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change EI of wall to 229558kN.m2/m run



Stage No.7 Change EI of wall to 229558kN.m2/m run



Units: kN,m

Stage No. 8 Excavate to elevation 62.65 on PASSIVE side

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 57.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
8	68.70	62.65	65.50	1.767	n/a	59.37	3.28

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	68.70	11.97	0.007	4.34E-04	0.0	-0.0		229558
2	68.40	10.91	0.007	4.33E-04	3.4	0.5		229558
3	67.80	9.17	0.007	4.27E-04	9.5	4.6		229558
4	67.32	9.89	0.007	4.11E-04	14.0	10.3		229558
5	66.84	10.53	0.006	3.81E-04	18.9	18.2		229558
6	66.51	10.91	0.006	3.50E-04	22.5	25.2		229558
7	66.17	11.21	0.006	3.07E-04	26.2	33.4		229558
8	65.84	11.40	0.006	2.51E-04	30.0	42.8		229558
9	65.50	12.72	0.006	1.81E-04	34.1	53.9	90.5	229558
		12.72	0.006	1.81E-04	-56.5	53.9		
10	65.00	17.62	0.006	9.26E-05	-48.9	27.7		229558
11	64.50	22.41	0.006	5.69E-05	-38.9	5.8		229558
12	64.05	25.55	0.006	6.13E-05	-28.1	-9.2		229558
13	63.60	28.70	0.006	9.05E-05	-15.9	-19.1		229558
14	63.13	32.05	0.006	1.35E-04	-1.5	-23.2		229558
15	62.65	35.44	0.006	1.82E-04	14.6	-20.1		229558
		-4.42	0.006	1.82E-04	14.6	-20.1		
16	62.23	-6.51	0.006	2.16E-04	12.2	-14.2		229558
17	61.80	-5.79	0.006	2.40E-04	9.6	-9.6		229558
18	61.20	-4.71	0.005	2.61E-04	6.5	-4.9		229558
19	60.60	-3.62	0.005	2.73E-04	4.0	-2.0		229558
20	60.00	-2.53	0.005	2.78E-04	2.1	-0.5		229558
21	59.40	-1.43	0.005	2.80E-04	0.9	0.1		229558
22	58.80	-0.76	0.005	2.80E-04	0.3	0.2		229558
23	58.25	-0.26	0.005	2.80E-04	0.0	0.1		229558
24	57.70	0.23	0.004	2.80E-04	-0.0	0.0		---

At elev. 65.50 Strut force = 90.5 kN/strut = 90.5 kN/m run

(continued)

Stage No.8 Excavate to elevation 62.65 on PASSIVE side

Node no.	Y coord	ACTIVE side: Water press. kN/m2	Effective stresses: Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	68.70	0.00	15.60	0.00	106.75	11.97	11.97	6925
2	68.40	0.00	21.00	0.00	129.90	10.91	10.91	6925
3	67.80	0.00	31.79	0.40	176.19	9.17	9.17	6925
4	67.32	0.00	40.42	2.86	213.18	9.89	9.89	6925
5	66.84	0.00	49.04	5.32	250.12	10.53	10.53	6925
6	66.51	0.00	55.04	7.03	275.86	10.91	10.91	6925
7	66.17	0.00	61.04	8.74	301.57	11.21	11.21	6925
8	65.84	0.00	67.02	10.45	327.24	11.40	11.40	6925
9	65.50	0.00	73.00	12.15	352.87	12.72	12.72	2953
10	65.00	0.00	81.90	14.69	391.04	17.62	17.62	2953
11	64.50	0.00	90.78	17.23	429.12	22.41	22.41	2953
12	64.05	0.00	98.76	19.50	463.30	25.55	25.55	2953
13	63.60	0.00	106.71	21.77	497.42	28.70	28.70	2953
14	63.13	0.00	115.09	24.16	533.35	32.05	32.05	2953
15	62.65	0.00	123.46	26.54	569.22	35.44	35.44	2953
16	62.23	4.25	126.68	27.46	583.03	37.45	41.70	2953
17	61.80	8.50	129.89	28.38	596.80	39.48	47.98	2953
18	61.20	14.50	134.41	29.67	616.18	42.35	56.85	2953
19	60.60	20.50	138.92	30.95	635.49	45.24	65.74	2953
20	60.00	26.50	143.41	32.24	654.76	48.12	74.62	2953
21	59.40	32.50	147.90	33.51	674.00	51.01	83.51	2953
22	58.80	38.50	152.38	34.79	693.22	53.69	92.19	2953
23	58.25	44.00	156.49	35.96	710.83	56.09	100.09	2953
24	57.70	49.50	160.59	37.14	728.44	58.49	107.99	2953

Node no.	Y coord	PASSIVE side: Water press. kN/m2	Effective stresses: Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	68.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	67.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	67.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	66.51	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	65.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	64.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	63.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	63.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	3395
16	62.23	4.25	3.40	0.00	54.44	43.96	48.21	3395
17	61.80	8.50	6.80	0.00	69.03	45.26	53.76	3395
18	61.20	14.50	11.62	0.00	89.67	47.07	61.57	3395
19	60.60	20.50	16.45	0.00	110.39	48.86	69.36	3395
20	60.00	26.50	21.31	0.00	131.21	50.65	77.15	3395
21	59.40	32.50	26.19	0.00	152.17	52.44	84.94	3395
22	58.80	38.50	31.12	0.21	173.27	54.45	92.95	3395
23	58.25	44.00	35.66	1.51	192.78	56.35	100.35	3395

(continued)

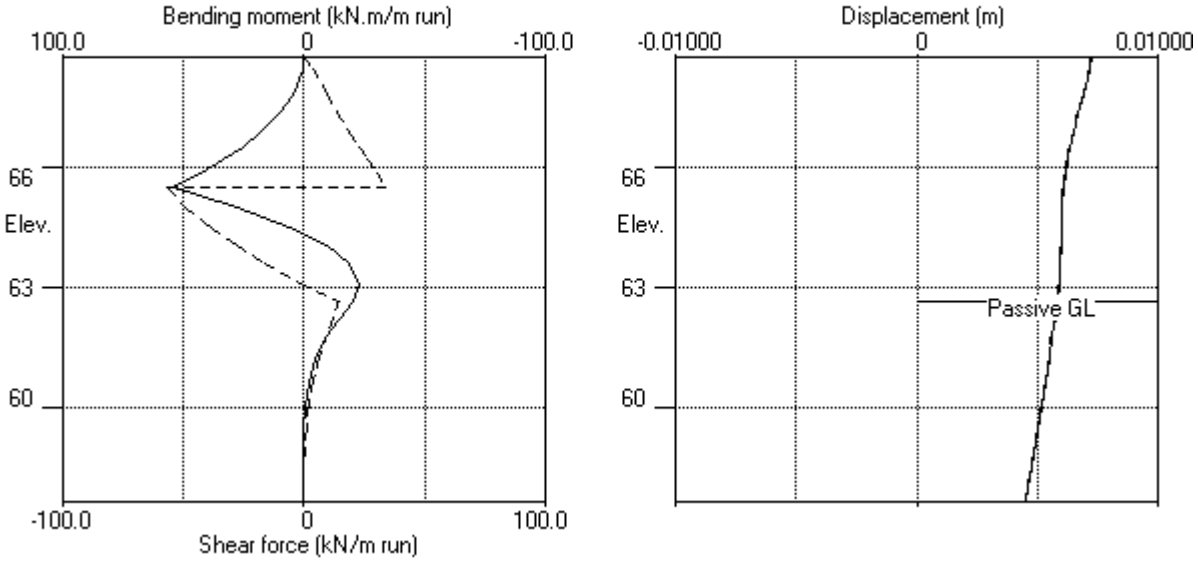
Stage No.8 Excavate to elevation 62.65 on PASSIVE side

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
24	57.70	49.50	40.25	2.81	212.45	58.26	107.76	3395

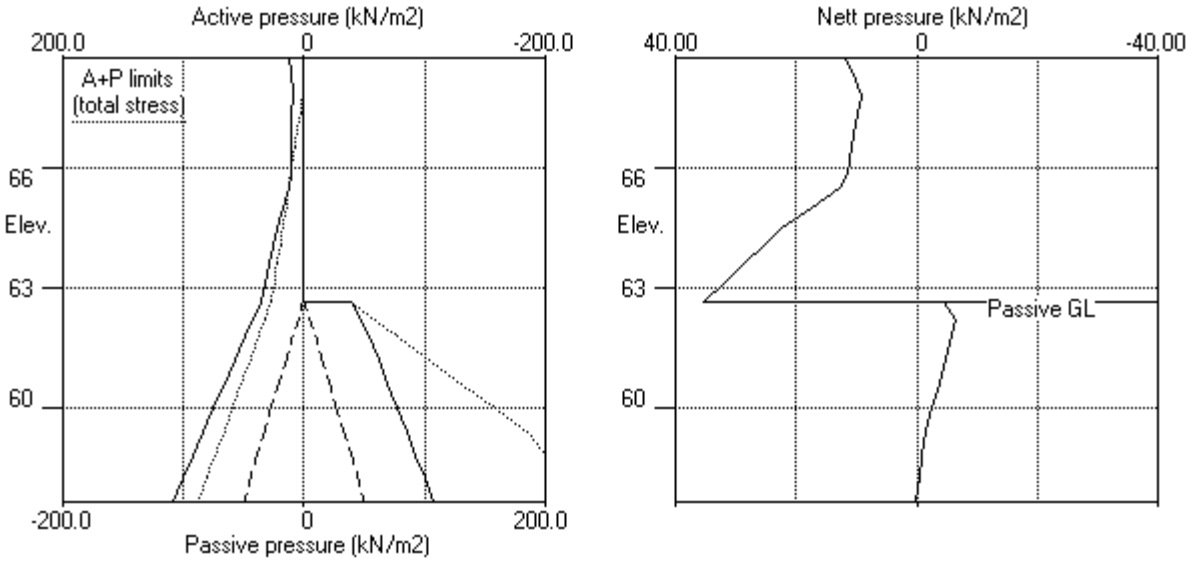
Note: 12.34a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.8 Excav. to elev. 62.65 on PASSIVE side



Stage No.8 Excav. to elev. 62.65 on PASSIVE side



Units: kN,m

Stage No. 10 Remove strut or anchor no.1 at elevation 65.50

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 57.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
10	68.70	62.65	66.84	1.677	n/a	58.83	3.82

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	68.70	22.41	0.006	-1.04E-04	0.0	-0.0		229558
2	68.40	19.57	0.006	-1.04E-04	6.3	1.0		229558
3	67.80	14.25	0.006	-1.17E-04	16.4	8.3		229558
4	67.32	12.06	0.006	-1.44E-04	22.8	18.0		229558
5	66.84	10.29	0.007	-1.95E-04	28.1	30.4	74.3	229558
		10.29	0.007	-1.95E-04	-46.2	30.4		
6	66.51	10.03	0.007	-2.28E-04	-42.8	15.5		229558
7	66.17	9.72	0.007	-2.41E-04	-39.5	1.8		229558
8	65.84	10.45	0.007	-2.34E-04	-36.1	-10.9		229558
9	65.50	12.15	0.007	-2.10E-04	-32.3	-22.0		229558
10	65.00	14.69	0.007	-1.46E-04	-25.6	-36.3		229558
11	64.50	19.08	0.007	-5.53E-05	-17.2	-46.8		229558
12	64.05	22.13	0.007	4.29E-05	-7.9	-52.4		229558
13	63.60	25.31	0.007	1.48E-04	2.8	-53.5		229558
14	63.13	28.80	0.007	2.56E-04	15.6	-49.1		229558
15	62.65	32.42	0.007	3.48E-04	30.2	-38.3		229558
		-7.44	0.007	3.48E-04	30.2	-38.3		
16	62.23	-14.09	0.007	4.09E-04	25.6	-26.0		229558
17	61.80	-12.60	0.006	4.50E-04	19.9	-16.4		229558
18	61.20	-10.37	0.006	4.83E-04	13.0	-6.8		229558
19	60.60	-8.10	0.006	4.95E-04	7.5	-0.9		229558
20	60.00	-5.84	0.006	4.96E-04	3.3	1.9		229558
21	59.40	-3.59	0.005	4.91E-04	0.5	2.7		229558
22	58.80	-1.82	0.005	4.86E-04	-1.1	2.1		229558
23	58.25	-0.32	0.005	4.82E-04	-1.7	1.1		229558
24	57.70	6.56	0.004	4.81E-04	-0.0	0.0		---

At elev. 66.84 Strut force = 74.3 kN/strut = 74.3 kN/m run

(continued)

Stage No.10 Remove strut or anchor no.1 at elevation 65.50

Node no.	Y coord	ACTIVE side: Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	68.70	0.00	15.60	0.00	106.75	22.41	22.41	11036
2	68.40	0.00	21.00	0.00	129.90	19.57	19.57	11036
3	67.80	0.00	31.79	0.40	176.19	14.25	14.25	11036
4	67.32	0.00	40.42	2.86	213.18	12.06	12.06	11036
5	66.84	0.00	49.04	5.32	250.12	10.29	10.29	3243
6	66.51	0.00	55.04	7.03	275.86	10.03	10.03	3243
7	66.17	0.00	61.04	8.74	301.57	9.72	9.72	3243
8	65.84	0.00	67.02	10.45	327.24	10.45	10.45a	3243
9	65.50	0.00	73.00	12.15	352.87	12.15	12.15a	3243
10	65.00	0.00	81.90	14.69	391.04	14.69	14.69a	3243
11	64.50	0.00	90.78	17.23	429.12	19.08	19.08	3243
12	64.05	0.00	98.76	19.50	463.30	22.13	22.13	3243
13	63.60	0.00	106.71	21.77	497.42	25.31	25.31	3243
14	63.13	0.00	115.09	24.16	533.35	28.80	28.80	3243
15	62.65	0.00	123.46	26.54	569.22	32.42	32.42	3243
16	62.23	4.25	126.68	27.46	583.03	34.67	38.92	3243
17	61.80	8.50	129.89	28.38	596.80	36.98	45.48	3243
18	61.20	14.50	134.41	29.67	616.18	40.28	54.78	3243
19	60.60	20.50	138.92	30.95	635.49	43.60	64.10	3243
20	60.00	26.50	143.41	32.24	654.76	46.91	73.41	3243
21	59.40	32.50	147.90	33.51	674.00	50.22	82.72	3243
22	58.80	38.50	152.38	34.79	693.22	53.30	91.80	3243
23	58.25	44.00	156.49	35.96	710.83	56.07	100.07	3243
24	57.70	49.50	160.59	37.14	728.44	61.65	111.15	30657

Node no.	Y coord	PASSIVE side: Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	68.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	67.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	67.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	66.51	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	65.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	64.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	63.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	63.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	5606
16	62.23	4.25	3.40	0.00	54.44	48.76	53.01	5606
17	61.80	8.50	6.80	0.00	69.03	49.58	58.08	5606
18	61.20	14.50	11.62	0.00	89.67	50.65	65.15	5606
19	60.60	20.50	16.45	0.00	110.39	51.70	72.20	5606
20	60.00	26.50	21.31	0.00	131.21	52.75	79.25	5606
21	59.40	32.50	26.19	0.00	152.17	53.81	86.31	5606
22	58.80	38.50	31.12	0.21	173.27	55.12	93.62	5606
23	58.25	44.00	35.66	1.51	192.78	56.39	100.39	5606

(continued)

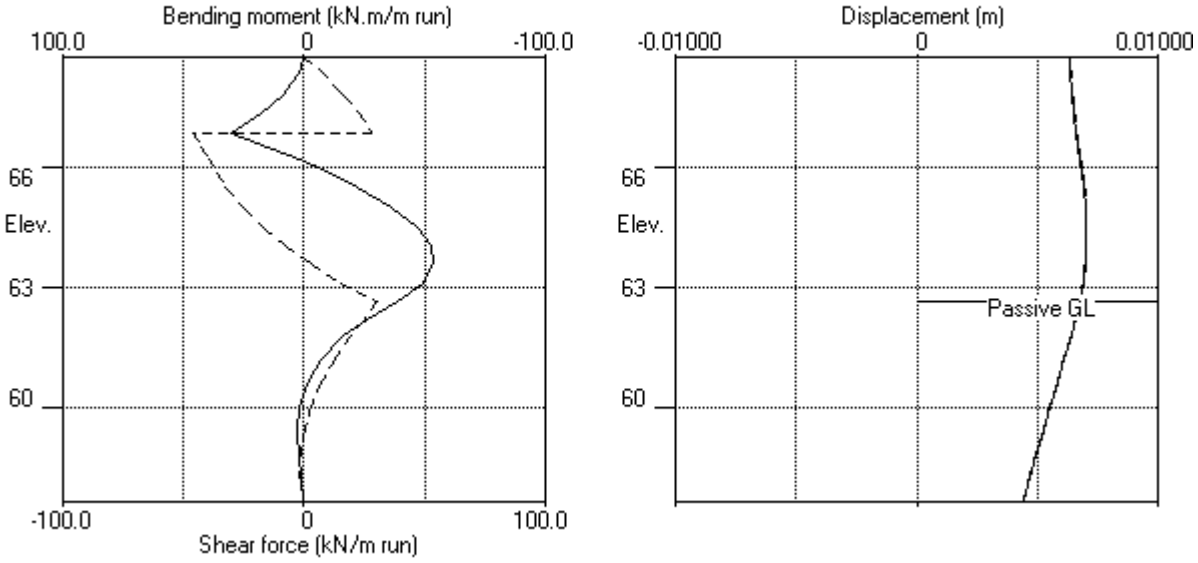
Stage No.10 Remove strut or anchor no.1 at elevation 65.50

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
24	57.70	49.50	40.25	2.81	212.45	55.09	104.59	30657

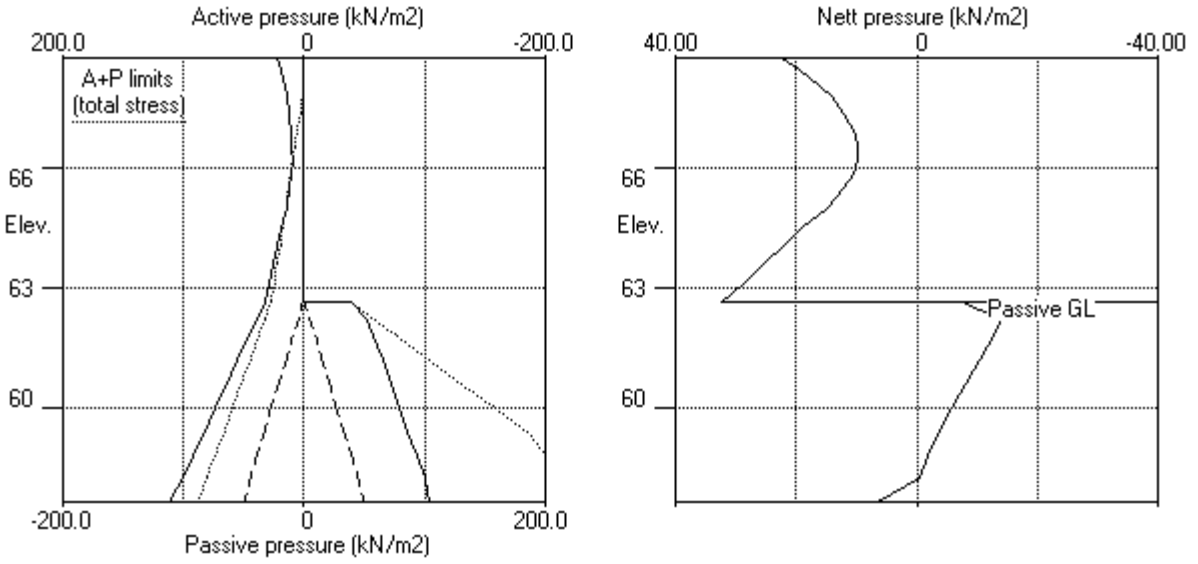
Note: 14.69a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.10 Remove strut no.1 at elev. 65.50



Stage No.10 Remove strut no.1 at elev. 65.50



Units: kN,m

Stage No. 11 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

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11	68.70	62.65	66.84	1.677	n/a	58.83	3.82

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall
Analysis options
Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

*** 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	Strut forces kN/m	EI of wall kN.m2/m
1	68.70	22.95	0.006	-1.25E-04	0.0	-0.0		163970
2	68.40	20.05	0.006	-1.26E-04	6.4	1.0		163970
3	67.80	14.61	0.006	-1.44E-04	16.8	8.5		163970
4	67.32	12.28	0.006	-1.83E-04	23.3	18.3		163970
5	66.84	10.30	0.007	-2.56E-04	28.7	30.9	73.2	163970
		10.30	0.007	-2.56E-04	-44.5	30.9		
6	66.51	9.95	0.007	-3.05E-04	-41.1	16.5		163970
7	66.17	9.52	0.007	-3.25E-04	-37.9	3.2		163970
8	65.84	10.45	0.007	-3.20E-04	-34.5	-9.1		163970
9	65.50	12.15	0.007	-2.92E-04	-30.7	-19.8		163970
10	65.00	14.69	0.007	-2.13E-04	-24.0	-33.5		163970
11	64.50	18.41	0.007	-9.75E-05	-15.8	-43.5		163970
12	64.05	21.40	0.007	2.71E-05	-6.8	-48.6		163970
13	63.60	24.58	0.007	1.60E-04	3.5	-49.4		163970
14	63.13	28.12	0.007	2.95E-04	16.1	-44.9		163970
15	62.65	31.83	0.007	4.07E-04	30.3	-34.0		163970
		-8.03	0.007	4.07E-04	30.3	-34.0		
16	62.23	-15.70	0.007	4.78E-04	25.3	-21.7		163970
17	61.80	-13.82	0.006	5.21E-04	19.0	-12.3		163970
18	61.20	-11.05	0.006	5.48E-04	11.5	-3.3		163970
19	60.60	-8.29	0.006	5.50E-04	5.7	1.7		163970
20	60.00	-5.62	0.005	5.40E-04	1.5	3.8		163970
21	59.40	-3.04	0.005	5.26E-04	-1.1	3.8		163970
22	58.80	-0.99	0.005	5.14E-04	-2.3	2.6		163970
23	58.25	0.71	0.005	5.08E-04	-2.3	1.2		163970
24	57.70	7.80	0.004	5.06E-04	-0.0	0.0		---

At elev. 66.84 Strut force = 73.2 kN/strut = 73.2 kN/m run

(continued)

Stage No.11 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	ACTIVE side						
		Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	15.60	0.00	106.75	22.95	22.95	8749
2	68.40	0.00	21.00	0.00	129.90	20.05	20.05	8749
3	67.80	0.00	31.79	0.40	176.19	14.61	14.61	8749
4	67.32	0.00	40.42	2.86	213.18	12.28	12.28	8749
5	66.84	0.00	49.04	5.32	250.12	10.30	10.30	8749
6	66.51	0.00	55.04	7.03	275.86	9.95	9.95	3942
7	66.17	0.00	61.04	8.74	301.57	9.52	9.52	3942
8	65.84	0.00	67.02	10.45	327.24	10.45	10.45a	3942
9	65.50	0.00	73.00	12.15	352.87	12.15	12.15a	3942
10	65.00	0.00	81.90	14.69	391.04	14.69	14.69a	3942
11	64.50	0.00	90.78	17.23	429.12	18.41	18.41	3942
12	64.05	0.00	98.76	19.50	463.30	21.40	21.40	3942
13	63.60	0.00	106.71	21.77	497.42	24.58	24.58	3942
14	63.13	0.00	115.09	24.16	533.35	28.12	28.12	3942
15	62.65	0.00	123.46	26.54	569.22	31.83	31.83	3942
16	62.23	4.25	126.68	27.46	583.03	34.19	38.44	3942
17	61.80	8.50	129.89	28.38	596.80	36.62	45.12	3942
18	61.20	14.50	134.41	29.67	616.18	40.08	54.58	3942
19	60.60	20.50	138.92	30.95	635.49	43.54	64.04	3942
20	60.00	26.50	143.41	32.24	654.76	47.02	73.52	7257
21	59.40	32.50	147.90	33.51	674.00	50.50	83.00	7257
22	58.80	38.50	152.38	34.79	693.22	53.71	92.21	7257
23	58.25	44.00	156.49	35.96	710.83	56.58	100.58	7257
24	57.70	49.50	160.59	37.14	728.44	62.27	111.77	7257

Node no.	Y coord	PASSIVE side						
		Effective stresses				Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	68.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	68.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	67.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	67.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	66.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	66.51	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	66.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	65.84	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	65.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	65.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	64.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	64.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	63.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	63.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	62.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	39.86	39.86	39.86p	9277
16	62.23	4.25	3.40	0.00	54.44	49.89	54.14	9277
17	61.80	8.50	6.80	0.00	69.03	50.43	58.93	9277
18	61.20	14.50	11.62	0.00	89.67	51.13	65.63	9277
19	60.60	20.50	16.45	0.00	110.39	51.83	72.33	9277
20	60.00	26.50	21.31	0.00	131.21	52.64	79.14	7257
21	59.40	32.50	26.19	0.00	152.17	53.53	86.03	7257

(continued)

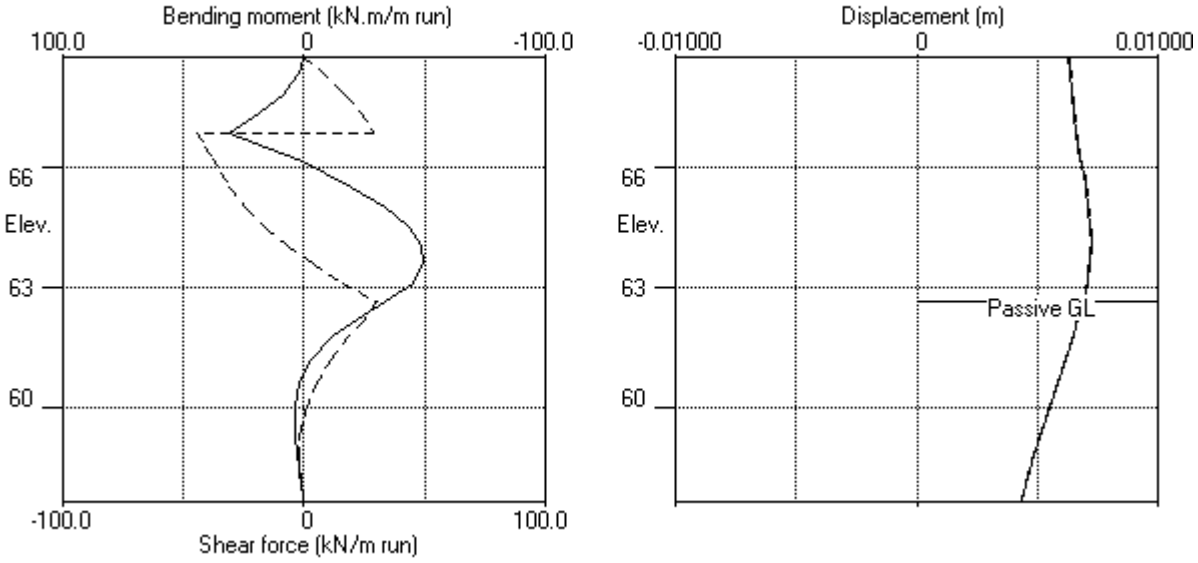
Stage No.11 Change EI of wall to 163970 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	PASSIVE side						
		Effective stresses					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
22	58.80	38.50	31.12	0.21	173.27	54.70	93.20	7257
23	58.25	44.00	35.66	1.51	192.78	55.87	99.87	7257
24	57.70	49.50	40.25	2.81	212.45	54.48	103.98	7257

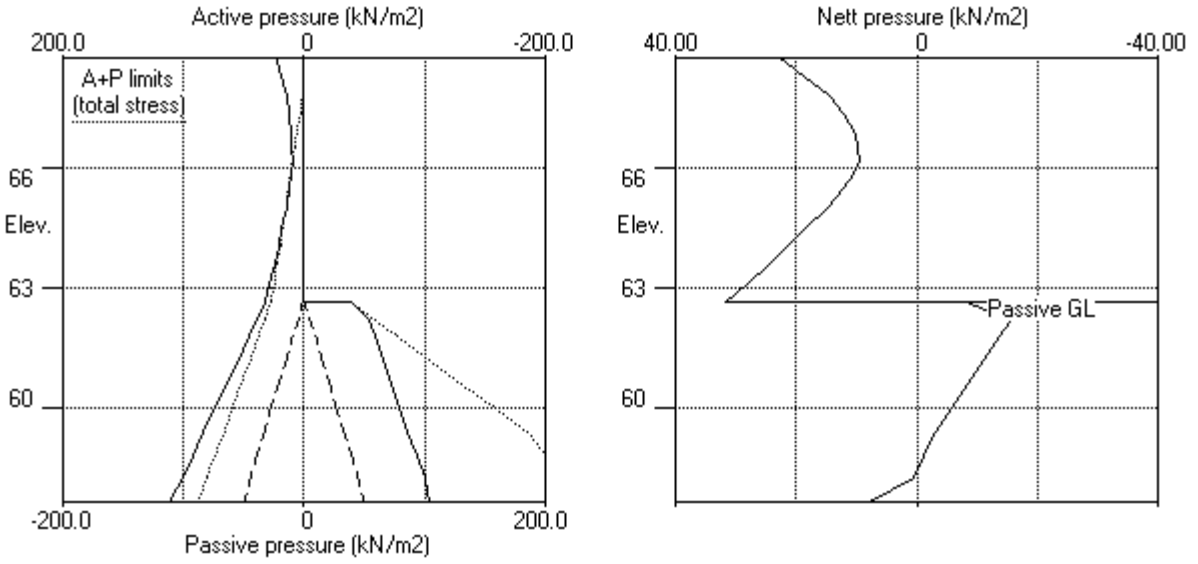
Note: 14.69a Soil pressure at active limit
39.86p Soil pressure at passive limit

Units: kN,m

Stage No.11 Change EI of wall to 163970kN.m2/m run



Stage No.11 Change EI of wall to 163970kN.m2/m run



Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 57.70: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500: Toe elev.	Wall Penetr -ation
1	68.70	68.70	Cant.	Conditions not suitable for FoS calc.			
2	68.70	68.70		No analysis at this stage			
3	68.70	68.70		No analysis at this stage			
4	68.70	68.70	Cant.	Conditions not suitable for FoS calc.			
5	68.70	65.00	Cant.	2.038	58.45	61.09	3.91
6	68.70	65.00		No analysis at this stage			
7	68.70	65.00	65.50	Conditions not suitable for FoS calc.			
8	68.70	62.65	65.50	1.767	n/a	59.37	3.28
9	68.70	62.65		No analysis at this stage			
10	68.70	62.65	66.84	1.677	n/a	58.83	3.82
11	68.70	62.65	66.84	1.677	n/a	58.83	3.82

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.75m; spacing = 1.50m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	68.70	0.009	0.000	0.0	-0.0	0.0	0.0
2	68.40	0.009	0.000	1.0	-0.0	6.4	-0.0
3	67.80	0.008	0.000	8.5	-0.0	16.8	-0.1
4	67.32	0.008	0.000	18.3	-0.1	23.3	-0.1
5	66.84	0.007	0.000	30.9	-0.2	28.7	-46.2
6	66.51	0.007	0.000	25.2	-0.2	22.5	-42.8
7	66.17	0.007	0.000	33.4	-0.2	26.2	-39.5
8	65.84	0.007	0.000	42.8	-10.9	30.0	-36.1
9	65.50	0.007	0.000	53.9	-22.0	34.1	-56.5
10	65.00	0.007	0.000	27.7	-36.3	22.7	-48.9
11	64.50	0.007	0.000	30.4	-46.8	14.6	-38.9
12	64.05	0.007	0.000	35.5	-52.4	8.4	-28.1
13	63.60	0.007	0.000	38.0	-53.5	3.5	-15.9
14	63.13	0.007	0.000	38.4	-49.1	16.1	-2.0
15	62.65	0.007	0.000	36.9	-38.3	30.3	-4.9
16	62.23	0.007	0.000	34.5	-26.0	25.6	-6.8
17	61.80	0.006	0.000	31.1	-16.4	19.9	-8.4
18	61.20	0.006	0.000	25.5	-6.8	13.0	-9.8
19	60.60	0.006	0.000	19.4	-2.0	7.5	-10.1
20	60.00	0.006	0.000	13.4	-0.5	3.3	-9.5
21	59.40	0.005	0.000	7.9	-0.1	0.9	-8.1
22	58.80	0.005	0.000	3.6	-0.0	0.3	-5.9
23	58.25	0.005	0.000	1.2	-0.0	0.0	-3.3
24	57.70	0.004	0.000	0.0	-0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	Bending moment elev.	Bending moment minimum kN.m/m	Bending moment elev.	Shear force maximum kN/m	Shear force elev.	Shear force minimum kN/m	Shear force elev.
1	0.0	58.80	-0.0	60.00	0.0	68.40	-0.0	60.00
2	No calculation at this stage							
3	No calculation at this stage							
4	0.0	68.70	-0.4	63.60	0.1	60.60	-0.1	66.51
5	38.4	63.13	-0.0	68.40	22.7	65.00	-10.1	60.60
6	No calculation at this stage							
7	35.3	63.13	-0.0	68.40	20.6	65.00	-9.0	61.20
8	53.9	65.50	-23.2	63.13	34.1	65.50	-56.5	65.50
9	No calculation at this stage							
10	30.4	66.84	-53.5	63.60	30.2	62.65	-46.2	66.84
11	30.9	66.84	-49.4	63.60	30.3	62.65	-44.5	66.84

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	minimum	elev.	Stage description
	m		m		
1	0.000	57.70	-0.000	62.65	Change EI of wall to 1.0000E-04kN.m2/m run
2	No calculation at this stage				Apply surcharge no.1 at elev. 68.70
3	Wall displacements reset to zero				Change EI of wall to 327940kN.m2/m run
4	0.001	68.70	0.000	68.70	Apply water pressure profile no.1
5	0.009	68.70	0.000	68.70	Excav. to elev. 65.00 on PASSIVE side
6	No calculation at this stage				Install strut no.1 at elev. 65.50
7	0.009	68.70	0.000	68.70	Change EI of wall to 229558kN.m2/m run
8	0.007	68.70	0.000	68.70	Excav. to elev. 62.65 on PASSIVE side
9	No calculation at this stage				Install strut no.2 at elev. 66.84
10	0.007	64.05	0.000	68.70	Remove strut no.1 at elev. 65.50
11	0.007	64.05	0.000	68.70	Change EI of wall to 163970kN.m2/m run

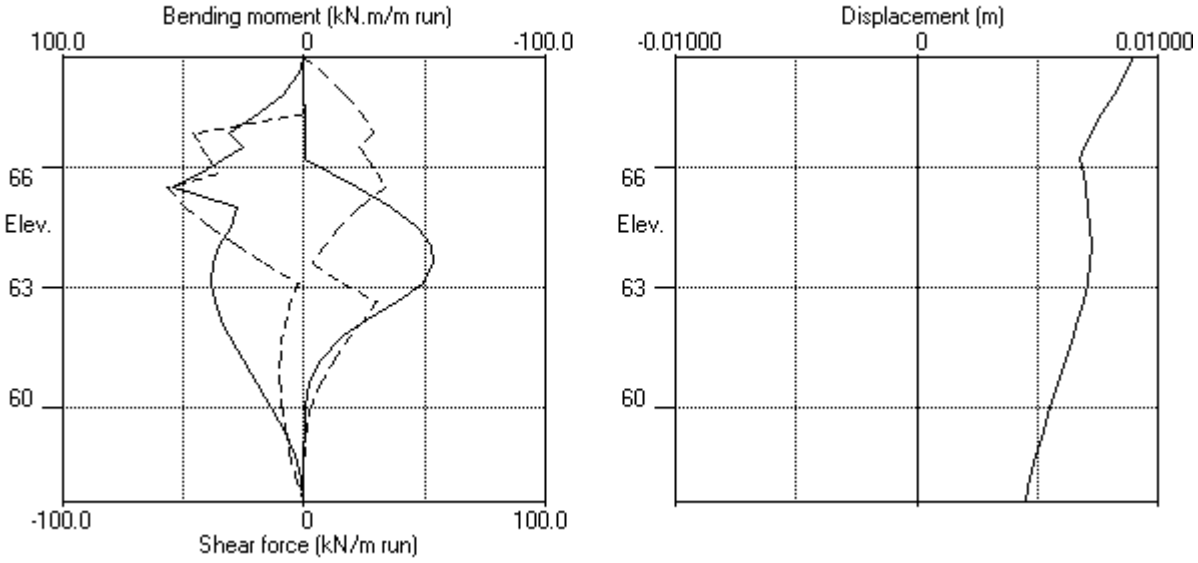
Summary of results (continued)

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 65.50 kN/m run	Strut no. 1 at elev. 65.50 kN/strut	Strut no. 2 at elev. 66.84 kN/m run	Strut no. 2 at elev. 66.84 kN/strut
7	2.10	2.10	---	---
8	90.53	90.53	---	---
10	---	---	74.31	74.31
11	---	---	73.24	73.24

Units: kN,m

Bending moment, shear force, displacement envelopes



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Appendix E

Settlement Calculations and Outputs

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Project No	Sheet No.	Rev
20111	1	C

Calculation Sheet

Project : **538 Karangahape Rd, Newton** Made by **MC**

Location : **Section C-C' - Grid AB** Date May-24

1. It is assumed that the dewatering has occurred prior to commencing excavation.

2. It is assumed that there will not be any change in total pressure in the soil,
thus the change in effective stress of the soil should be equal to the change in pore water pressure.

Settlement, Sd = dσ' x dH x m_v => dσ'= increase in effective vertical stress due to GW drawdown

dH = the thickness of soil layer

m_v = the coefficient of volume compressibility = 1/M' => M' = stiffness modulus = $\frac{E \times (1-\vartheta)}{(1+\vartheta)(1-2\vartheta)}$,

where E = Young's modulus

ϑ = Poisson's ratio

Weathered Waitemata Group (Above Drawdown Zone)

Ground Level (RL) = 68.4
Initial Groundwater Level (RL) = 65.6
Layer thickness (m) = 2.8

E (MPa) = 24
ϑ (-) = 0.2
M (MPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	1.0	2.0	3.0	4.0	5.0	50.0
Groundwater drawdown (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg Increase vertical stress, dσ' (kPa)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlement, Sd (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Weathered Waitemata Group Soils (Within Drawdown Zone)

Initial Groundwater Level (RL) = 65.6
Base of Drawdown (RL) = 62.7
Layer thickness (m) = 2.9

E (MPa) = 24
ϑ (-) = 0.2
M (MPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	1.0	2.0	3.0	4.0	5.0	50.0
Groundwater drawdown (m)	2.90	2.70	2.50	2.30	2.20	2.10	0.00
Avg Increase vertical stress, dσ' (kPa)	14.2	13.2	12.3	11.3	10.8	10.3	0.0
Settlement, Sd (mm)	0.8	0.7	0.7	0.6	0.6	0.6	0.0

Weathered Waitemata Group Soils (Below Drawdown Zone)

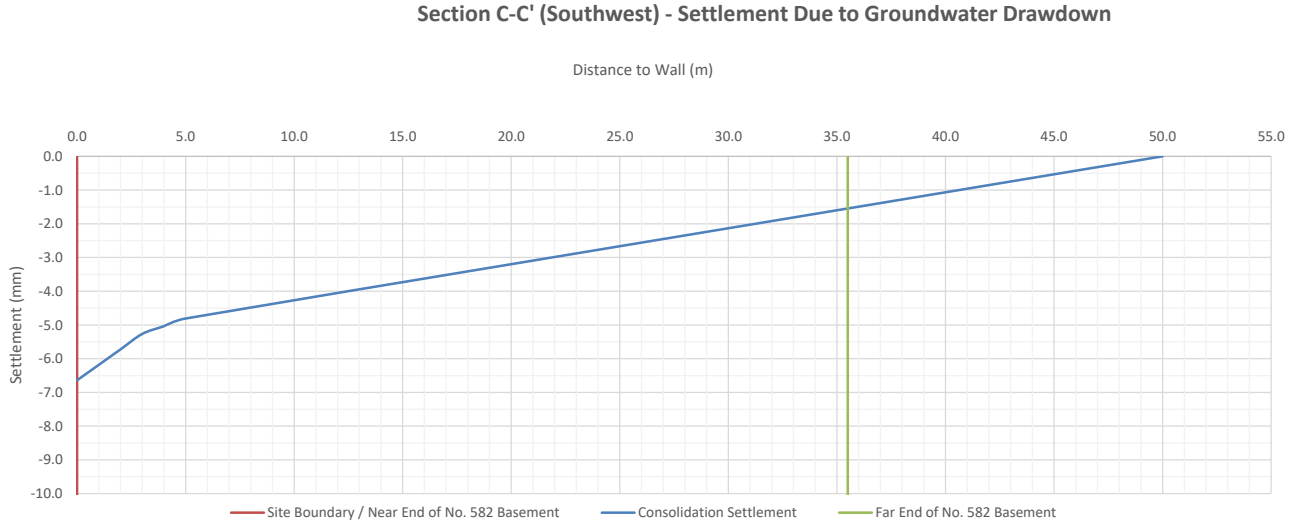
Base of Drawdown(RL) = 62.7
Top of Incompressible Layer (RL) = 57.2
Layer thickness (m) = 5.5

E (MPa) = 24
ϑ (-) = 0.2
M (MPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	1.0	2.0	3.0	4.0	5.0	50.0
Groundwater drawdown (m)	2.90	2.70	2.50	2.30	2.20	2.10	0.00
Increase vertical stress dσ' (kPa)	28.4	26.5	24.5	22.6	21.6	20.6	0.0
Settlement, Sd (mm)	5.9	5.5	5.1	4.7	4.5	4.2	0.0

TOTAL :

Distance from excavation (m)	0.0	1.0	2.0	3.0	4.0	5.0	50.0
Settlement, Sd (mm)	-6.6	-6.2	-5.7	-5.3	-5.0	-4.8	0.0



For Short-term

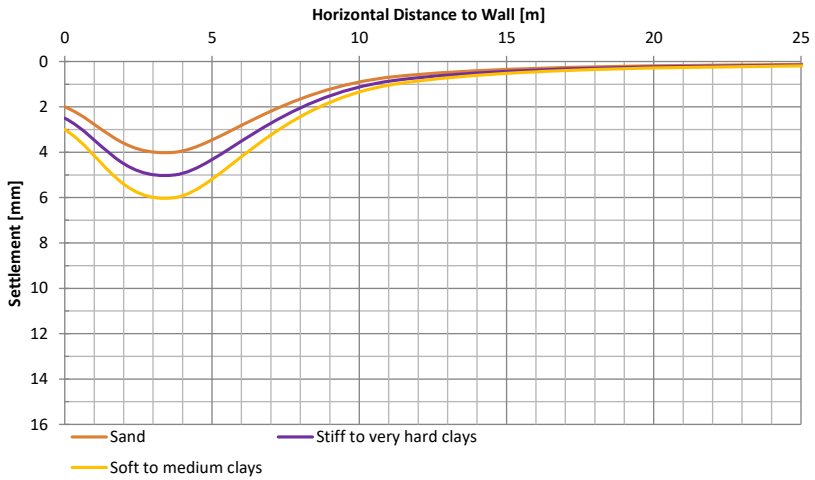
Section	H_e [m]	H_g [m]	$PIZ_1 = min(2H_e, H_g)$ [m]	H_f [m]	B [m]	$PIZ_2 = min(H_f, B)$ [m]	$PIZ = max(PIZ_1, PIZ_2)$ [m]	$D_m = PIZ/3$ [m]	A_c [m^2]	A_s [m^2]	$1.6A_c$ [m^2]	δ_{hm} [mm]	Deformation Type
C-C'	7.4	11.2	11.2	0	20.0	0	11.2	3.73	-0.033	0.127	-0.052	8.0	Concave Type

Concave Type	Sand		Stiff to very hard clays		Soft to medium clays	
Section	$\delta_{vm} = 0.5\delta_{hm}$		$\delta_{vm} = 0.625\delta_{hm}$		$\delta_{vm} = 0.75\delta_{hm}$	
	X	Y	X	Y	X	Y
C-C'	0.0	2.00	0.0	2.50	0.0	3.00
	3.7	4.00	3.7	5.00	3.7	6.00
	11.2	0.67	11.2	0.83	11.2	1.00
	33.6	0.00	33.6	0.00	33.6	0.00

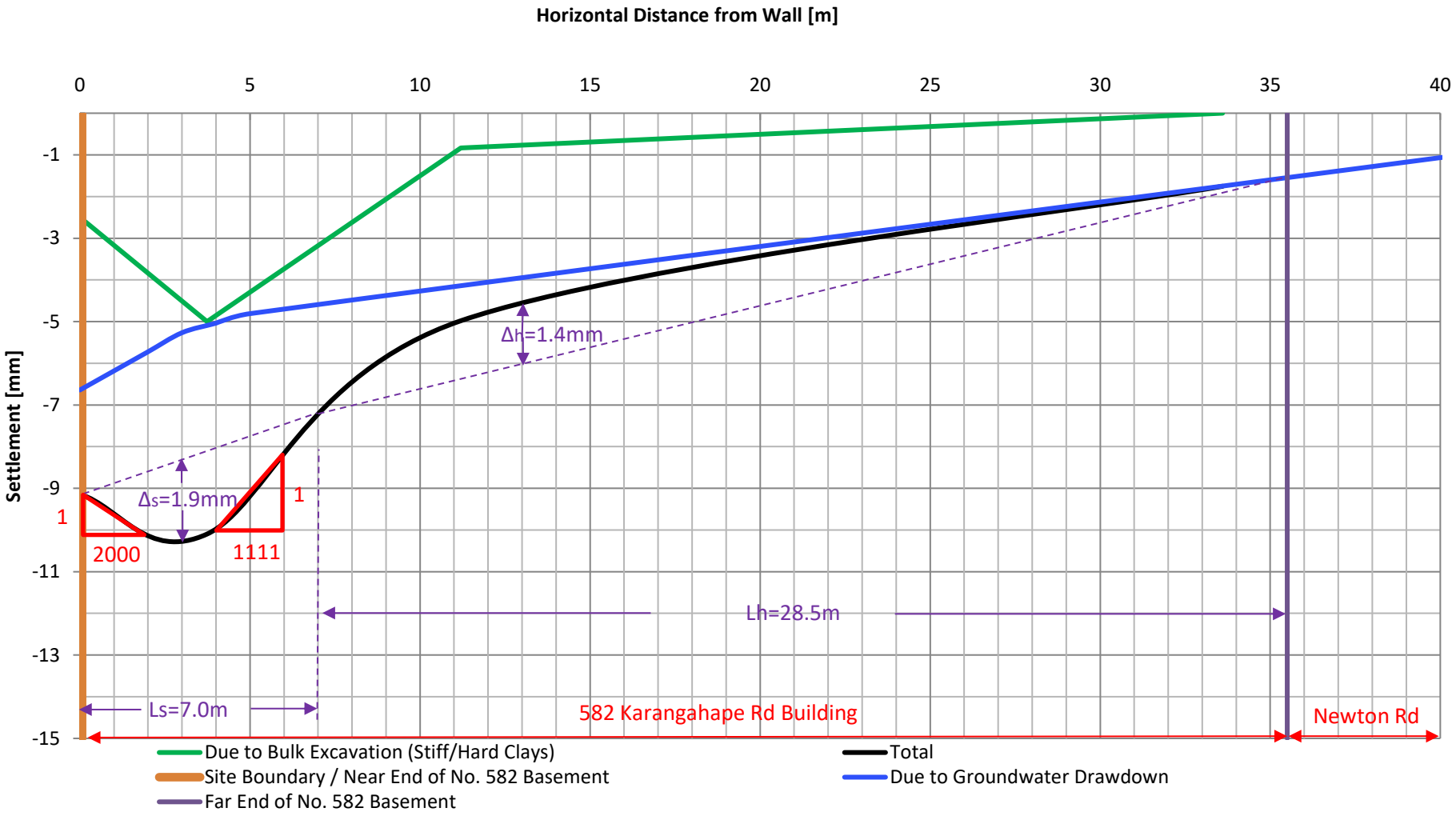
H_e = Excavation Depth
H_g = Hard Soil Depth
H_f = Depth of Soft Clay Bottom
B = Excavation Width
PIZ = Primary Influence Zone
D_m = Location of Maximum Settlement

A_c = Area of Cantilever Component
A_s = Area of Total Wall Movement
δ_{hm} = Maximum Settlement

Section C-C' - Estimated Short-Term Ground Deformation Profile



Section C-C'
Estimated Total Settlement vs. Distance from Excavation



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Project No	Sheet No.	Rev
20111	2	E

Calculation Sheet

Project : **538 Karangahape Rd, Newton** Made by **MC**

Location : **Section D-D' - Grid A5** Date Aug-24

1. It is assumed that the dewatering has occurred prior to commencing excavation.

2. It is assumed that there will not be any change in total pressure in the soil,
thus the change in effective stress of the soil should be equal to the change in pore water pressure.

Settlement, Sd = dσ' x dH x m_v => dσ'= increase in effective vertical stress due to GW drawdown

dH = the thickness of soil layer

m_v = the coefficient of volume compressibility = 1/M' => M' = stiffness modulus = $\frac{E \times (1-\vartheta)}{(1+\vartheta)(1-2\vartheta)}$,

where E = Young's modulus

ϑ = Poisson's ratio

Weathered Waitemata Group (Above Drawdown Zone)

Ground Level (RL) = 70.8
Initial Groundwater Level (RL) = 64
Layer thickness (m) = 6.8

E (MPa) = 24
ϑ (-) = 0.2
M (mPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	2.0	4.0	10.0	15.0	20.0	50.0
Groundwater drawdown (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg Increase vertical stress, dσ' (kPa)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlement, Sd (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Weathered Waitemata Group Soils (Within Drawdown Zone)

Initial Groundwater Level (RL) = 64
Base of Drawdown (RL) = 62.6
Layer thickness (m) = 1.4

E (MPa) = 24
ϑ (-) = 0.2
M (mPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	2.0	4.0	10.0	15.0	20.0	50.0
Groundwater drawdown (m)	1.40	1.20	1.00	0.80	0.60	0.50	0.00
Avg Increase vertical stress, dσ' (kPa)	6.9	5.9	4.9	3.9	2.9	2.5	0.0
Settlement, Sd (mm)	0.2	0.2	0.1	0.1	0.1	0.1	0.0

Weathered Waitemata Group Soils (Below Drawdown Zone)

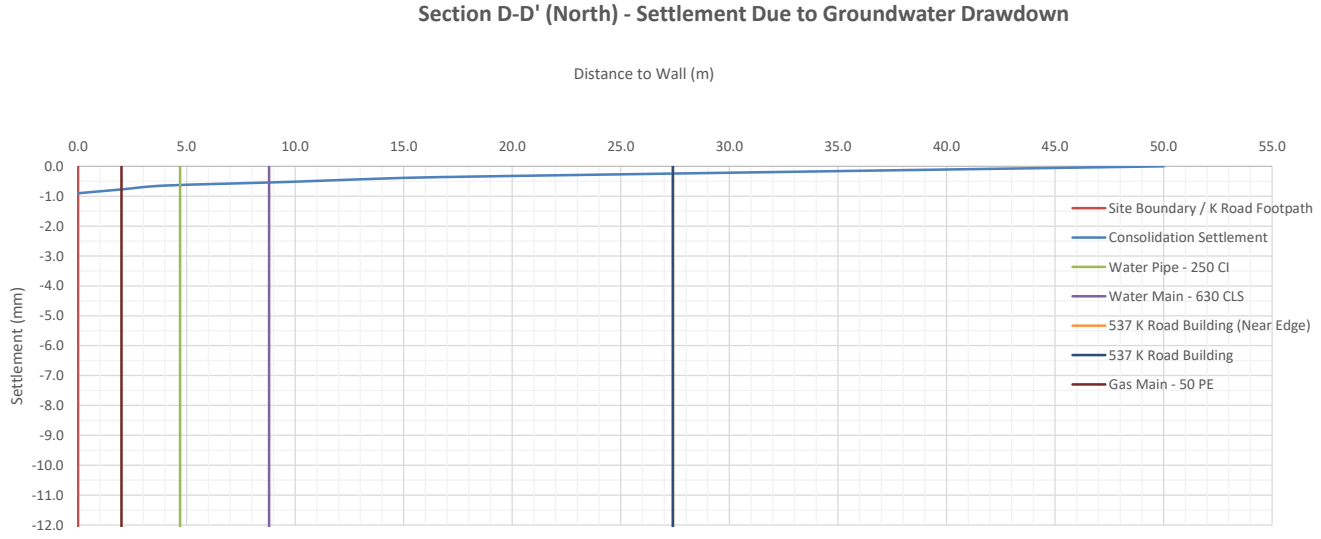
Base of Drawdown(RL) = 62.6
Top of Incompressible Layer (RL) = 61.2
Layer thickness (m) = 1.4

E (MPa) = 24
ϑ (-) = 0.2
M (mPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	2.0	4.0	10.0	15.0	20.0	50.0
Groundwater drawdown (m)	1.40	1.20	1.00	0.80	0.60	0.50	0.00
Increase vertical stress dσ' (kPa)	13.7	11.8	9.8	7.8	5.9	4.9	0.0
Settlement, Sd (mm)	0.7	0.6	0.5	0.4	0.3	0.3	0.0

TOTAL :

Distance from excavation (m)	0.0	2.0	4.0	10.0	15.0	20.0	50.0
Settlement, Sd (mm)	-0.9	-0.8	-0.6	-0.5	-0.4	-0.3	0.0



For Short-term

Section	H_e [m]	H_g [m]	$PIZ_1 = min(2H_e, H_g)$ [m]	H_f [m]	B [m]	$PIZ_2 = min(H_f, B)$ [m]	$PIZ = max(PIZ_1, PIZ_2)$ [m]	$D_m = PIZ/3$ [m]	A_c [m^2]	A_s [m^2]	$1.6A_c$ [m^2]	δ_{hm} [mm]	Deformation Type
D-D'	8.2	9.6	9.6	0	20.0	0	9.6	3.20	0.137	-0.020	0.219	17.0	Spandrel Type

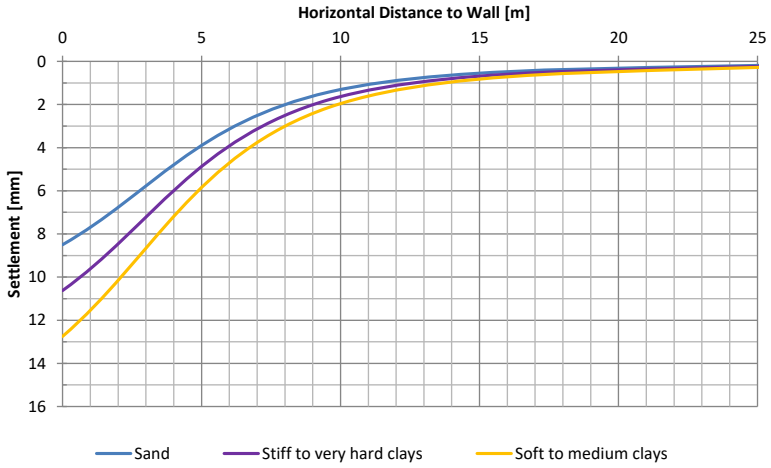
Spandrel Type

Section	$\delta_{vm} = 0.5\delta_{hm}$		$\delta_{vm} = 0.625\delta_{hm}$		$\delta_{vm} = 0.75\delta_{hm}$	
	X	Y	X	Y	X	Y
D-D'	0.0	8.5	0.0	10.6	0.0	12.8
	9.6	1.4	9.6	1.8	9.6	2.1
	28.8	0.0	28.8	0.0	28.8	0.0

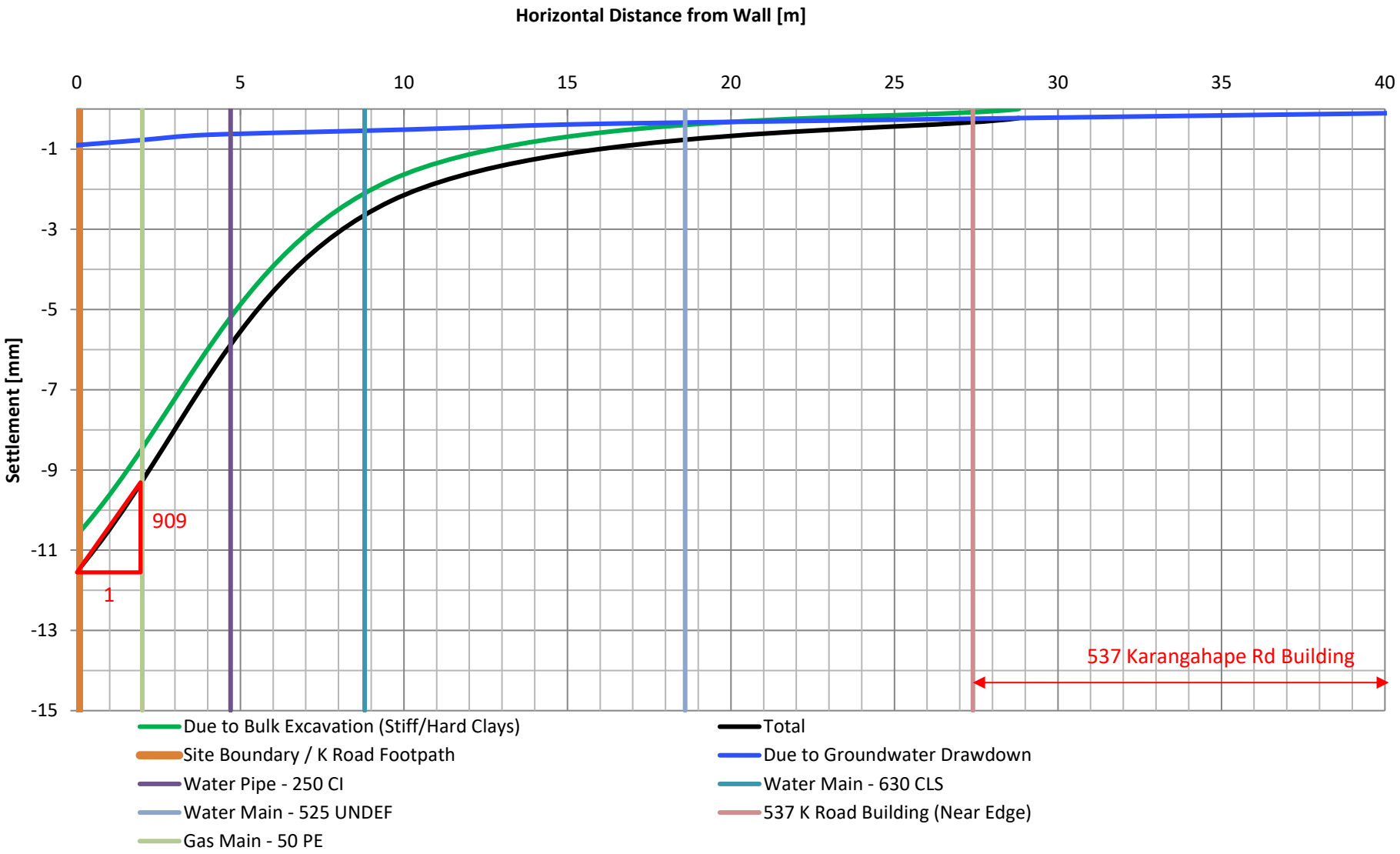
H_e = Excavation Depth
H_g = Hard Soil Depth
H_f = Depth of Soft Clay Bottom
B = Excavation Width
PIZ = Primary Influence Zone
D_m = Location of Maximum Settlement = 0m

A_c = Area of Cantilever Component
A_s = Area of Total Wall Movement-Ac
δ_{hm} = Maximum Settlement

Section D-D' - Estimated Short-Term Ground Deformation Profile



Section D-D'
Estimated Total Settlement vs. Distance from Excavation



For Short-term

Section	H_e [m]	H_g [m]	$PIZ_1 = min(2H_e, H_g)$ [m]	H_f [m]	B [m]	$PIZ_2 = min(H_f, B)$ [m]	$PIZ = max(PIZ_1, PIZ_2)$ [m]	$D_m = PIZ/3$ [m]	A_c [m^2]	A_s [m^2]	$1.6A_c$ [m^2]	δ_{hm} [mm]	Deformation Type
E-E'	4.3	10.6	8.2	0	20	0	8.2	2.73	0.088	-0.013	0.141	13.0	Spandrel Type

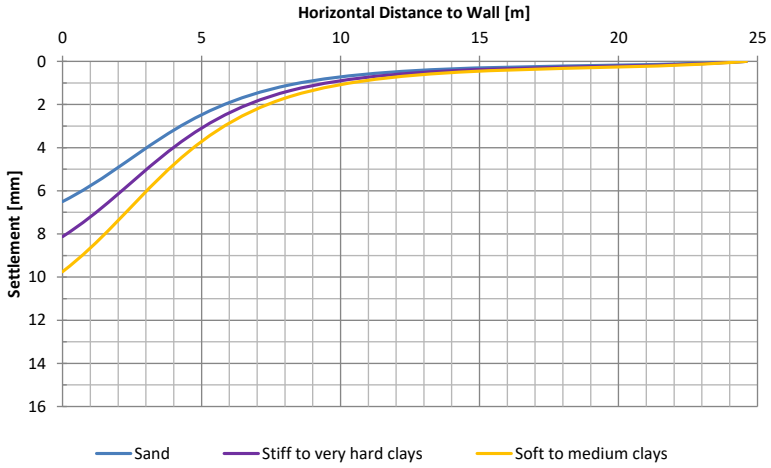
Spandrel Type

Section	$\delta_{vm} = 0.5\delta_{hm}$		$\delta_{vm} = 0.625\delta_{hm}$		$\delta_{vm} = 0.75\delta_{hm}$	
	X	Y	X	Y	X	Y
E-E'	0.0	6.5	0.0	8.1	0.0	9.8
	8.2	1.1	8.2	1.4	8.2	1.6
	24.6	0.0	24.6	0.0	24.6	0.0

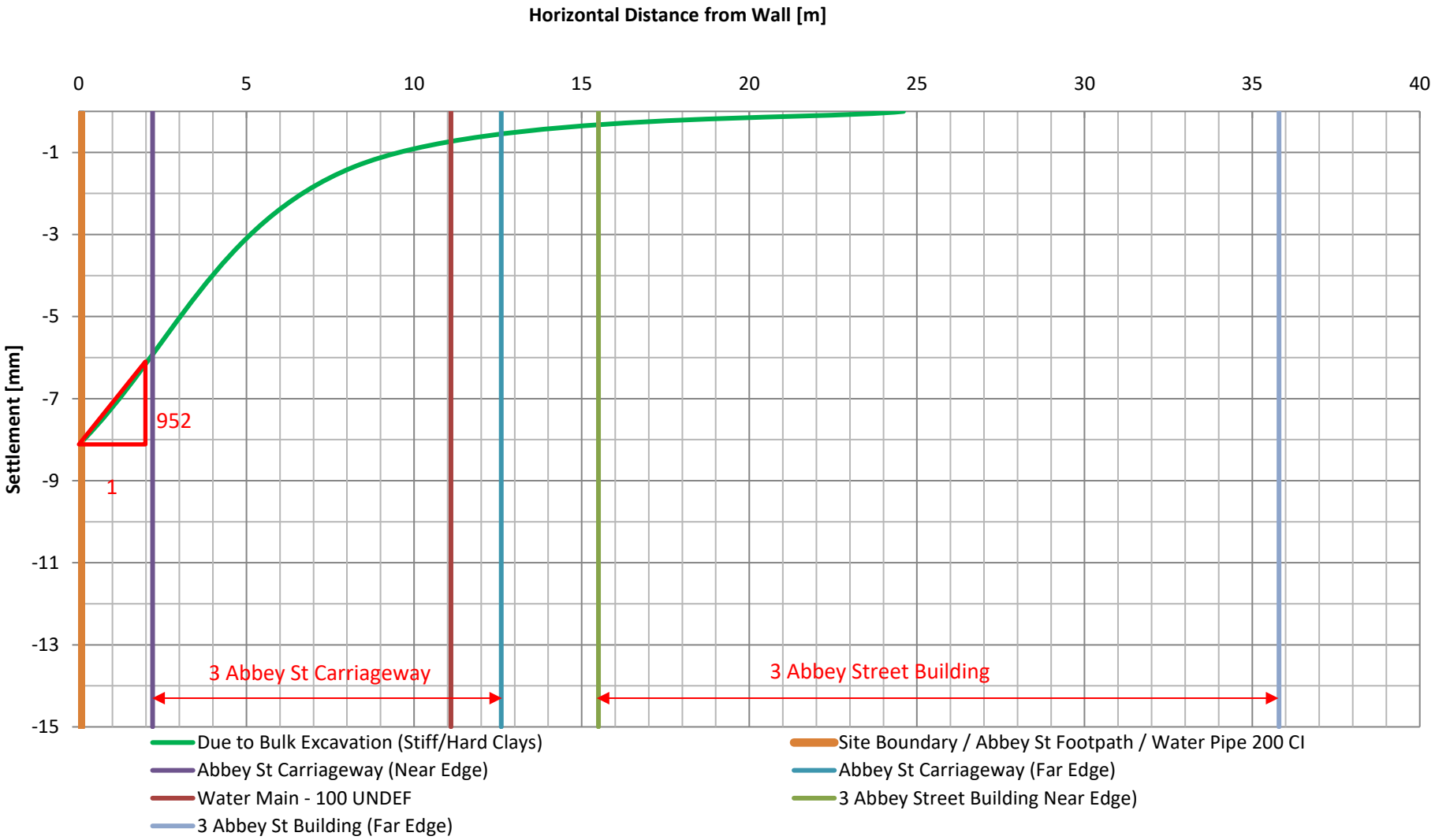
H_e = Excavation Depth
H_g = Hard Soil Depth
H_f = Depth of Soft Clay Bottom
B = Excavation Width
PIZ = Primary Influence Zone
D_m = Location of Maximum Settlement = 0m

A_c = Area of Cantilever Component
A_s = Area of Total Wall Movement-Ac
δ_{hm} = Maximum Settlement

Section D-D' - Estimated Short-Term Ground Deformation Profile



Section E-E'
Estimated Total Settlement vs. Distance from Excavation



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Calculation Sheet

Project : **538 Karangahape Rd, Newton** Made by **MC**

Location : **Section F-F' - Grid A1/AD** Date Jul-24

1. It is assumed that the dewatering has occurred prior to commencing excavation.

2. It is assumed that there will not be any change in total pressure in the soil,
thus the change in effective stress of the soil should be equal to the change in pore water pressure.

Settlement, Sd = dσ' x dH x m_v => dσ'= increase in effective vertical stress due to GW drawdown

dH = the thickness of soil layer

m_v = the coefficient of volume compressibility = 1/M' => M' = stiffness modulus = $\frac{E \times (1-\vartheta)}{(1+\vartheta)(1-2\vartheta)}$,

where E = Young's modulus

ϑ = Poisson's ratio

Weathered Waitemata Group (Above Drawdown Zone)

Ground Level (RL) = 66.1
Initial Groundwater Level (RL) = 64.5
Layer thickness (m) = 1.6

E (MPa) = 24
ϑ (-) = 0.2
M (mPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	1.0	4.0	10.0	15.0	20.0	50.0
Groundwater drawdown (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avg Increase vertical stress, dσ' (kPa)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlement, Sd (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Weathered Waitemata Group Soils (Within Drawdown Zone)

Initial Groundwater Level (RL) = 64.5
Base of Drawdown (RL) = 62.6
Layer thickness (m) = 1.9

E (MPa) = 24
ϑ (-) = 0.2
M (mPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	1.0	4.0	10.0	15.0	20.0	50.0
Groundwater drawdown (m)	1.90	1.60	1.30	0.70	0.50	0.30	0.00
Avg Increase vertical stress, dσ' (kPa)	9.3	7.8	6.4	3.4	2.5	1.5	0.0
Settlement, Sd (mm)	0.3	0.3	0.2	0.1	0.1	0.1	0.0

Weathered Waitemata Group Soils (Below Drawdown Zone)

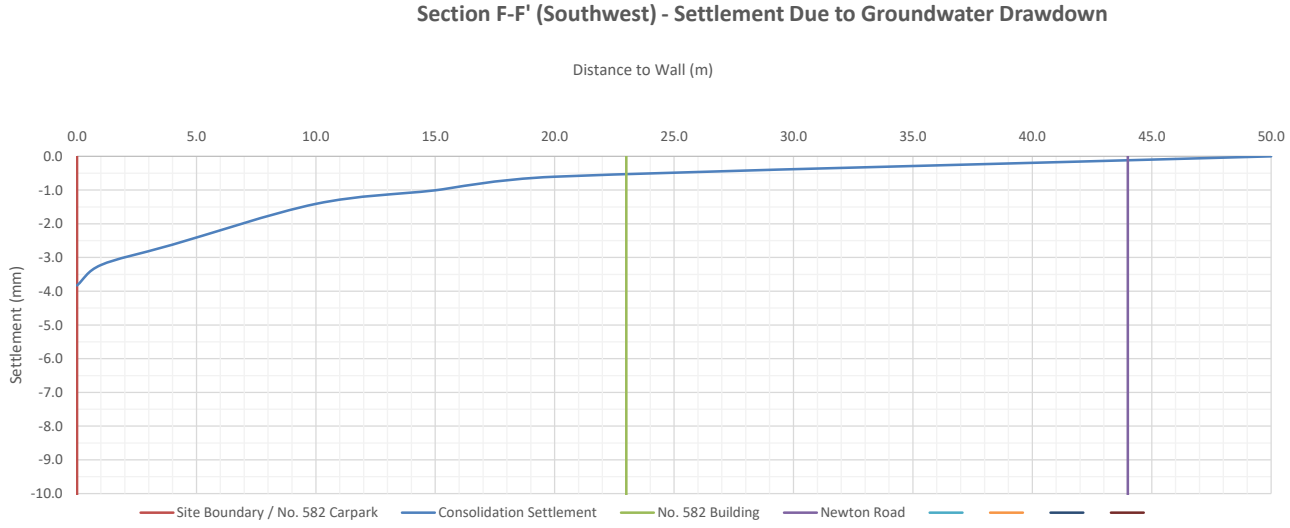
Base of Drawdown(RL) = 62.6
Top of Incompressible Layer (RL) = 57.6
Layer thickness (m) = 5

E (MPa) = 24
ϑ (-) = 0.2
M (mPa) = 26.67
m_v (m2/MN) = 0.0375

Distance from excavation (m)	0.0	1.0	4.0	10.0	15.0	20.0	50.0
Groundwater drawdown (m)	1.90	1.60	1.30	0.70	0.50	0.30	0.00
Increase vertical stress dσ' (kPa)	18.6	15.7	12.8	6.9	4.9	2.9	0.0
Settlement, Sd (mm)	3.5	2.9	2.4	1.3	0.9	0.6	0.0

TOTAL :

Distance from excavation (m)	0.0	1.0	4.0	10.0	15.0	20.0	50.0
Settlement, Sd (mm)	-3.8	-3.2	-2.6	-1.4	-1.0	-0.6	0.0



For Short-term

Section	H_e [m]	H_g [m]	$PIZ_1 = min(2H_e, H_g)$ [m]	H_f [m]	B [m]	$PIZ_2 = min(H_f, B)$ [m]	$PIZ = max(PIZ_1, PIZ_2)$ [m]	$D_m = PIZ/3$ [m]	A_c [m^2]	A_s [m^2]	$1.6A_c$ [m^2]	δ_{hm} [mm]	Deformation Type
F-F'	6.0	9.6	9.6	0	20.0	0	9.6	3.20	0.033	0.001	0.053	9.0	Spandrel Type

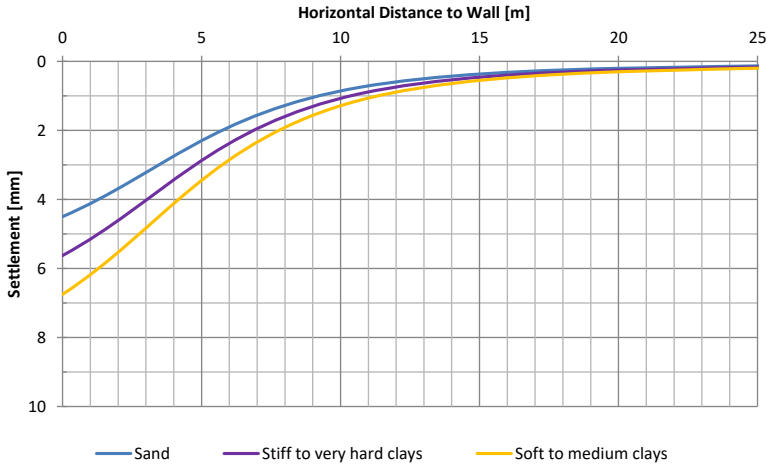
Spandrel Type

Section	$\delta_{vm} = 0.5\delta_{hm}$		$\delta_{vm} = 0.625\delta_{hm}$		$\delta_{vm} = 0.75\delta_{hm}$	
	X	Y	X	Y	X	Y
F-F'	0.0	4.5	0.0	5.6	0.0	6.8
	10.7	0.8	10.7	0.9	10.7	1.1
	32.1	0.0	32.1	0.0	32.1	0.0

H_e = Excavation Depth
H_g = Hard Soil Depth
H_f = Depth of Soft Clay Bottom
B = Excavation Width
PIZ = Primary Influence Zone
D_m = Location of Maximum Settlement = 0m

A_c = Area of Cantilever Component
A_s = Area of Total Wall Movement-Ac
δ_{hm} = Maximum Settlement

Section F-F' - Estimated Short-Term Ground Deformation Profile



Section F-F'
Estimated Total Settlement vs. Distance from Excavation