

**Land between 26 Gordon Square and
15 Gordon Street, London NW1H**

**Basement Impact Assessment
Audit**

For

London Borough of Camden

Project Number: 12066-24
Rev: F1

August 2015

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Document Details

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1.0 NON-TECHNICAL SUMMARY

- 1.1. CampbellReith was instructed by London Borough of Camden (LBC) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for land between 26 Gordon Square and 15 Gordon Street, London NW1H (planning reference 2015/3302/P). The basement is considered to fall with Category C as defined by the Terms of Reference.
- 1.2. The Audit reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development in accordance with LBC's policies and technical procedures.
- 1.3. CampbellReith was able to access LBC's Planning Portal and gain access to the latest revision of submitted documentation and review it against an agreed audit check list. The initial audit identified a number of areas that required more detailed consideration and this updated report comprises an audit of the revised material provided directly by the Engineer and his sub-consultant. This additional information is presented in Appendix 3.
- 1.4. The BIA has been prepared by an individual who is a chartered structural engineer. The revised version was reviewed by a chartered geologist.
- 1.5. It is proposed that the perimeter walls to the two level basement will be formed using secant piles in order to construct the proposed two storey basement. It is understood that the piles along one of the four sides were installed under a previous contract.
- 1.6. It is accepted that the development will have no adverse effect on drainage or run off as there is no increase in impermeable area and the site is not in an area known to be at risk from surface water flooding.
- 1.7. It was stated in the original BIA that whilst the basement is underlain by an aquifer and will be founded below the shallow water table, groundwater flow is unlikely to be significantly affected by the development. However, it was recommended that Curtins confirm their assumptions with respect to the dimensions of this and neighbouring below ground structures and the depth and direction of groundwater flow. Curtins have supplied additional information confirming the depth of nearby basements and have undertaken to carry out groundwater monitoring prior to construction. This is accepted.
- 1.8. The original building damage assessment suggested Category 0 damage (negligible) to surrounding structures, however, it was based on a previous scheme and a number of assumptions required to be clarified. Curtins subsequently provided a Ground Movement and Damage Assessment based in an assumed construction sequence for the currently proposed

scheme. It is accepted that assuming good workmanship and an appropriate level of design, damage to surrounding structured can be limited to no worse than Burland Category 2.

- 1.9. For a basement of this depth on a site, ground movements and resultant building damage are highly dependent on the construction sequence and methodology. It is understood that the ground movement and building damage assessment will be updated by the GCG on behalf of Curtins once a contractor is appointed and the final scheme has been developed.
- 1.10. It is recommended that a Basement Construction Plan is prepared prior to construction with the results of groundwater monitoring and an updated ground movement and building damage assessment. The BCP should include the following:
 - Detailed construction method statement
 - Groundwater monitoring and confirmation of impact on groundwater flow
 - Updated Ground Movement and Building Damage Assessment for final scheme
 - Confirmation of impact on surrounding buried services.

2.0 INTRODUCTION

- 2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 19 May 2015 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 41 Frognal, Camden Reference 2015/2026/P.
- 2.2. The Audit was carried out in accordance with the Terms of Reference set by LBC. It reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development.
- 2.3. A BIA is required for all planning applications with basements in Camden in general accordance with policies and technical procedures contained within
- Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.
 - Camden Planning Guidance (CPG) 4: Basements and Lightwells.
 - Camden Development Policy (DP) 27: Basements and Lightwells.
 - Camden Development Policy (DP) 23: Water.
- 2.4. The BIA should demonstrate that schemes:
- a) maintain the structural stability of the building and neighbouring properties;
 - b) avoid adversely affecting drainage and run off or causing other damage to the water environment; and,
 - c) avoid cumulative impacts upon structural stability or the water environment in the local area.
- and evaluate the impacts of the proposed basement considering the issues of hydrology, hydrogeology and land stability via the process described by the GSD and to make recommendations for the detailed design.
- 2.5. LBC's Audit Instruction described the planning proposal as the "*Erection of part 4, part 5 storey (with two storey basement) Student Centre to provide learning space and student support (Use Class D1) following demolition of theatre staircase and plantroom in Japanese Garden; with associated landscaping, cycle parking, vehicular and pedestrian access.*"
- and confirmed that 26 Gordon Square is Grade II Listed and the University building to the rear of the site is also Grade II Listed.

2.6. CampbellReith accessed LBC's Planning Portal on 20 July 2015 and gained access to the following relevant documents for audit purposes:

- Basement Impact Assessment UCL Student Centre, March 2015 (BIA)
- Basement Impact Assessment Stage 4 UCL New Student Centre, July 2015 (BIA Stage 4)
- Architect's drawings, Nos
 - 689-NHA-PL-001 Location plan
 - 689-NHA-PL-002 Site plan as existing
 - 689-NHA-PL-004 Site plan as proposed
 - 689-NHA-PL-007 Basement 1 plan
 - 689-NHA-PL-008 Basement 2 plan
 - 689-NHA-PL-009 Level 00 plan
 - 689-NHA-PL-010 Level 0M plan
 - 689-NHA-PL-011 Level 01 plan
 - 689-NHA-PL-200 Section AA
 - 689-NHA-PL-201 Section BB
- Engineer's drawings, Nos
 - LO1254/S-01 GA basement level -2
 - LO1254/S-02 GA basement level -1
 - LO1254/S-03 GA ground floor level
 - LO1254/S-30 Section AA
 - LO1254/S-31 Section AA

2.7. Clarification with respect to surrounding basements was provided by Curtins directly to CampbellReith by email on 21 July in response to a query from CampbellReith. That information is presented in Appendix 3.

2.8. Subsequent to the issue of the draft audit report Curtins issued revised and/or additional information. This is presented in Appendix 3 together with CampbellReith's audit findings. The key documents are listed below:

- Email clarification RE: BIA Review – Land between 26 Gordon Sq and 15 Gordon St, 19 August 2015
- Basement Impact Assessment stage 4 rev3, issue date 21 August 2015
- Ground Movement and Damage Assessment rev3, issue date 21 August 2015
- Movement monitoring rev2, issue date 19 August 2015

- Groundwater monitoring data, dated 2006
- Email clarification RE: BIA Review – Land between 26 Gordon Sq and 15 Gordon St, 21 August 2015
- PDisp input and output data with accompanying email from GCG, 21 August 2015.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	No	Both the BIA and BIA Stage 4 have been prepared by a Chartered Structural Engineer.
Is data required by Cl.233 of the GSD presented?	Yes	BIA and drawings referred to above. However, construction method statement is generic and assessment of impact on surrounding structures is based on an earlier scheme.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	Chapter 5 BIA Stage 4, although assessment of impact on surrounding structures is based on an earlier scheme.
Are suitable plan/maps included?	Yes	BIA Section 2 and Appendix
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	BIA and architect's drawings
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	BIA Section 8.3.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	BIA Section 8.2.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	BIA Section 8.1.
Is a conceptual model presented?	Yes	BIA Sections 3.1, 3.2, 4.1 and 4.2.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	BIA Stage 4.

Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	BIA Stage 4.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	No Yes	Not required, consistent with screening outcome.
Is factual ground investigation data provided?	Yes	BIA Stage 4 Appendices F and G
Is monitoring data presented?	No	Curtins have stated that groundwater monitoring will be carried out prior to construction.
Is the ground investigation informed by a desk study?	Yes	
Has a site walkover been undertaken?	Yes	
Is the presence/absence of adjacent or nearby basements confirmed?	Yes	Supplementary information provided on 21 July 2015 (Appendix 3).
Is a geotechnical interpretation presented?	Yes	BIA Stage 4 Appendix F.
Does the geotechnical interpretation include information on retaining wall design?	No	Curtins are relying on a previous design for retaining walls – BIA 15 July 2015, Stage 4 Appendix C
Are reports on other investigations required by screening and scoping presented?	Yes	FRA presented as Appendix E of BIA Stage 4
Are baseline conditions described, based on the GSD?	Yes	However, no contemporary groundwater monitoring
Do the base line conditions consider adjacent or nearby basements?	Yes	Supplementary information provided on 21 July 2015 (Appendix 3).
Is an Impact Assessment provided?	Yes	BIA Stage 4.
Are estimates of ground movement and structural impact presented?	Yes	Ground Movement and Damage Assessment, dated 21 August 2015.

Item	Yes/No/NA	Comment
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	Hydrogeological Impact assessment provided.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	Requirements for propping and monitoring of surrounding structures identified in BIA Stage 4.
Has the need for monitoring during construction been considered?	Yes	Movement monitoring scheme provided – BIA Stage 4 Appendix D.
Have the residual (after mitigation) impacts been clearly identified?	Yes	
Has the scheme demonstrated that the structural stability of the building and neighbouring properties maintained?	Yes	
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	
Are non-technical summaries provided?	No	However, information presented in format which is easily understandable.

4.0 DISCUSSION

- 4.1. The BIA and BIA Stage 4 have been carried out by an established firm of consultants. The lead author is a Chartered Structural Engineer. The revised BIA was reviewed by a Chartered Geologist.
- 4.2. The proposed development comprises the erection of a four to five storey student centre over a two storey basement (c 8-10m deep). Proposals include a link tunnel to an existing single storey basement beneath the neighbouring theatre.
- 4.3. The basement will be constructed within a secant piled retaining wall. It is understood that the secant piled wall along one side of the basement was installed under the previous contract. A brief construction method statement has been provided referring to temporary propping and bottom up construction. This should be developed in a Basement Construction Plan.
- 4.4. It is accepted that there is no significant adverse impact of surface water flows and the risk of flooding. There is no appreciable change to the area of hardstanding at the site and the scheme will incorporate a volume of attenuation with low flow control systems. The site is not within an area prone to flooding.
- 4.5. The basement will penetrate through an aquifer and is founded below the shallow water table. The site is within 100m of a former water course (a former tributary of the River Fleet flows west to east to the north of the site). In their BIA (Section 9), Curtins undertook to carry out a reconnaissance survey of basements along with Gordon Street within 250m of the subject site. On 21 July 2015, Curtins provided to CampbellReith supplementary information detailing eight basements and tunnels around the site of which they were aware (presented in Appendix 3 – scale of plan and extent of reconnaissance not clear).
- 4.6. Reference was made by Curtins to research undertaken by Mott Macdonald in relation to the impact of underground construction on groundwater and the BIA Stage 4 concludes that there will be no adverse impact. This was based on a basement dimension of 30m and a southerly groundwater flow. Curtins were requested to confirm their assumptions with respect to the geometry and dimensions of the underground structures at the site and its surroundings, and the depth and direction of groundwater flow as changes in groundwater levels could have an impact on construction. The revised BIA includes details of the depths of the surrounding basements and confirmed that they are likely to lie above the water table. Curtins have noted that groundwater monitoring will be carried out prior to construction. This should be reported in the BCP with a confirmation of the likely impact.

- 4.7. The BIA has shown the surrounding slopes to the development are stable. The basement is surrounded by structures on three sides, two of which are listed. The initial Ground Movement Assessment carried out by Curtins was based on information relating to a previous scheme states the surrounding buildings will be subject to no more than Burland Category 0 damage (negligible). However, whilst the new scheme is for a shallower basement, the originally assumed propping regime was considered unrealistic for a 9-10m deep basement and ground movements could therefore be greater than those assumed within the BIA Stage 4. A scheme specific ground movement and building damage assessment was requested.
- 4.8. Curtins noted that ground movements of up 0.05% of pile length can occur associated with pile installation. These were not included in the ground movement/building damage assessment, which also gave no consideration to heave.
- 4.9. The previous ground movement assessment considered eight sections around the basement perimeter and Curtins noted that only five are applicable to the current scheme which are those relating to the Bloomsbury Theatre, 26 Gordon Street and the ACBE building. However, the site is within 5m of Gordon Street, thus it was requested that the impact of the basement on the adjacent highway was considered.
- 4.10. Clarification was also required on the assumptions made in relation to the distance from the site within which buildings may be affected and the building geometries adopted in the ground movement assessments. For example, it was assumed that settlement will occur within approximately 15m of the basement excavation, although angular distortion is calculated over 28 to 30m.
- 4.11. The revised Ground Movement and Damage Assessment provided on 21 August considered likely ground movements for the currently proposed scheme based on the empirical approach detailed in CIRIA C580. The assessment was based on the secant piled wall with stiff props and a bottom up construction. Estimates of heave resulting from basement excavation were also provided.
- 4.12. It is now accepted that the estimates of ground movement and building damage have been undertaken in a clear and methodical way and are appropriate for the scheme at this stage. The damage assessment has ignored the heave but it is considered that this will be negligible or have a slight beneficial effect. The assessment has shown that damage to surrounding structures can be limited to not worse than Burland Category 2 assuming as appropriate level of design, good control of workmanship, and that the affected buildings are in sound structural condition.

- 4.13. The Ground Movement and Building Damage assessment will have to be updated once a contractor is appointed in this regard. The final GMDA should be provided in the Basement Construction Plan.
- 4.14. Monitoring proposals are put forward within the BIA Stage 4 with indicative recommendations for monitoring locations and trigger levels. The monitoring scheme and trigger levels should be agreed based on the final GMDA.
- 4.15. The BIA states that the site lies on the edge of the safeguarding zone for Crossrail 2. Although beyond the scope of this audit, it should be confirmed that the scheme addresses any constraints that Crossrail may impose.

5.0 CONCLUSIONS

- 5.1. CampbellReith was instructed by London Borough of Camden (LBC) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for land between 16 Gordon Square and 15 Gordon Street, London NW1H (planning reference 2015/3302/P). The basement is considered to fall with Category C as defined by the Terms of Reference.
- 5.2. The Audit reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development in accordance with LBC's policies and technical procedures.
- 5.3. CampbellReith was able to access LBC's Planning Portal and gain access to the latest revision of submitted documentation and review it against an agreed audit check list. Revised information was provided on 21 August 2015 in response to CampbellReith's draft audit report.
- 5.4. The BIA has been prepared by an individual who is a Chartered Structural Engineer. The revised version was reviewed by a Chartered Geologist.
- 5.5. It is proposed that the perimeter walls will be formed using secant piles in order to construct the proposed two storey basement.
- 5.6. It is accepted that the development will have no adverse effect on drainage or run off as there is no increase in impermeable area and the site is not in an area known to be at risk from surface water flooding.
- 5.7. It is accepted groundwater flow is unlikely to be significantly affected by the development. However, Curtins recommendation for groundwater monitoring should be adopted and reported in a Basement Construction Plan with confirmation of the likely impact.
- 5.8. The building damage assessment suggests that damage to surrounding structures should not exceed Category 2 (very slight). An email provided on 21 August 2015 indicated that the only services likely to be at risk between Gordon Street comprise a sewer at 4m bgl.
- 5.9. For a basement of this depth, ground movements and resultant building damage are highly dependent on the construction sequence and methodology. It is understood that the ground movement and building damage assessment will be updated by the GCG on behalf of Curtins once a contractor is appointed and the scheme has been finalised.
- 5.10. The BIA and appended documents have confirmed that the impacts of basement construction on surface water flow, subterranean groundwater flow and stability can be successfully

mitigated. It is recommended that the following matters are addressed in a Basement Construction Plan.

- Detailed Construction Method Statement
- Groundwater monitoring and confirmation of impact on groundwater flow
- Updated Ground Movement and Building Damage Assessment for final scheme
- Confirmation of impacts on surrounding buried services.

Appendix 1: Residents' Consultation Comments

None

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	Author qualifications	The BIA and BIA Stage 4 have been prepared by a chartered structural engineer	Evidence of experience to be provided as required by CPG4	21.8.2015
2	Subterranean water flow	Potential changes to groundwater flow to be confirmed	Groundwater level, flow direction and extent of underground construction to be confirmed	21.8.2015
3	Stability	Scheme specific ground movement and building damage assessments required	To be provided	21.8.2015
4	Stability	Impact on adjacent highway to be considered	To be provided	21.8.2015
5	Stability	Construction sequence for current scheme is generic	Scheme specific sequence to be provided	21.8.2015
6	Stability	Monitoring proposals to be revised for scheme specific GMA	To be provided in BCP	N/A
7	Crossrail 2 safeguarding zone	Impact of any constraints to development to be confirmed and agreed with Crossrail	To be confirmed	N/A

Appendix 3: Supplementary Supporting Documents

GREATER LONDON LONDON BOROUGH OF CAMDEN

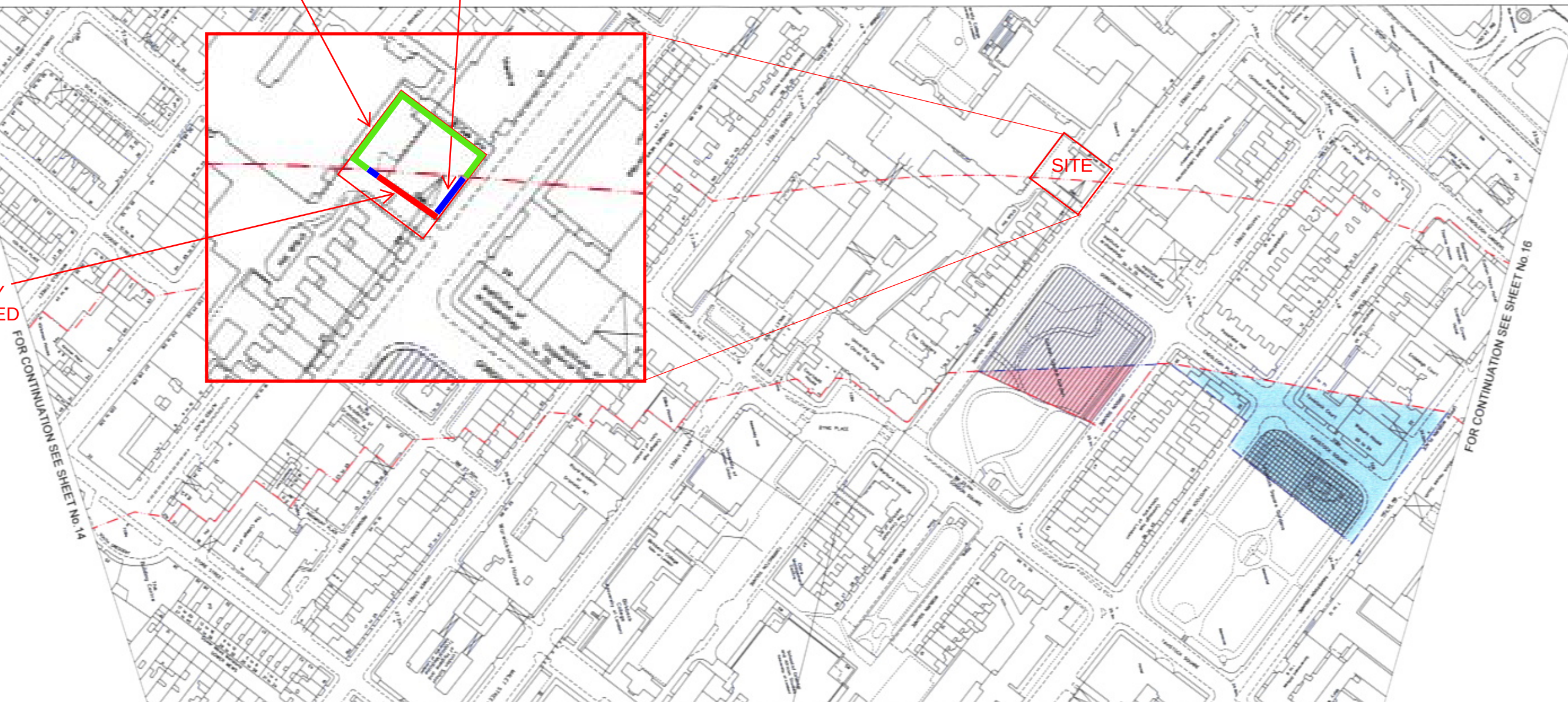


PILES OUTSIDE THE SAFEGUARDING
ZONE OF CROSSRAIL 2

PILES TO BE INSTALLED WITHIN THE SAFEGUARDING
ZONE WILL MOVE AWAY FROM THE EXISTING PILES
AND FROM THE PROPOSED ROUTE OF CROSSRAIL 2

PILES
ALREADY
INSTALLED

SITE



--- 1991 Safeguarding Limits where different from 2007 Limits
--- 2007 Safeguarding Limits

Limit of Land Subject to Consultation

Areas of Surface Interest

CHELSEA HACKNEY LINE SAFEGUARDING DIRECTIONS SHEET NO.15

DRAWING No. 210501-GOG00-F00-F-50015 SCALE 1:1,250 @ A1
1:2,500 @ A3

DATE 5 March 2007

Cross London Rail Links Ltd
1 Butler Place
London
SW1H 0PT

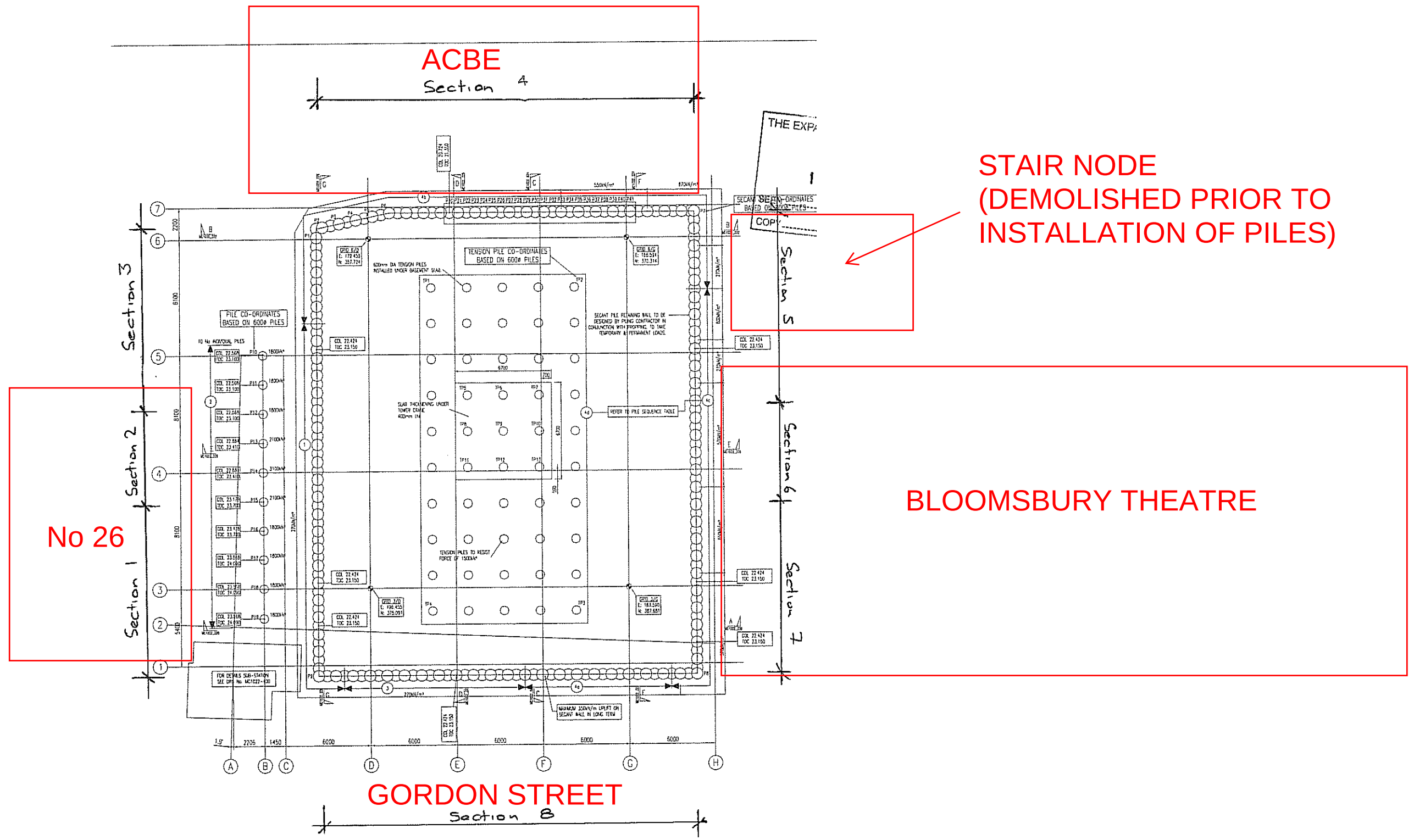
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DRAWN	CW
CHECKED	IWH
APPROVED	TW

Area where 2007 Safeguarding limits are
greater than the Limits of November 1991.
Area where November 1991 Safeguarding
limits are greater than the Limits of 2007.

Area where 2007 Area of Surface Interest is greater
than the Surface Interest of November 1991.
Area where November 1991 Area of Surface Interest
is greater than the Surface Interest of 2007.

Scale for Plan
50 0 50 100 150 Metres





RE: 2015/3302/P - UCL Student Centre

Stefano Strazzullo to: Carr, Seonaid, Maung, Richard (UK - London) (rmaung@deloitte.co.uk),
Oliva, Leonie (UK - London)
Cc: "Bird, Ellie (UK - London) (ebird@deloitte.co.uk)", "Simons, Tom (UK - London) (tsimons@deloitte.co.uk)",
"LizBrown@campbellreith.com",

24/07/2015 12:40

2 attachments



UCL Student Centre - Piled wall sections.pdf Crossrail 2 safeguarding zone.pdf

Dear Seonaid,

Thank you for your e-mail, I will try to reply as quickly as possible once the Campbell Reith report is returned.

My initial comments are:

The calculations produced by Expanded piling are for piles that have already been installed. These have been designed for the proposed propping arrangement therefore the 4 lines of props will need to be adopted and if required we will put that in the specifications. The reason why the previous pile calculations have been adopted is because almost ¼ of the piles are already in the ground and will be reused therefore in our view those are applicable in view of my previous comment.

On the second point I have attached a mark-up of the plan with the 8 sections and indication of the orientation, this should help to better understand which section applies where.

With regards to cross rail 2 I have attached a mark-up of the safeguarding zones mentioned in our conversation highlighting that the pinch point is already in the ground and only a small number of the new piles is within the zone but behind the piles already installed in relation to the Crossrail line. As the site is on the boundary most of the piles are outside the safeguarding zone.

We will re-assess ground movement based on the Campbell Reith report when received.

Best,
Stefano

Stefano Strazzullo Associate

Curtins

T. 020 7324 2240 | F. 020 7324 2241 | stefano.strazzullo@curtins.com

From: Carr, Seonaid [mailto:Seonaid.Carr@camden.gov.uk]

Sent: 24 July 2015 11:38

To: Stefano Strazzullo; Maung, Richard (UK - London) (rmaung@deloitte.co.uk); Oliva, Leonie (UK - London) (lOliva@deloitte.co.uk)

Cc: Bird, Ellie (UK - London) (ebird@deloitte.co.uk); Simons, Tom (UK - London) (tsimons@deloitte.co.uk); LizBrown@campbellreith.com; c.mason@nicholashare.co.uk; Sexton, Gavin

Subject: 2015/3302/P - UCL Student Centre

Dear All,

Unfortunately the application is not going to make the agenda for the 6th August

Committee.

Campbell Reith have raised some observations to the approach used for the ground movement assessment within the BIA which need to be addressed ahead of the proposal being presented to Members with the recommendation of approval. The ground movement assessment provided has used the assessment of the retaining wall deflection from the previous application done by Expanding Piling. This is not an acceptable assessment of the impact of the proposed basement on neighbouring buildings. It is expected that assessments are based on the proposals which form the application as proposed, not previous applications.

Campbell Reith have identified a number observations on the approach of using studies from the previous application:

- Expanded Piling's assessments were for a 10-12m deep excavation with 4 rows of temporary props. As a result of the propping, they predict very low wall movements (8 to 24mm). In our experience, it would be unlikely to have so many levels of propping. The new basement depth is around 10m, so whilst shallower, it will definitely have fewer levels of propping and they might be at larger intervals than assumed by Expanded. This could give greater wall movements with the potential for greater damage.
- Expanded looked at 8 different sections of basement and Curtins note that 3 are not significant. There is no orientation on the plan or indication of surrounding buildings to demonstrate that.
- Curtins note that ground movements occur due to pile installation as well as excavation. Expanded's predictions are related solely to excavation. Curtins suggest that movement associated with installation could be 0.05% of the pile length (agreed) and state that is negligible. Assuming a 15m long pile, horizontal movement of 7.5mm might be expected, resulting in total horizontal movements of 15 - 30mm if Expanded's figures are correct.
- In Curtins damage assessment (text and calculation) there appears to be some confusion over small delta and whether it relates to vertical and horizontal deflection. In the example that was checked in detail (wall part 2), we would also disagree with the assumption of 'L'. If Curtins statement that movements revert to zero at a distance equivalent to the pile length is correct, it would seem reasonable that L should be roughly equivalent to the pile length (or 13m from the plot of data for wall part 2), otherwise the strain is underestimated. CIRIA C580 indicates that horizontal movements reduce to zero at a distance equivalent to 4D. If Expanded's figures were correct, using L = 13m and assuming that horizontal deflections reduce linearly to zero at 4D, and vertical deflections reduce to zero over 13m, gives a damage category of 1.
- As noted above, the damage assessment is highly dependent on the construction methodology, thus for a basement of this depth, with surrounding listed buildings, we consider that a scheme specific methodology and ground movement assessment should be carried out to demonstrate that damage to surrounding structures can be limited to Category 2 using normal construction techniques. The method of calculating building strain also need revisiting.

There is also some concern in respect of the impact on Crossrail 2, I spoke to Stefano about this, this morning, who advised that the piles located to the southern area of the site are already in situ given the implementation of the previous

permission. However we need to know how far the piles are from the crossrail2 safeguarding zone and what type of piles they are: bearing piles or perimeter piles. Some further information on this would be appreciated. If you have had any contact with Crossrail2 to ensure the development would not be impacted in the future by the crossrail2 line can this be forwarded on. One principle within the Site Allocations Document is to safeguard the future potential of the Chelsea -Hackney line which is now known as crossrail2, therefore any development on site is expected to be mindful of this connection.

Campbell Reith's full report will be with us on Monday and I will send this on once I have it.

In respect of timeframes to ensure the application makes the committee on 03rd September, I would need to have a revised ground movement assessment by 3rd August to ensure Campbell Reith have time to review the report for me then to finalise my report for the agenda. Reports have to be completed by 18th August, however I am on leave from 7th -17th August and would like to ensure this is on the agenda ahead of going on leave.

In terms of the Section 106 and ensuring a decision is issued within 13 weeks, I can instruct this today and we can commence negotiations on the clauses and contributions between now and the committee meeting. Therefore the S106 will be ready for signing should Members agree with the recommendation of approval at Committee.

Regards,

Seonaid Carr
Principal Planning Officer

Telephone: 020 7974 2766

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UCL Student Centre

Stefano Strazzullo to: Lizbrown@campbellreith.com

21/07/2015 10:47

History:

This message has been replied to.

1 attachment



UCL Student Centre - Visited basements.pdf

Dear Liz,

I am the engineer looking at the UCL Student Centre design and I have prepared the BIA with my colleague Suleyman.

When compiling the Bia we have visited or had colleagues visit buildings within the 250m radius described in the scoping BIA.

Most of the basements are single storey but three of the ones assessed were two storeys of varying depth.

All the single storey basements visited were dry and of the two storeys deep basements, one (identified as No. 8 on the attached map) was found to have water ingress at the lower level, but this is over 10m deep.

Will call to discuss further.

Best,

Stefano



[Click here](#)

Stefano Strazzullo

Associate

T. 020 7324 2240

stefano.strazzullo@curtins.com



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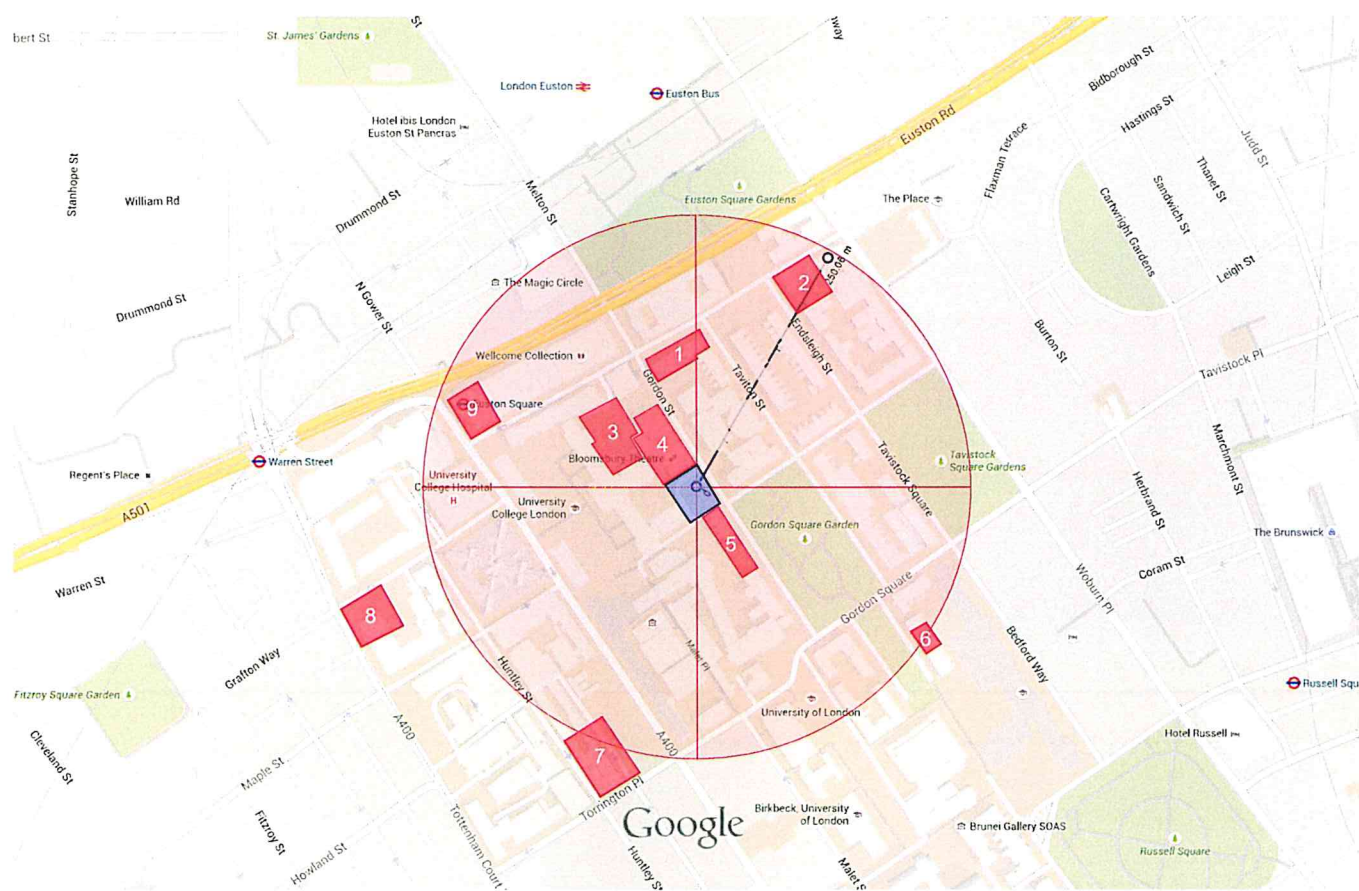
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Site of proposed UCL Student Centre ■

100 m 

- 1 UCL Wates House - Single storey basement, dry.
- 2 UCL Faculty of Laws - Two storey basement, dry.
- 3 UCL Wilkins Terrace - Shallow tunnels, dry.
- 4 Bloomsbury Theatre - Single storey basement and shallow tunnel, dry.
- 5 UCL Department of German, Archaeology and other - Single storey basements and semi-basements, dry.
- 6 Confucius Institute - Single storey basement, dry.
- 7 UCLH PTBC - Two storey basement, dry upper level (to 4m deep), water ingress in lower level, (7m high).
- 8 UCLH Cancer Centre - Single storey basement, dry.
- 9 Euston Station - Underground station, no evidence of water ingress in entrance hall, 6+m deep.

Appendix 4 – Detailed comments on BIA Stage 4

Groundwater flow

Curtins noted that they would carry out a reconnaissance survey of basements for a distance of 250m along Gordon St. Subsequent clarification confirms they visited the basements of the properties either side together with a number of others within the vicinity of the site. The scale bar indicates the distance of the reconnaissance zone is a little over 100m of the site. We know of a number of other basements within the radius that were not identified and do not know if others exist within the zone of influence.

Curtins have referred to a technical paper by Mott MacDonald to estimate changes to groundwater levels resulting from construction. They state that for a development of 30m by 30m, the groundwater level will not be altered by more than 200mm and therefore is not significant. This does not consider the impact of neighbouring basements which increases the dimension of the underground basement construction to around 80 - 100m.

Although this will not result in flooding, changes in water level could be significant for construction so maybe Curtins should revisit and confirm their assumptions about the length of underground construction and depths where appropriate. The assumption about the depth and direction of groundwater flow should also be confirmed as it may be affected by the proximity of a former tributary to the 'lost' River Fleet.

Ground movement assessment and building damage estimates

Curtins have used assessments of retaining wall deflection prepared by Expanded Piling for a previous scheme at the site. Curtins predict Category 0 damage (negligible), however, we have a number of observations on this approach

- Expanded Piling's assessments were for a 10-12m deep excavation with 4 rows of temporary props. As a result of the propping, they predict very low wall movements (8 to 24mm). In our experience, it would be unlikely to have so many levels of propping. The new basement depth is around 10m, so whilst shallower, it will definitely have fewer levels of propping and they might be at larger intervals than assumed by Expanded. This could give greater wall movements with the potential for greater damage.
- Expanded looked at 8 different sections of basement and Curtins note that 3 are not significant. There is no orientation on the plan or indication of surrounding buildings to demonstrate that.
- Curtins note that ground movements occur due to pile installation as well as excavation. Expanded's predictions are related solely to excavation. Curtins suggest that movement associated with installation could be 0.05% of the pile length (agreed) and state that is negligible. Assuming a 15m long pile, horizontal movement of 7.5mm might be expected, resulting in total horizontal movements of 15 - 30mm if Expanded's figures are correct.
- In Curtins damage assessment (text and calculation) there appears to be some confusion over small delta and whether it relates to vertical and horizontal deflection. In the example that was checked in detail (wall part 2), we would also disagree with the assumption of 'L'. If Curtins statement that movements revert to zero at a distance equivalent to the pile length is correct, it would seem reasonable that L should be roughly equivalent to the pile length (or 13m from the plot of data for wall part 2), otherwise the strain is underestimated. CIRIA C580 indicates that horizontal movements reduce to zero at a distance equivalent to 4D. If Expanded's figures were correct, using L = 13m and assuming that horizontal deflections reduce linearly to zero at 4D, and vertical deflections reduce to zero over 13m, gives a damage category of 1.

As noted above, the damage assessment is highly dependent on the construction methodology, thus for a basement of this depth, with surrounding listed buildings, we consider that a scheme specific methodology and ground movement assessment should be carried out to demonstrate that damage to surrounding structures can be limited to Category 2 using normal construction techniques. The method of calculating building strain also need revisiting.

Appendix 4 Rev 1 – Detailed comments on BIA Stage 4 and Ground Movement and Damage Assessment

Groundwater flow

Curtins noted that they would carry out a reconnaissance survey of basements for a distance of 250m along Gordon St. Whilst it is not known if this has been done, the revised BIA has provided details on the depths of neighbouring basements.

Ground movement assessment and building damage estimates

Curtins revised assessment still relies on estimates of retaining wall deflection prepared by Expanded Piling for a previous scheme at the site. Curtins now predict Category 2 damage to 26 – 28 Gordon St and Category 1 elsewhere. We still have a number of reservations with respect to this approach. In addition to the technical reservations described below, does the client have the authority to be able to rely on this information?

A detailed commentary on the revised documentation is provided below:

BIA Report Text

- Para 1.1 states the basement is approximately 10m deep. Other references state the basement depth is c 8.50m depth.
- Section 2 notes that there is the potential for damage to structures and the highway – there is no consideration of the impact on the highway.
- Section 3 - Curtins propose to calculate the damming effect of the basement and cross check against the results of a similar exercise (Mott MacDonald for Crossrail). Curtins have estimated the impact on the groundwater using Mott MacDonald's research but we have not seen Curtins independent calculations.
- Section 4 notes that the information from two GIs has been used to produce the GMA and that Curtins Phase 2 investigation confirmed the validity of the original design. Curtins Phase 2 investigation comprised 3 window sample holes to a maximum depth of 4m. It is also noted that perched water was encountered at 4m bgl – where is this recorded?
- Section 5 states that the lower 6m of the basement will be in the London Clay. However, Table 1 notes that the London Clay surface is at around +18m OD (i.e. <4m above basement level).
- Section 5.3 states that heave of 180kN is anticipated. This needs to be clarified. It should be demonstrated that the heave will be contained within the basement area (Section 5.4).
- Construction method statement – this has been expanded and now contains the key details. However, it differs significantly from the assumptions made in the Wallap analyses prepared by Expanded Piling.

Ground Movement and Damage Assessment

- Section 1 gives the basement depth at c 8.50m and notes that the retaining wall piles will be 880mm diameter. Wallap analyses for sections 4 to 8 are for a 750mm dia pile wall. The ground conditions are noted as being Made Ground over London Clay. However, there is a notable thickness of River Terrace Gravel between the two.
- Section 2 – the distance behind the wall within which settlement might be experienced should be determined as part of the ground movement assessment.
- Section 4 – para 2 notes that the methodology and sequence in Expanded Piling's analyses are valid because the ground parameters are the same. This is not true. The propping arrangement, dig level and possibly pile diameter are all different. Section 4.2 is also not correct in this regard.
- Section 4.3 – for the reasons given above and in our previous comments, it is not appropriate to use Expanded Piling's analyses. This section does not acknowledge the potential damage to the highway referred to in the BIA text.
- Section 3 para 3 needs to be clarified. Additionally it seems to suggest that part of the basement has already been constructed. Table 3 is not based on reliable information as noted above.

Design calculations for Building Damage Assessment

The following comments are generally applicable to all sections considered.

- The cross sections prepared by Curtins show 3 props with vertical spacing up to 5.30m. Expanded Piling's analyses are based on props with a maximum spacing of 3.30m
- Pile lengths do not correspond with those assumed by Expanded Piling. For example the toe depth for section 1 is given as +13.85m vs +10.25m by Expanded Piling. It is unlikely that the piles will terminate 2m below SSL. In other sections, piles are as short as 6m.
- In section 1 (and others) the plot of settlement due to pile installation doesn't agree with the value estimated previously e.g 5mm estimated and 13mm plotted at the back of the wall.
- The plots show settlement only. Where has horizontal movement been considered?
- The lengths assumed for the affected buildings could underestimate strain as the settlement is not linear. The strain should be calculated between foundations and not for the full length of the building. This was described previously.
- In section 2, how is the ground supported between +20 and +23.65m?

Monitoring Proposals

These are generally fine but will need to be revisited for the predicted ground movements.

Groundwater Monitoring



Soil Mechanics

Hole ID	Instrument ID	Instrument Type	Base of Instrument (mBGL)	Reference Depth (mBGL)	Reading				Comments
					Date	Time (hhmmss)	Water Level (mBGL) * calculated	Head (m above Tip) * calculated	
BH2	1	SP	6.3	0.00	27 Oct 2006		5.05		
BH2	1	SP	6.3	0.00	10 Nov 2006	073000	5.50		
BH2	1	SP	6.3	0.00	20 Nov 2006	080000	5.00		
BH2	1	SP	6.3	0.00	30 Nov 2006	070000	5.00		
BH2	1	SP	6.3	0.00	15 Dec 2006	103000	5.10		
BH2	3	SPIE	8.4	8.40	27 Oct 2006		4.92	3.48 *	
BH2	3	SPIE	8.4	8.40	10 Nov 2006				Dry
BH3	1	SP	6.7	0.00	27 Oct 2006	111000	5.09		
BH3	1	SP	6.7	0.00	10 Nov 2006	071000	5.09		
BH3	1	SP	6.7	0.00	20 Nov 2006	073500	5.10		
BH3	1	SP	6.7	0.00	30 Nov 2006	072000	5.00		
BH3	1	SP	6.7	0.00	15 Dec 2006	110000	5.05		
BH3	3	SPIE	25	25.00	27 Oct 2006				Dry
BH3	3	SPIE	25	25.00	10 Nov 2006				Dry
BH3	3	SPIE	25	25.00	20 Nov 2006		5.10	19.90 *	

Notes: Type: SP - Standpipe, SPIE - Standpipe Piezometer, HPIE - Hydraulic Piezometer, PPIE - Pneumatic Piezometer, EPIE - Vibrating Wire Piezometer, PWEL - Pumping Well



Project UCL Panopticon Building
Project No. D6056
Carried out for UCL Estates and Facilities

Sheet

B2

UCL Student Centre

Movement monitoring

Curtins Ref: LO1254A

Revision: 02

Issue Date: 04 August 2015

Client Name: University College London

Site Address:

Gower Street, vacant site between No 26 and Bloomsbury Theatre



Rev	Description	Issued by	Checked	Date
00	Preliminary issue for comment	SS	SS	10/07/2015
01	Issue for comment	SS	SS	04/08/2015
01	Updated to suit revised Ground movement and damage assessment report	SS	SS	19/08/2015

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Author	Signature	Date
Stefano Strazzullo BEng(Hons) Associate		19/08/2015

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1.0 Introduction

Due to the close proximity of the Bloomsbury Theatre, Georgian Terrace at No. 26 and the ACBE the method of construction, type of retaining wall, propping, monitoring and excavation sequencing have been assessed, with the Contractor responsible to undertake the final design of the wall, propping, excavation sequence and relevant monitoring of movement to the adjacent properties.

The foundations have been designed with the intent to minimise ground movements and anticipate their likely consequences to the neighbouring buildings.

The potential risks have been identified together with the methodology to minimise them, however some residual risks remain during the construction of the basement as ground movements will be unavoidable and whilst it cannot be eliminated it can be managed.

The magnitude of the movement of the perimeter wall to the basement and effect to existing building will vary around the perimeter of the basement as the distance, loads and construction of the existing buildings differ. The movement cannot be predicted accurately as it will depend on a number of factors including ground conditions, the chosen method and sequence of construction and the response of the existing buildings to the movement.

To understand the effects of the movements it is essential that a condition survey of the adjacent buildings is carried out before the excavation commences. As with all excavations adjacent to existing buildings, the installation of a monitoring system is to be provided by the contractor together with a detailed methodology of recording and monitoring the results agreed prior to the commencement of any ground works.

This system will provide useful information on how excavation is affecting the buildings and will provide an early warning of excessive deflections. A proposal for the minimum monitoring requirements is given on drawing LO1254-S-M01. This will need to be reviewed by the Contractor to make adjustments as he feels necessary to be fully satisfied that these will be adequate. Monitoring equipment should be installed as soon as the Contractor takes possession of the site to enable baseline conditions to be established before any piling or excavation works begin. A minimum of 20% of the monitoring stations should be accessible after completion of the works to allow for ongoing monitoring should it be deemed necessary.

The construction of a deep basement will result in unavoidable movement of the ground caused by the change in pressure within the soil matrix and the effect of introducing ground works such as piled walls. The ground movement will cause movement of the existing foundations adjacent to the new excavation, the magnitude of movement reducing with distance from the excavation.

Predicted ground movements have been estimated using the procedure outlined CIRIA report C580.

These expected settlement of the ground around the excavation is dependent on the design of the basement structure, the construction techniques used, the sequencing of works and the quality of the workmanship.

The contractor is responsible for all of these and the design must set an acceptable level of movement that will limit the damage to adjacent structures at the end of the defects period to Damage Category Classification 2 (Slight damage) as defined by Burland, 2001 (1)

Whilst movement from the flow of ground water should be relatively small in comparison to those described above as the majority of the excavation occurs in cohesive material it should be considered. The SI report shows a perched water table within the Taplow Gravels. Most of the flow from this should be cut off by the secant pile wall however should dewatering be necessary it would be advisable to monitor the water table outside of the excavation by, for instance, the installation of a standpipe.

1. Burland, J. B. Standing, J. R. Jardine, F. M. Building response to tunnelling: case studies from construction of the Jubilee Extension, London. Volume 1: Projects and methods, CIRIA Special publication 200, CIRIA and Thomas Telford, London, Sections: 3.3.4, 3.4, 3.5, 3.6. The key table is also included in the CIRIA report C580.

2.0 Target Points

The following monitoring methods are proposed for the site:

1. Settlement points to be installed around the perimeter of the secant pile wall before the works commence. These are then monitored during construction in order to both confirm the movement predictions are correct and to give a warning in the event that they are likely to be exceeded to allow the construction procedure to be modified if necessary.

It is proposed that 4 settlement points on the south boundary along No 26, 3 settlement points on the footpath along Gordon Street and 4 settlement points adjacent to the “node” stair on the north boundary are monitored.

2. Inclinometers to be installed on the piles along the perimeter of the excavation, minimum three per side, final location to be agreed with the contractor.
3. Tilt meters attached to the façade of the existing buildings around the perimeter of the excavation, proposed three each on the façades of the Bloomsbury Theatre, ACBE and No 26.

All the proposed monitoring points above summarised on plan on drawing LO1254 – S-M01 in Appendix A.

3.0 Trigger Levels

The movement will be monitored using a staged trigger level with a traffic light warning system based on the final movements expected and proposed mitigation measures to control further movement. The minimum trigger levels are to be set as shown in the table below but the final system used by the contractor is to be submitted for approval in advance of commencing works on site.

It should be noted that the structures that bound the site perimeter vary and therefore so does their susceptibility to movement during the installation of the wall and the subsequent excavation.

Trigger Level	% of anticipated maximum overall movement	Suggested action
1	50	Notify the structural engineer and provide proposals on how the work will continue
2	75	Notify the structural engineer and provide proposals on how the work will continue with the inclusion of further measures taken, such as increasing the occurrence of the measuring.
3	100	Stop work. Assess safety on site. Notify the structural engineer and provide proposals on how the work will continue, such as installing additional temporary propping.

From the Ground movement assessment report the predicted values of horizontal and vertical movement vary around the perimeter therefore it is proposed that different trigger levels will be adopted in each location to suit the predicted ground movement.

Based on a notional predicted settlement of 20mm proposed trigger levels would be as follows:

	1	2	3
Maximum predicted settlement 20mm	10mm	15mm	20mm

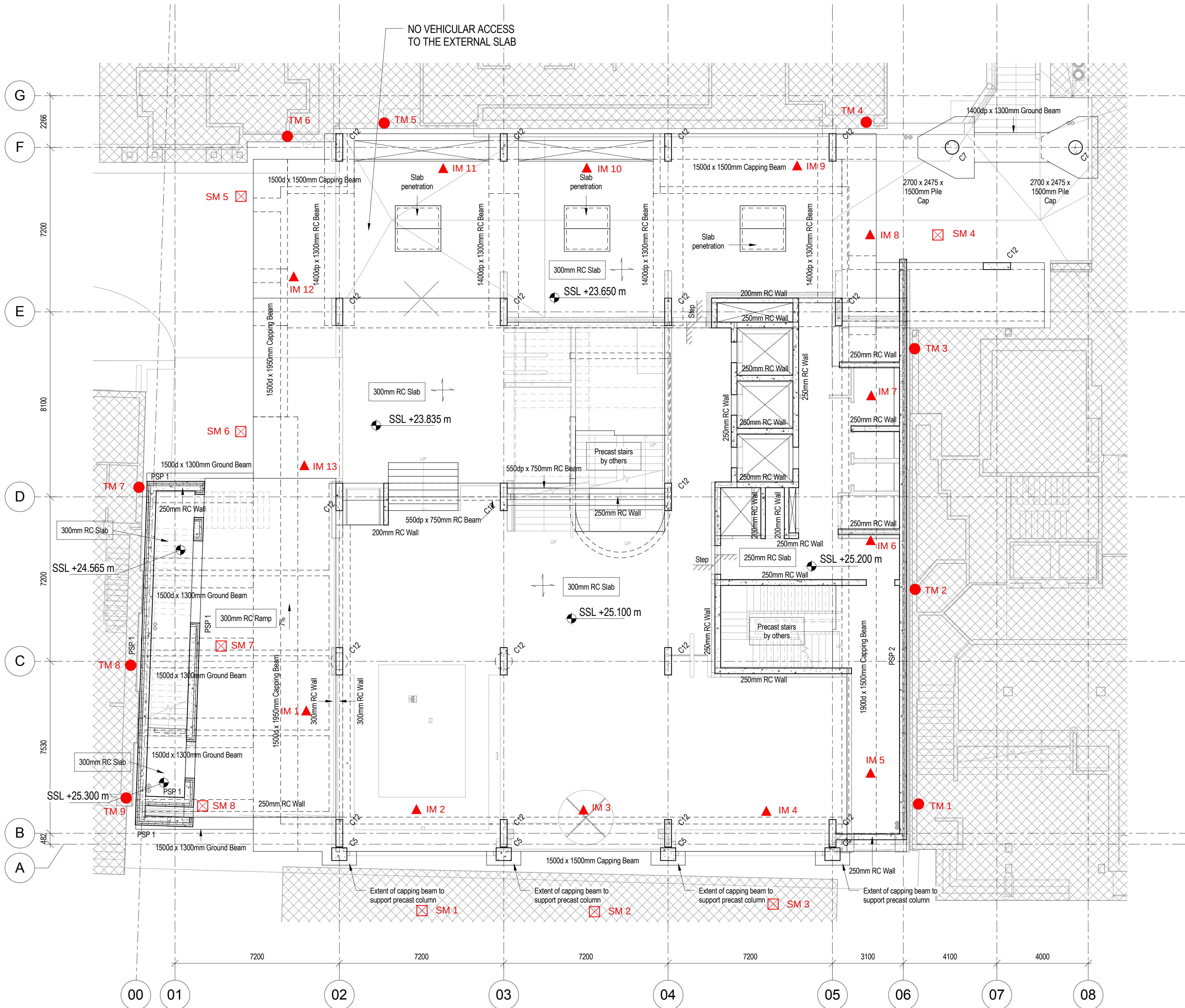
The “Amber” level triggers an immediate review of the situation and proposals on any modification to the works, the “Red” level triggers immediate action as agreed at the “Amber” stage.

4.0 Monitoring Frequency

It is proposed that monitoring of movement will continue throughout the construction period and at least till the end of the defects liability period. For this reason all monitoring stations must be installed, protected and maintained throughout.

The proposed monitoring frequency is on a daily basis during the piling operations and basement excavation, to be reduced to once a week following the completion of the basement slab until all parties are satisfied that no further movement is taking place.

Appendix A – Proposed Monitoring



GA GROUND FLOOR LEVEL

1 : 100

NOTES:

1. This drawing is to be read in conjunction with all relevant Architects and Engineers drawings, details and specifications.
2. Do not scale this drawing. All details and dimensions are to be checked by the contractor and fabricator onsite prior to commencement of construction/fabrication. Any discrepancies are to be reported to the Engineer. Any existing dimensions noted on this drawing are to be checked by the contractor prior to commencement of works.
3. Any ambiguities, omissions and errors on the drawings, shall be brought to the Engineers attention immediately.

- ▲ IM Inclinometers with the piles to full depth. Final locations to be agreed with the Contractor.
- ☒ SM Settlement monitoring point.
- TM Tilt meters attached to the facade of the existing buildings.

P1	Preliminary Issue	15.07.15	AL	SS
Rev:	Description:	Date:	By:	Chkd:



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Status: **STAGE 3**

Project: **UCL - NEW STUDENT CENTRE**

Drig Title: **PROPOSED MONITORING**

Scale:	Size:	First Issue:	Drawn:	Checked:
1 : 100	A1	15.07.15	AL	SS

Drig No:	Rev:
LO1254 / S-M01	P1

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RE: BIA Review - Land between 26 Gordon Sq and 15 Gordon Street

Stefano Strazzullo to: LizBrown@campbellreith.com,
Sexton, Gavin ,
camdenaudit@campbellreith.com,
Cc: Jeremy Jones, Charlie Renold

19/08/2015 19:20

Dear Liz,
Information sent but on the "heavy side". Please let me know if you haven't received it and we will forward again in parts.
Best Regards,
Stefano

Stefano Strazzullo Associate

Curtins

T. 020 7324 2240 | F. 020 7324 2241 | stefano.strazzullo@curtins.com

From: Stefano Strazzullo

Sent: 19 August 2015 19:19

To: 'LizBrown@campbellreith.com'; Sexton, Gavin; camdenaudit@campbellreith.com; Carr, Seonaid

Cc: Jeremy Jones; Charlie Renold

Subject: RE: BIA Review - Land between 26 Gordon Sq and 15 Gordon Street

Dear Liz,

Please find attached revised Ground Movement and Damage assessment report and also Monitoring report updated to suit.

These have been carried out in accordance with CIRIA C580 and therefore provide a fairly conservative estimate of the ground movement as horizontal movements due to the installation of retaining walls are generally very small nowadays provided a competent contractor is undertaking the work and the actual deflection of the secant walls is also conservative.

The revised Ground Movement and Damage assessment report addresses all the your comments on the previous revision, i.e. the last two bullet points list on your schedule sent Friday.

To answer the queries in the first bullet point list:

- Basement depth varies, for the purpose of the revised calculations as discussed we have now assumed a 9.3m excavation and a secant wall piles length of 150% of the excavation depth.
- We looked at the highway settlement considered as part of the revised Ground Movement and Damage assessment report purely to estimate the settlement as the damage assessment method is not relevant.
We expect some movement of the highway and possibly some repair work required. The most likely damaged element, the pavement, will be resurfaced as part of the works.
- The figures presented from the Mott MacDonald work are directly read off the table presented and is provided as supporting information only;
- The water level monitoring is in the SI (buried in one of the 500 odd pages!), extracted and attached. It shows water 5m b.g.l. in the middle of the site therefore 4m b.g.l. at the lowest point of the site.
- Correct, that should have said 4m.
- We have looked at the ground movement due to heave with Pdisp, see attached, both immediately after the excavation and after the building has been completed (short and

long term).

Based on the check we believe that the movement due to heave at the perimeter of the excavation could be up to 15-17mm. This value does not take into account the likely reduction due to the presence of the piled wall.

The heave will counteract the settlement due to the installation and deflection of the piles and possibly result in some small upwards movement.

- The revised calculations are now aligned with the construction method statement.

I have also attached a revised monitoring proposal. This is now more generic as we are proposing that trigger levels are set for the predicted movement at each location. The expected movement and trigger levels will be set by calculations to be carried out on the final secant pile wall design rather than the initial assessment on which the Ground Movement and Damage assessment has been carried out to make sure that the monitoring is relevant.

Hopefully the attached answers all your queries.

I will be on annual leave from tomorrow but reachable via e-mail for any clarification.

Best Regards,

Stefano

Stefano Strazzullo Associate

Curtins

T. 020 7324 2240 | F. 020 7324 2241 | stefano.strazzullo@curtins.com

From: LizBrown@campbellreith.com [<mailto:LizBrown@campbellreith.com>]

Sent: 14 August 2015 14:38

To: Stefano Strazzullo; Sexton, Gavin; camdenaudit@campbellreith.com; Carr, Seonaid

Subject: BIA Review - Land between 26 Gordon Sq and 15 Gordon Street

Dear Stefano

We have completed our review of Curtin's revised BIA and ground movement assessment and have attached our comments. Despite our previous comments, the ground movement assessment still relies on analyses carried out for the previous scheme. For the reasons given previously and reiterated here, we do not consider this is an appropriate approach.

Perhaps we can speak on Monday once you have had an opportunity to review our comments.

The BIA requires a scheme specific assessment of likely wall deflections and the method of determining building damage also needs to be reviewed. I have agreed with Camden that if you can get the revised information to me by noon on Thursday next week, I will be able to get my comments to them on Friday.

Regards,

Liz Brown

Partner

CampbellReith
consulting engineers

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Re: BIA Review - Land between 26 Gordon Sq and 15 Gordon Street

Stefano Strazzullo to: LizBrown@campbellreith.com

21/08/2015 08:08

"camdenaudit@campbellreith.com", "Charlie Renold", "Sexton,

Cc: Gavin", Jeremy Jones, "Carr, Seonaid", "Peres Da

Costa, David"

2 attachments

CampbellReith CampbellReith

mime-attachment.jpg ATT00001.jpg

Dear Liz,

Reducing the file sizes must have affected resolution, we are re-sending the graphs.

We are also making the small changes to the BIA and GMDA documents re soil and the horizontal movement statement. This can again be done today.

The heave is 180 kN/m^2 , small typo there.

There is movement in the pavement where some services are present, but we don't believe it is significant enough to damage what is there. The sewer, which is more "delicate" is over 4m deep therefore barely affected.

Best,

Stefano

Sent from my iPad

On 20 Aug 2015, at 19:17, "LizBrown@campbellreith.com" <LizBrown@campbellreith.com> wrote:

Stefano

As a matter of urgency can you arrange to have the Category Assessments issued at a readable scale - I cannot read the axes on the plots of ground movement vs distance.

I have the following comments so far

Will the BIA and other documents be updated to be consistent with respect to basement depth? The conceptual model also needs to be updated to reflect the ground conditions e.g. thickness of London Clay at base of excavation = 4m, and River Terrace Gravel present (GMA section 1)

I note you have looked at settlement along the highway. Is there the potential for any services to be damaged?

The groundwater level readings that you provided are 9 years old, however, we note your intention to confirm groundwater levels prior to construction.

Re heave - should this be 180 kPa rather than 180 kN ?

In the Ground Movement and Damage Assessment, the distance over which settlement and horizontal movements are expected is given as being approximately equivalent to the length of the piles. That is not what CIRIA C580 says and it does not agree with your own analyses.

When will the revised BIA be issued?

Thanks
Elizabeth Brown
Partner

<mime-attachment.jpg>

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From: Stefano Strazzullo <Stefano.Strazzullo@curtins.com>

To: "LizBrown@campbellreith.com" <LizBrown@campbellreith.com>

Cc: "camdenaudit@campbellreith.com" <camdenaudit@campbellreith.com>, "Charlie Renold" <Charlie.Renold@curtins.com>, "Sexton, Gavin" <gavin.sexton@camden.gov.uk>, Jeremy Jones <Jeremy.Jones@curtins.com>, "Carr, Seonaid" <Seonaid.Carr@camden.gov.uk>

Date: 20/08/2015 12:45

Subject: Re: BIA Review - Land between 26 Gordon Sq and 15 Gordon Street

Dear Liz,

GCG have prepared that for us as part of the more detailed assessment we are setting up for the next stage, I have asked them to forward and Jeremy will pass over.

Best,

Stefano

Sent from my iPhone

On 20 Aug 2015, at 11:35, "LizBrown@campbellreith.com" <LizBrown@campbellreith.com> wrote:

Stefano

Thanks for the appended information which we are currently reviewing. Can you please send through the tabulated input and output data for the PDisp analyses (summary data as opposed to full data will be fine).

Regards
Elizabeth Brown
Partner

<mime-attachment.jpg>

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From: Stefano Strazzullo <Stefano.Strazzullo@curtins.com>
To: "LizBrown@campbellreith.com" <LizBrown@campbellreith.com>, "Sexton, Gavin" <gavin.sexton@camden.gov.uk>, "camdenaudit@campbellreith.com" <camdenaudit@campbellreith.com>, "Carr, Seonaid" <Seonaid.Carr@camden.gov.uk>
Cc: Jeremy Jones <Jeremy.Jones@curtins.com>, Charlie Renold <Charlie.Renold@curtins.com>
Date: 19/08/2015 19:28
Subject: RE: BIA Review - Land between 26 Gordon Sq and 15 Gordon Street

Dear Liz,

Please find attached revised Ground Movement and Damage assessment report and also Monitoring report updated to suit.

These have been carried out in accordance with CIRIA C580 and therefore provide a fairly conservative estimate of the ground movement as horizontal movements due to the installation of retaining walls are generally very small nowadays provided a competent contractor is undertaking the work and the actual deflection of the secant walls is also conservative.

The revised Ground Movement and Damage assessment report addresses all the your comments on the previous revision, i.e. the last two bullet points list on your schedule sent Friday.

To answer the queries in the first bullet point list:

- Basement depth varies, for the purpose of the revised calculations as discussed we have now assumed a 9.3m excavation and a secant wall piles length of 150% of the excavation depth.
- We looked at the highway settlement considered as part of the revised Ground Movement and Damage assessment report purely to estimate the settlement as the damage assessment method is not relevant.

We expect some movement of the highway and possibly some repair work required. The most likely damaged element, the pavement, will be resurfaced as part of the works.

- The figures presented from the Mott MacDonald work are directly read off the table presented and is provided as supporting information only;
- The water level monitoring is in the SI (buried in one of the 500 odd pages!), extracted and attached. It shows water 5m b.g.l. in the middle of the site therefore 4m b.g.l. at the lowest point of the site.

- Correct, that should have said 4m.
- We have looked at the ground movement due to heave with Pdisp, see attached, both immediately after the excavation and after the building has been completed (short and long term). Based on the check we believe that the movement due to heave at the perimeter of the excavation could be up to 15-17mm. This value does not take into account the likely reduction due to the presence of the piled wall.

The heave will counteract the settlement due to the installation and deflection of the piles and possibly result in some small upwards movement.

- The revised calculations are now aligned with the construction method statement.

I have also attached a revised monitoring proposal. This is now more generic as we are proposing that trigger levels are set for the predicted movement at each location. The expected movement and trigger levels will be set by calculations to be carried out on the final secant pile wall design rather than the initial assessment on which the Ground Movement and Damage assessment has been

carried out to make sure that the monitoring is relevant.

Hopefully the attached answers all your queries.

I will be on annual leave from tomorrow but reachable via e-mail for any clarification.

Best Regards,

Stefano

Stefano Strazzullo Associate

Curtins

T. 020 7324 2240 | F. 020 7324 2241 | stefano.strazzullo@curtins.com

From: LizBrown@campbellreith.com [<mailto:LizBrown@campbellreith.com>]

Sent: 14 August 2015 14:38

To: Stefano Strazzullo; Sexton, Gavin; camdenaudit@campbellreith.com; Carr, Seonaid

Subject: BIA Review - Land between 26 Gordon Sq and 15 Gordon Street

Dear Stefano

We have completed our review of Curtin's revised BIA and ground movement assessment and have attached our comments. Despite our previous comments, the ground movement assessment still relies on analyses carried out for the previous scheme. For the reasons given previously and reiterated here, we do not consider this is an appropriate approach.

Perhaps we can speak on Monday once you have had an opportunity to review our comments.

The BIA requires a scheme specific assessment of likely wall deflections and the method of determining building damage also needs to be reviewed. I have agreed with Camden that if you can get the revised information to me by noon on Thursday next week, I will be able to get my comments to them on Friday.

Regards,

Liz Brown

Partner

<mime-attachment.jpg>

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Click [here](#) to report this email as spam.[attachment "Groundwater monitoring extract.pdf" deleted by Liz Brown/CRH] [attachment "LO1254-Movement monitoring-rev02.pdf" deleted by Liz Brown/CRH] [attachment "Ground movement and damage category assessment rev3.pdf" deleted by Liz Brown/CRH] [attachment "ShortTerm Heave.pdf" deleted by Liz Brown/CRH] [attachment "Long Term Heave.pdf" deleted by Liz Brown/CRH]

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[attachment "ATT00001.jpg" deleted by Liz Brown/CRH] [attachment "ATT00002.jpg" deleted by Liz Brown/CRH]

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UCL Student Centre

Ground Movement and Damage Assessment

Curtins Ref: LO1254A

Issue Date: 21 August 2015

Client Name: University College London

Client Address:

Gower Street, vacant site between No. 26 and Bloomsbury Theatre



Rev	Description	Issued by	Checked	Date
00	Preliminary issue for comment	JJ	SS	15/07/2015
01	Issued for comment	JJ	SS	04/08/2015
02	Revised with CIRIA C580 ground settlement calculations	SS	SS	19/08/2015
03	Updated graphs in report	JJ	SS	21/08/2015

This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

Author	Signature	Date
Stefano Strazzullo BEng(Hons) Associate		19/08/2015

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2. Ground movement due to secant piled wall installation	2
3. Ground movements arising from excavation in front of wall	4
4. Ground movements due to retaining wall deflection.....	5
5. CONTROL OF GROUND MOVEMENT.....	6
6. BUILDING DAMAGE ASSESSMENT	7
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1. INTRODUCTION

The site is located on the west side of Gordon Street and consists of an urban setting constrained by a row of houses to the South (No.26/27/28/29 Gordon Street), the ACBE building to the West and Bloomsbury Theatre to the North.

The proposed development is a multi-storey building with a two-storey basement approximately 9.5 meters deep.

It is intended that an 880mm diameter secant piled retaining wall will support the sides of the excavation. This will be installed first followed by the bulk excavation. The excavation of the basement will be carried out in stages with three levels of temporary props. Once the excavation has been completed a thick slab will be cast to permanently prop the base of the retaining wall. The construction will then progress upwards with the permanent lining walls and floor slabs installed at B1 and ground, each slab propping the secant piled wall in the permanent condition. The superstructure will then be erected once sub ground structure is constructed.

Ground conditions comprise of made ground overlying River Terrace gravel and stiff London clay. The clay is homogenous, therefore it is assumed to behave in an undrained manner during the excavation period and in a drained manner in the long term.

Following the CIRIA C580 Guide tables to assign the category wall, it has been specified the wall is geotechnical Category 2 (Figure 2.4). Category 2 walls comprise conventional structures with no abnormal risks or unusual or exceptionally difficult ground or loading conditions.

The ground movements arising depend upon the ground conditions, the construction duration, methods used and the quality of workmanship

This report will concentrate on predicting the horizontal and vertical ground movements of the wall installation and soil excavation under adjacent structures using the procedure outlined in CIRIA guide C580.

2. Ground movement due to secant piled wall installation

Sequential construction of piles to form a wall causes the ground to move and to take up support in adjacent ground or on the back of an adjacent pile. Movements are therefore confined to local areas around the piles.

Ground surface settlements are greatest at the face of the wall and reduce to zero at a lateral distance corresponding to approximately 1 to 2 times the wall depth behind the wall. Vibrations caused by boring or piling may have caused densification of the coarse grained soils close to the piles.

Figures 2.8a and 2.8b in CIRIA C580 have been used to estimate the ground movements when installing the secant piled retaining wall in stiff clay (a for horizontal and b for vertical movement).

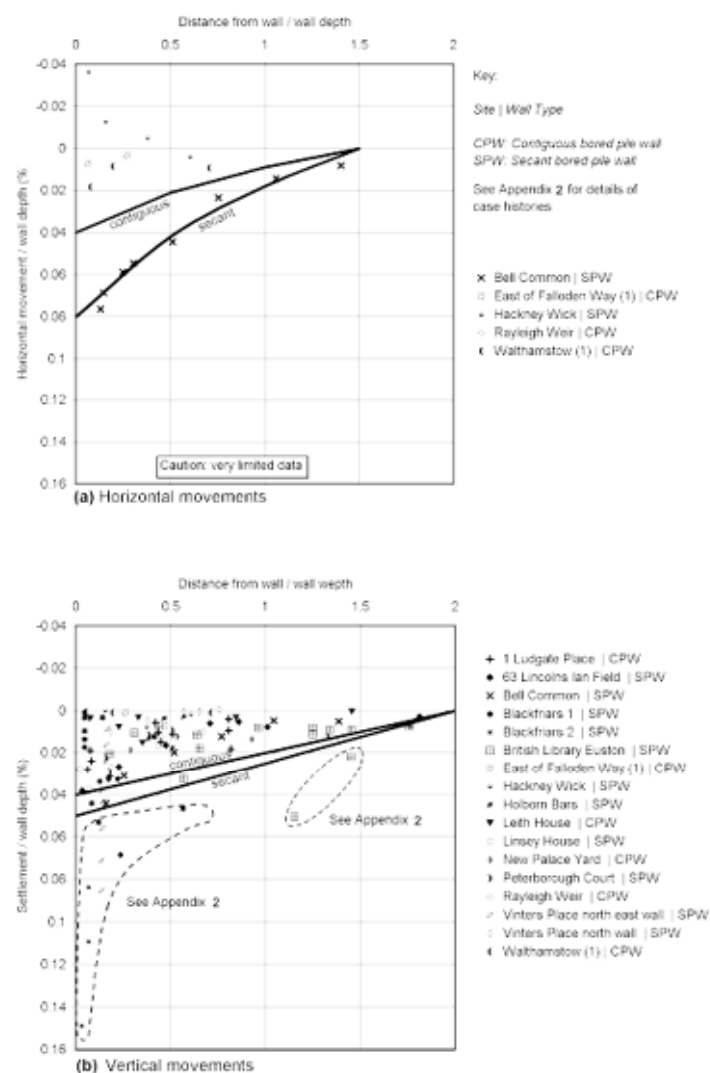


Figure 2.8 Ground surface movements due to bored pile wall installation in stiff clay

Figure 1 - Figures 2.8a and 2.8b from CIRIA C580

Ground Movement and Damage Assessment

The calculations of the predicted installation ground movement are shown in Appendix A. Calculations have been made on each condition around the perimeter of the excavation, a total of 8 different sections, as shown in figure 2 below.

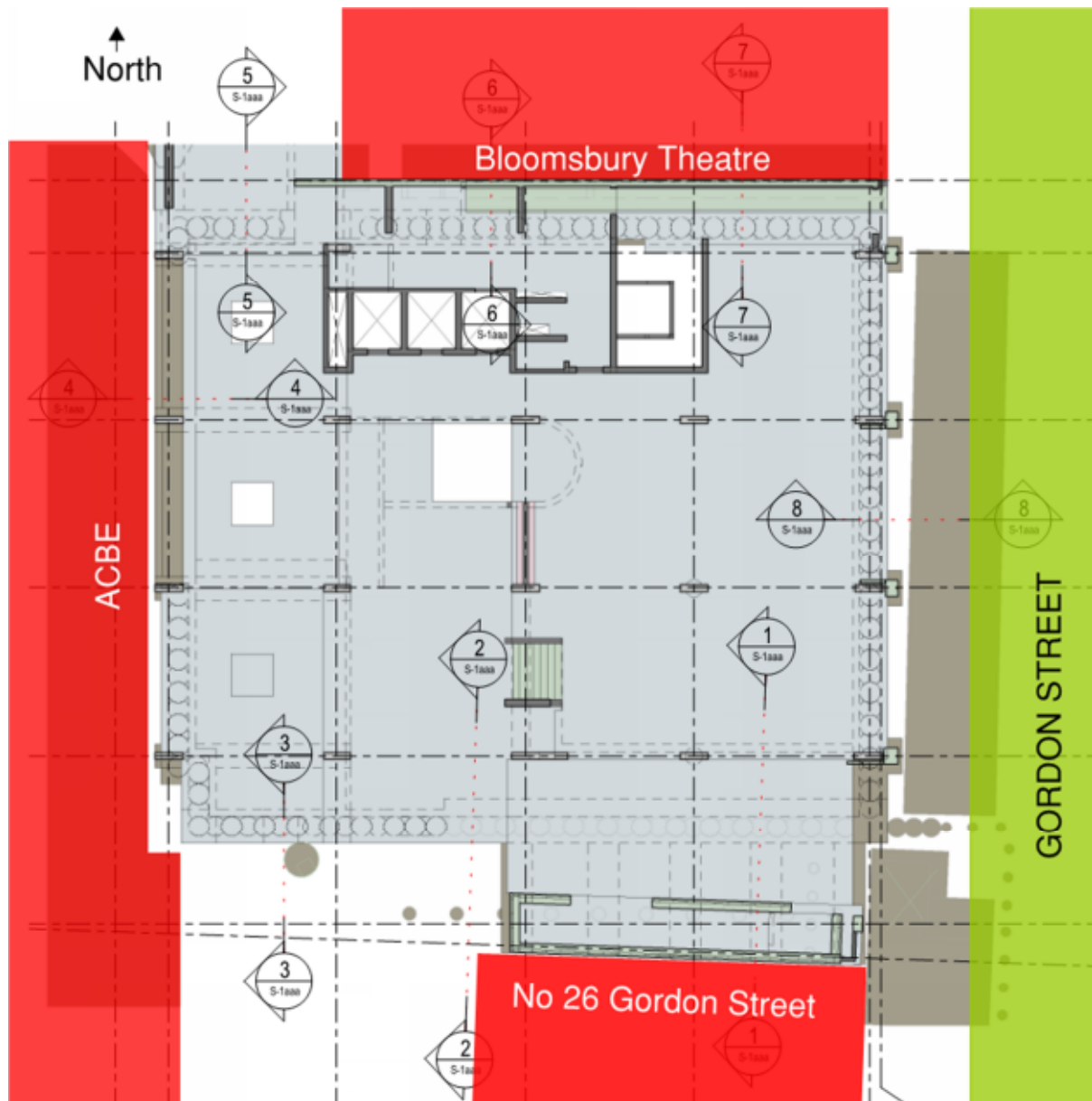


Figure 2 - Site with surrounding buildings and sections where ground movement has been calculated

3. Ground movements arising from excavation in front of wall

Movements induced by the excavation are made up of the response to the removal of lateral support to the sides of the wall and vertical load at the base of the excavation.

Figure 3 below shows typical movement patterns of the soil after excavation, the horizontal and vertical movements in the soil. The magnitude of the vertical movement depends on the plan and depth of the excavation and ground stratigraphy.

The construction of the retaining wall in this project has been taken as a high support stiffness being a propped secant pile retaining wall (Carder, Table 2.3 CIRIA C580).

From previous cases, the magnitude of horizontal wall deflection is almost totally dependent on the effectiveness of the support system.

The initial deflection, which takes place as the wall cantilevers after an initial excavation and before the first prop is installed, can, on occasions, be the largest component of the overall wall deflection. It is also the form of displacement most likely to cause damage to nearby structures. The early installation of a stiff first prop with a shallow first-stage excavation is one of the best ways to reduce wall deflections. Preloading the supports help to limit movements, and also could be obtained by using pre-stressed anchors.

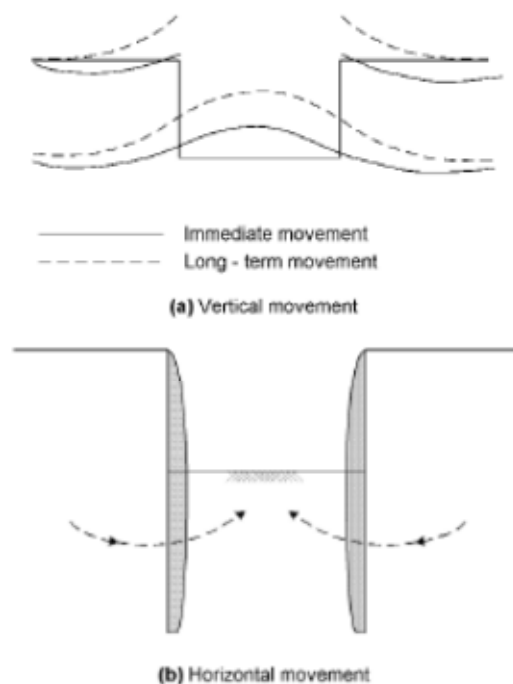


Figure 2.10 Typical ground movement pattern associated with excavation stress relief

Figure 3 - Figure 2.10 from CIRIA C580

4. Ground movements due to retaining wall deflection

At this stage the deflection of the piled wall has been assessed using the method described in CIRIA C580. At a later design stage the piling contractor will undertake a retaining wall analysis using WALLAP software or similar.

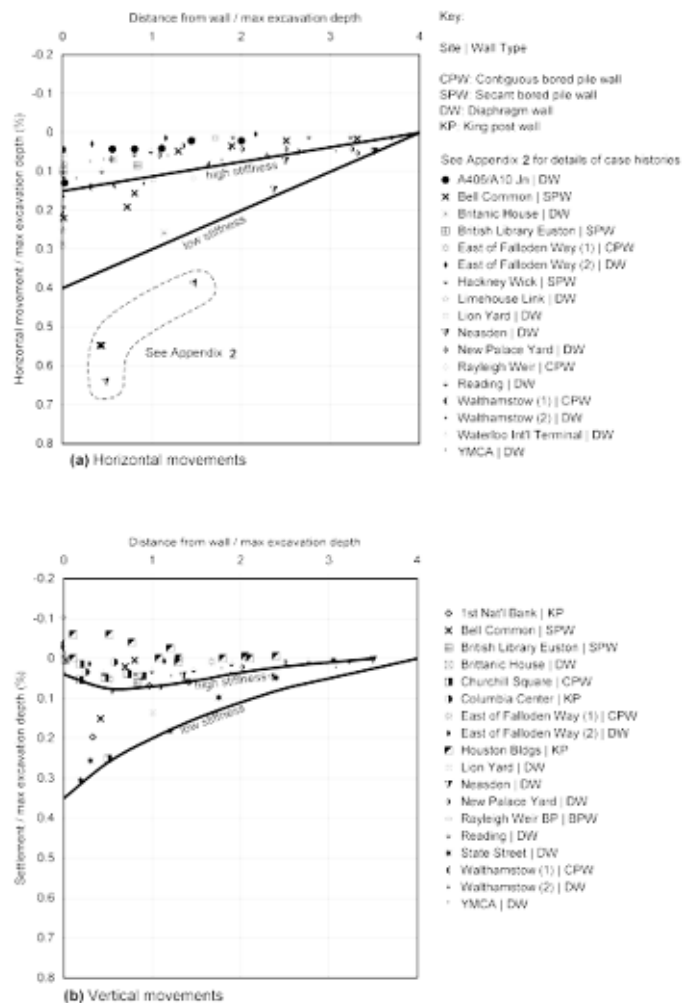


Figure 2.11 Ground surface movements due to excavation in front of wall in stiff clay

Figure 4 - Figures 2.11a and 2.11b from CIRIA C580

Figure 2.11a of CIRIA C580 has been used to determine the horizontal ground movement on the back of the wall due to the basement excavation in front of it. Figure 2.11b has been used to calculate the corresponding vertical movement. The results of the calculations around the perimeter of the basement are summarised in Appendix A.

5. CONTROL OF GROUND MOVEMENT

The calculations of the ground movement to the back of the retaining wall around the perimeter of the basement have been undertaken with the methodology described in CIRIA C580. Graphs showing the predicted ground vertical movement resulting from the piled installation, basement excavation and a combination of both have been plotted for each section considered and included in appendix A, together with the sample of the excel spreadsheet used to plot the movement curves in the worst situation.

Some measures can be adopted to minimise ground movements around and beneath the excavation. These are summarised below:

- Good workmanship is essential. Supports should be installed tight to the wall. The prop, and any packing between the prop and waling, should not rely on friction or adhesion between the prop end and waling to hold it in place
- The wall should have adequate embedment in stiff strata for satisfactory vertical and lateral stability
- Minimise the first-stage excavation and install the first (stiff) support as early as possible in the construction sequence
- Minimise the extent of the dig beyond the proposed support levels
- Minimise delays to the construction of the wall and its support system
- Prevent deterioration of lateral support from a clay berm by blinding it or covering it with a waterproof membrane to maintain the berm's natural moisture content
- Avoid over-excavation
- Minimise removal of fines during dewatering
- Minimise drawdown outside excavation

At locations where such movements are critically important, appropriate instrumentation should be installed and the ground movements monitored. It is crucial to show good workmanship and effective control of construction operation to minimise ground movements as this is usually the reason for larger magnitudes of ground movements than predicted.

6. BUILDING DAMAGE ASSESSMENT

The calculated ground movement have been used to assess potential 'damage categories' that may apply to neighbouring properties due to the proposed basement construction, as per CIRIA C580 section 2.5.4. The methodology proposed by *Burland and Wroth* and later supplemented by the work of *Boscardin and Cording* has been used, as described in CIRIA C580.

General damage categories are summarised in figure5 below:

Table 2.5 Classification of visible damage to walls (after Burland et al, 1977, Boscardin and Cording, 1989; and Burland, 2001)

Category of damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain ϵ_{tm} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible.	< 0.1	0.0–0.05
1 Very slight	<u>Fine cracks that can easily be treated during normal decoration.</u> Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.	< 1	0.05–0.075
2 Slight	<u>Cracks easily filled. Redecoration probably required.</u> Several slight fractures showing inside of building. Cracks are visible externally and <u>some repointing may be required externally</u> to ensure weathertightness. Doors and windows may stick slightly.	< 5	0.075–0.15
3 Moderate	<u>The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced.</u> Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5–15 or a number of cracks > 3	0.15–0.3
4 Severe	<u>Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows.</u> Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 but also depends on number of cracks	> 0.3
5 Very severe	<u>This requires a major repair involving partial or complete rebuilding.</u> Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	usually > 25 but depends on number of cracks.	

Notes

1. In assessing the degree of damage, account must be taken of its location in the building or structure.
2. Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

Figure 5 - Table 2.5 from CIRIA C580

For the critical neighbouring developments the combined impact of ground movement due to secant piled wall deflection and installation have been combined to determine the overall ground movement and impact on adjacent properties due to the construction of the basement.

The method for calculating the deflection ratios for the structures of No. 26 Gordon Street, Bloomsbury and ACBE are represented graphically in design calculations in Appendix A. The deflection ratio is calculated by using the relationship between the ground displacements and the perpendicular length of the adjacent structure. The lateral movements are considered to dissipate from a maximum at point of excavation to zero at a distance equivalent to 1.5 to 3 times the pile depth. Differential movements taken at footing levels across the span of adjacent structure are used to calculate lateral strain when considering the structure width.

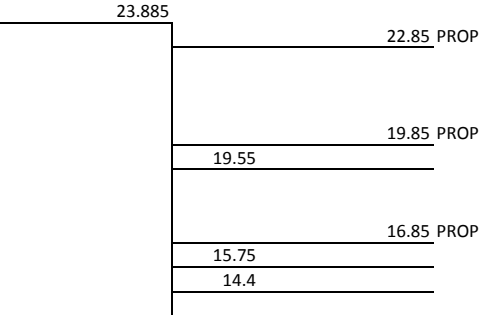
The predicted ground movement and damage assessment at each boundary has been assessed; see Appendix A, with a worse case of a damage category 2 indicating that only slight damage to the neighbouring properties is expected.

APPENDIX A

Design Calculations for Building Damage Assessment

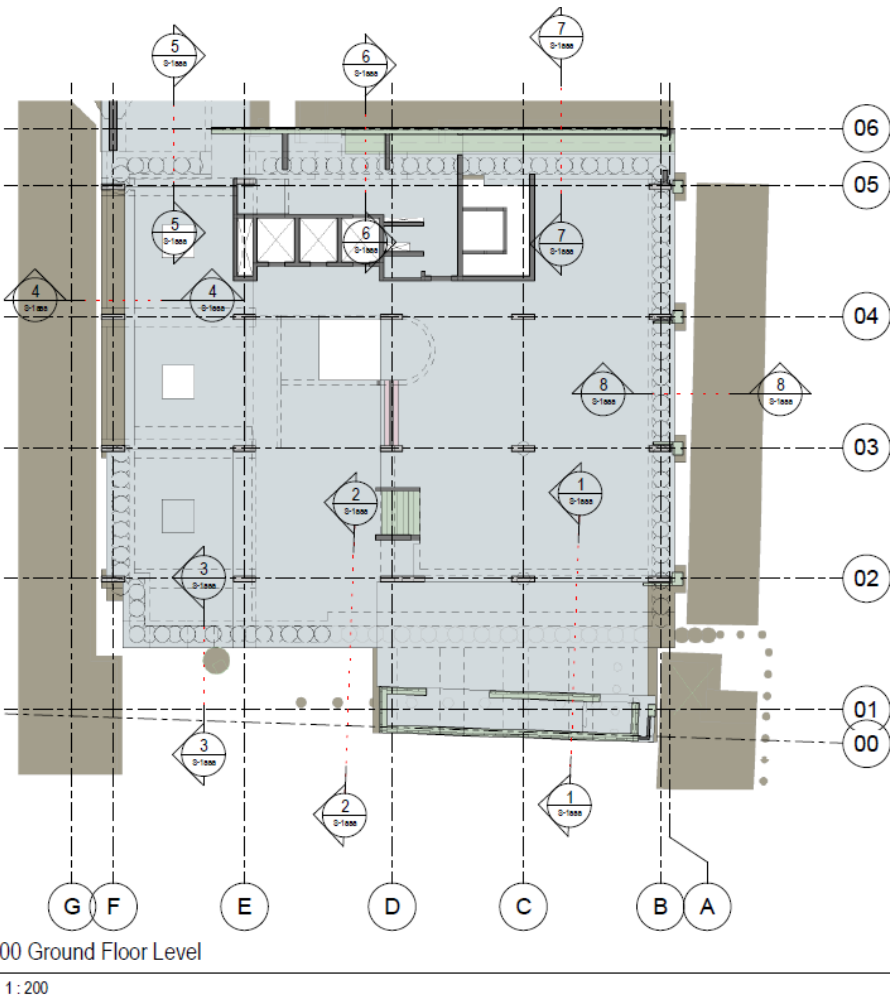
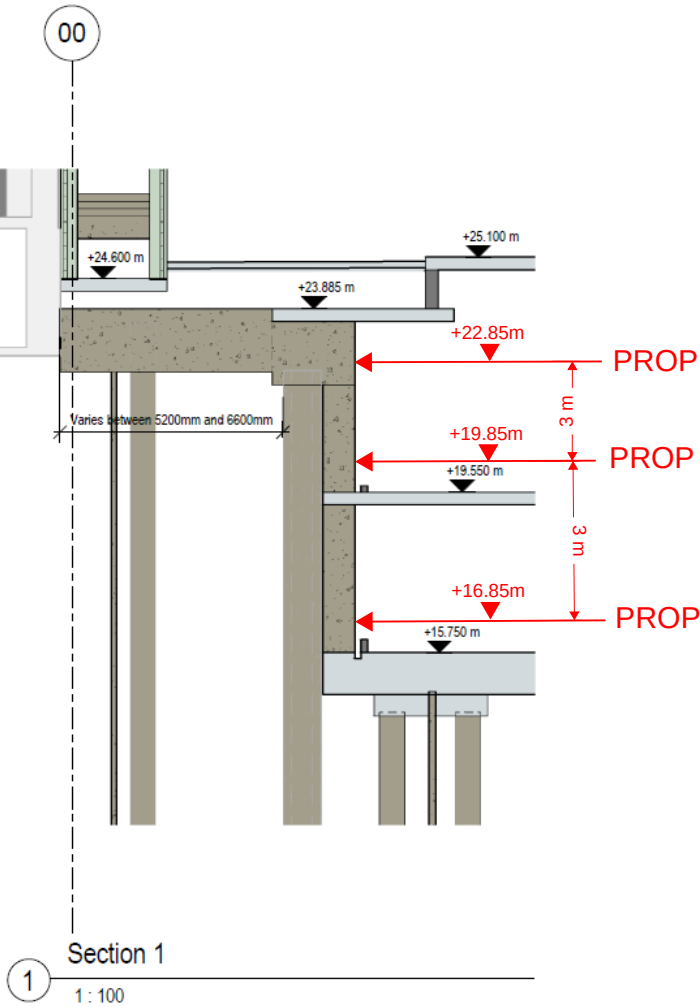
SECTION 1

Properties



SECANT PILING			
Excavation depth	=	9.485 m	
Pile Length	=	14.2275 m	= 1.5 x excavation depth
Pile diameter	=	880 mm	
EI	=	565600 kN.m ² /m	
h	=	3 m	= average depth between props

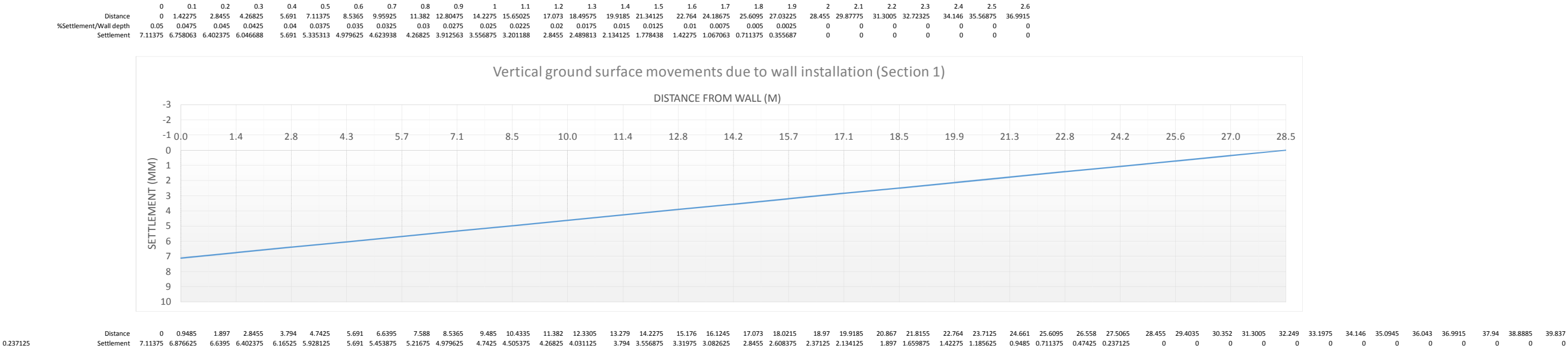
Damage Category 2 Wall



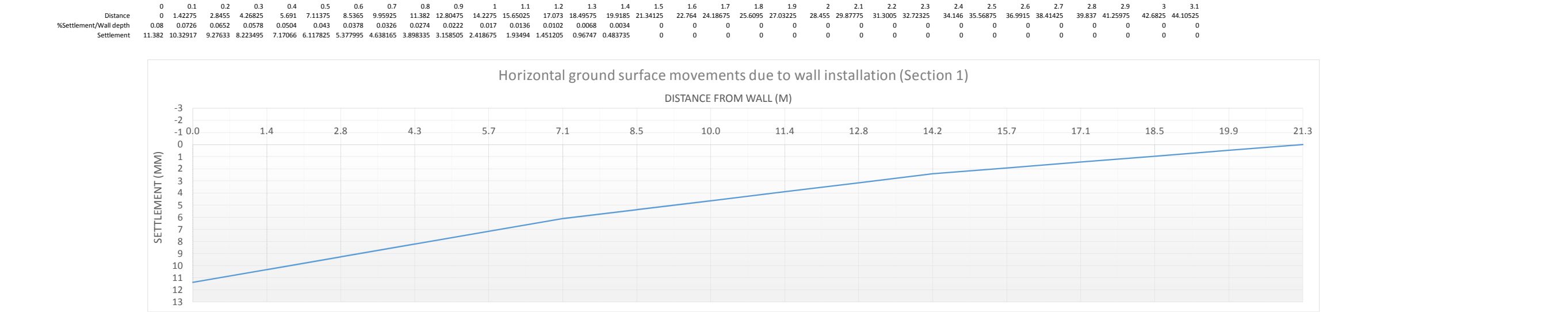
Settlement due to wall installation (SECTION 1)

Excavation depth	=	9.485 m
Pile Length	=	14.2275 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL



HORIZONTAL

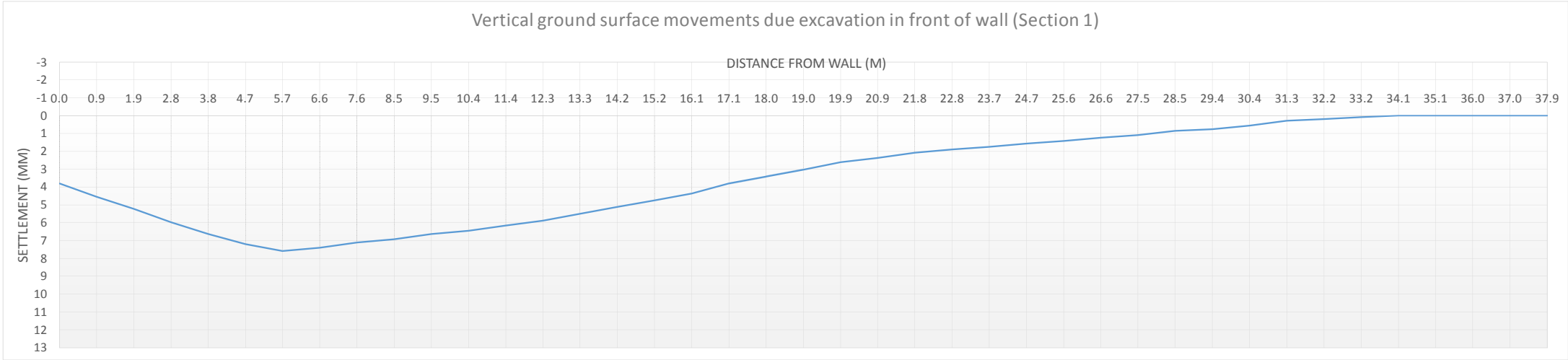


Settlement due to excavation in front of wall (SECTION 1)

Excavation depth	=	9.485 m
Pile Length	=	14.2275 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

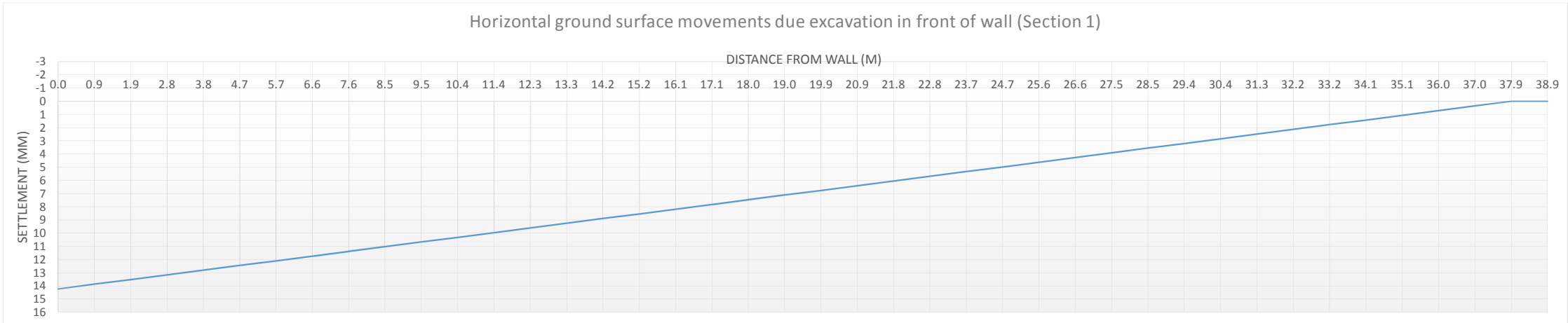
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	0.9485	1.897	2.8455	3.794	4.7425	5.691	6.6395	7.588	8.5365	9.485	10.4335	11.382	12.3305	13.279	14.2275	15.176	16.1245	17.073	18.0215	18.97	19.9185	20.867	21.8155	22.764	23.7125	24.661	25.6095	26.558	27.5065	28.455	29.4035	30.352	31.3005	32.249	33.1975	34.146	35.0945	36.043	36.9915	37.94	38.8885	39.837	40.7855	41.734
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	3.794	4.5528	5.21675	5.97555	6.6395	7.2086	7.588	7.3983	7.11375	6.92405	6.6395	6.4498	6.16525	5.8807	5.5013	5.1219	4.7425	4.3631	3.794	3.4146	3.0352	2.608375	2.37125	2.0867	1.897	1.754725	1.565025	1.42275	1.23305	1.090775	0.85365	0.7588	0.5691	0.28455	0.1897	0.09485	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1
Distance	0	0.9485	1.897	2.8455	3.794	4.7425	5.691	6.6395	7.588	8.5365	9.485	10.4335	11.382	12.3305	13.279	14.2275	15.176	16.1245	17.073	18.0215	18.97	19.9185	20.867	21.8155	22.764	23.7125	24.661	25.6095	26.558	27.5065	28.455	29.4035	30.352	31.3005	32.249	33.1975	34.146	35.0945	36.043	36.9915	37.94	38.8885
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0
Settlement	14.2275	13.87181	13.51613	13.16044	12.80475	12.44906	12.09338	11.73769	11.382	11.02631	10.67063	10.31494	9.95925	9.603563	9.247875	8.892188	8.5365	8.180812	7.825125	7.469437	7.11375	6.758062	6.402375	6.046687	5.691	5.335312	4.979625	4.623937	4.26825	3.912562	3.556875	3.201187	2.8455	2.489812	2.134125	1.778437	1.42275	1.067062	0.711375	0.355687	0	0



Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Settlement	14.2275	13.69397	13.16044	12.62691	12.09338	11.55984	11.02631	10.49278	9.95925	9.425719	8.892187	8.358656	7.825125	7.291594	6.758062	6.224531	5.691	5.157469	4.623937	4.090406	3.556875	3.023344	2.489812	1.956281	1.42275	0.889219	0.355687	0	39.837	41.25975	42.6825	44.10525

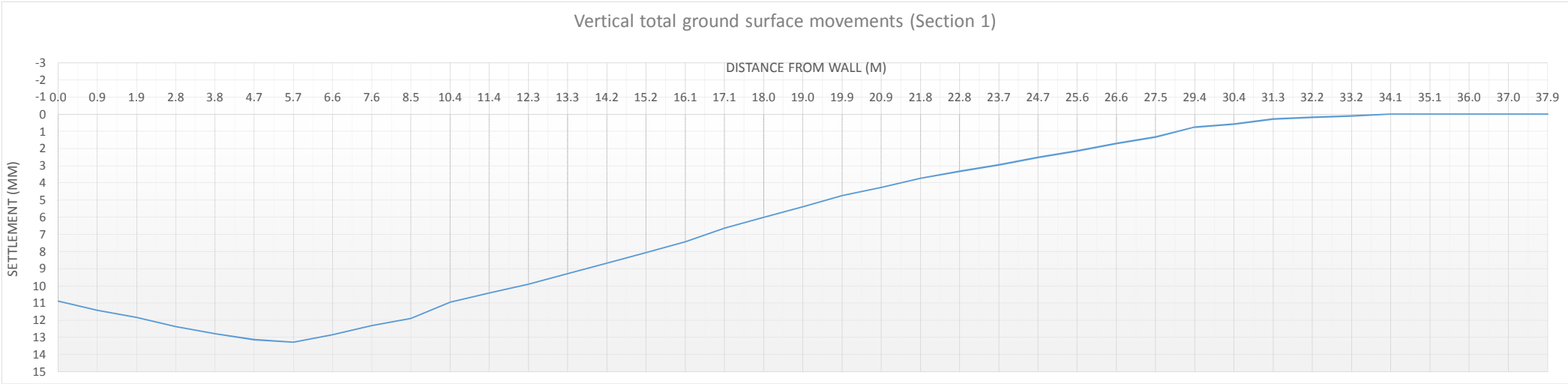
0.533531

Settlement due to wall installation and deflection (SECTION 1)

Excavation depth = 9.485 m
Pile Length = 14.2275 m
Pile diameter = 880 mm
EI = 565600 kN.m²/m

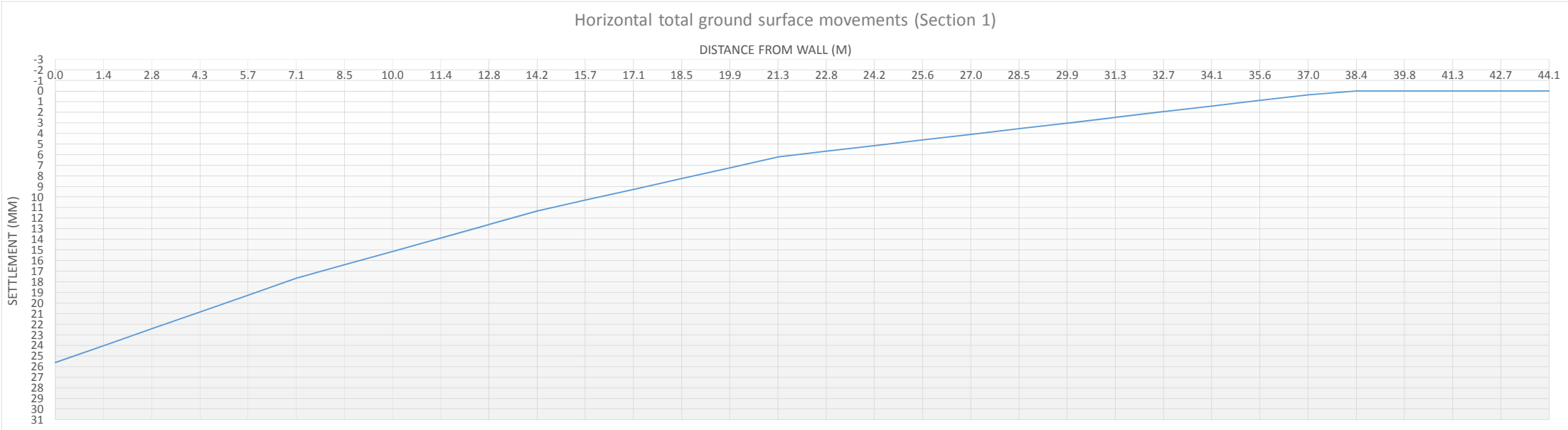
VERTICAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	
Distance	0	0.9485	1.897	2.8455	3.794	4.7425	5.691	6.6395	7.588	8.5365	9.485	10.4335	11.382	12.3305	13.279	14.2275	15.176	16.1245	17.073	18.0215	18.97	19.9185	20.867	21.8155	22.764	23.7125	24.661	25.6095	26.558	27.5065	28.455	29.4035	30.352	31.3005	32.249	33.1975	34.146	35.0945	36.043	36.9915	37.94	
Settlement due to wall installation	7.11375	6.876625	6.6395	6.402375	6.16525	5.928125	5.691	5.453875	5.21675	4.979625	4.7425	4.505375	4.26825	4.031125	3.794	3.556875	3.31975	3.082625	2.8455	2.608375	2.37125	2.134125	1.897	1.659875	1.42275	1.185625	0.9485	0.711375	0.47425	0.237125	0	0	0	0	0	0	0	0	0	0	0	
Settlement due to excavation in front of wall	3.794	4.5528	5.21675	5.97555	6.6395	7.2086	7.588	7.3983	7.11375	6.92405	6.6395	6.4498	6.16525	5.8807	5.5013	5.1219	4.7425	4.3631	3.794	3.4146	3.0352	2.608375	2.37125	2.0867	1.897	1.754725	1.565025	1.42275	1.23305	1.090775	0.85365	0.7588	0.5691	0.28455	0.1897	0.09485	0	0	0	0	0	0
Total Settlement	10.90775	11.42943	11.85625	12.37793	12.80475	13.13673	13.279	12.85218	12.3305	11.90368	11.382	10.95518	10.4335	9.911825	9.2953	8.678775	8.06225	7.445725	6.6395	6.022975	5.40645	4.7425	4.26825	3.746575	3.31975	2.94035	2.513525	2.134125	1.7073	1.3279	0.85365	0.7588	0.5691	0.28455	0.1897	0.09485	0	0	0	0	0	0



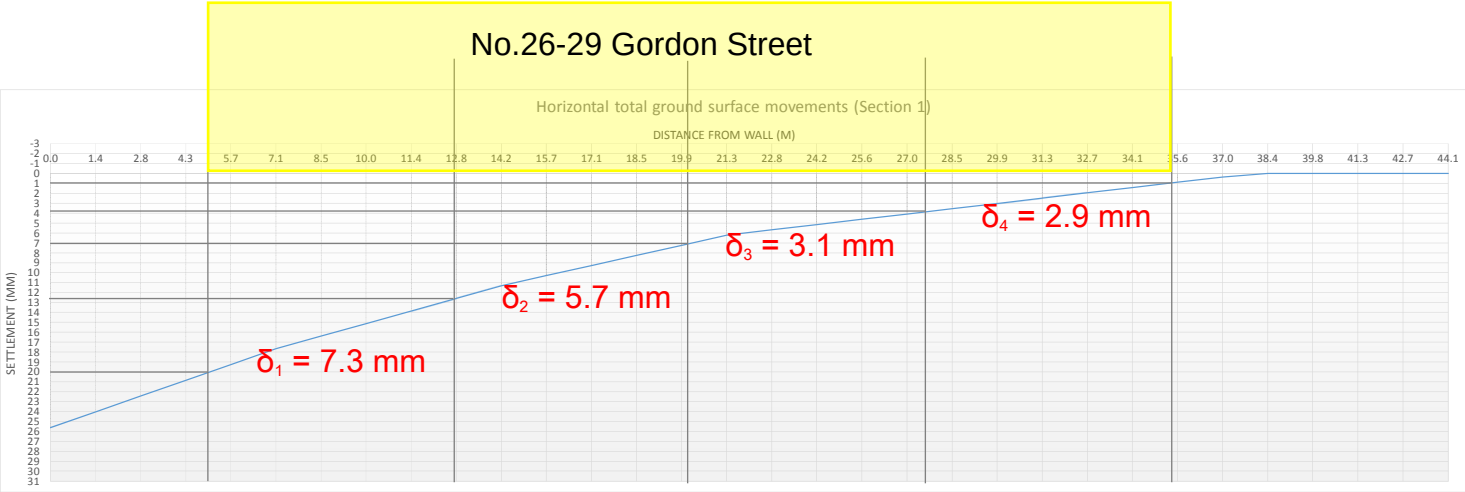
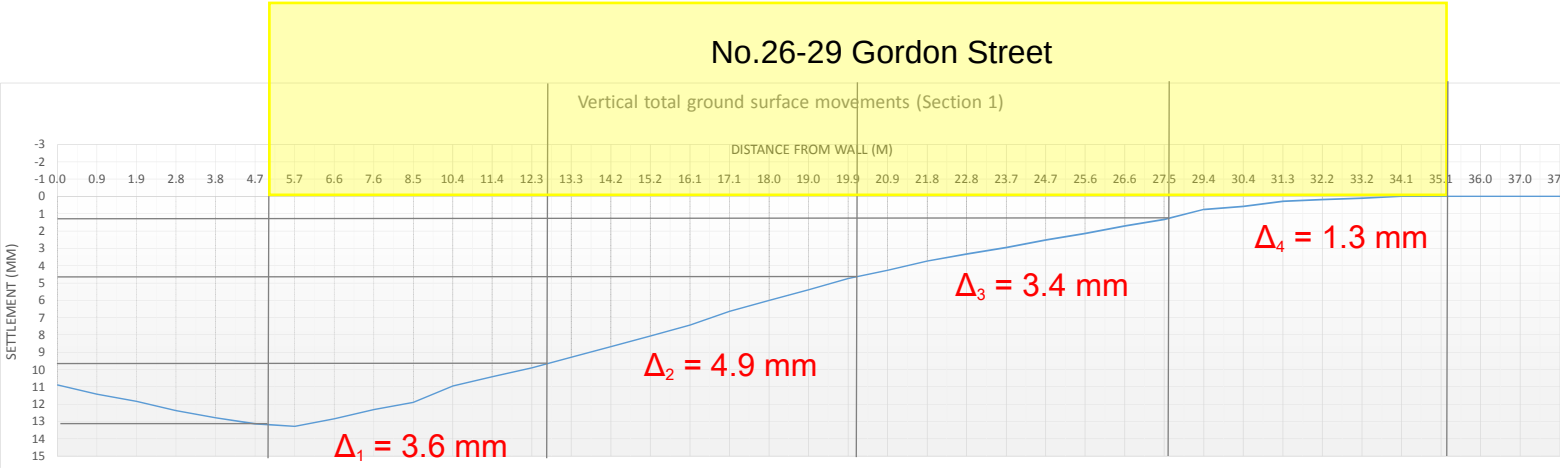
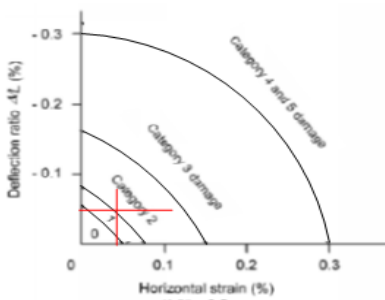
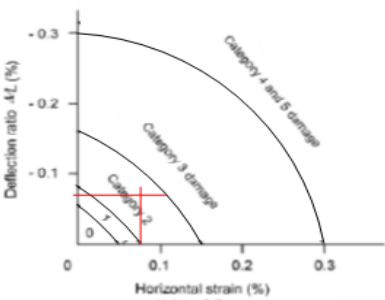
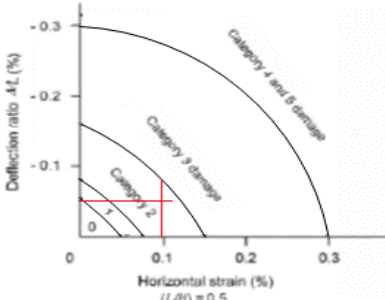
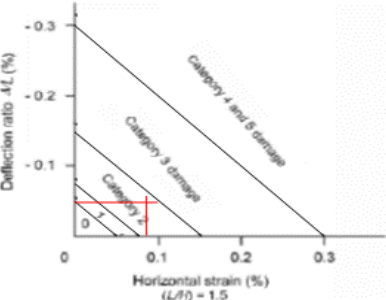
HORIZONTAL

	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	Distance	0	1.42275	2.8455	4.26825	5.691	7.11375	8.5365	9.95925	11.382	12.80475	14.2275	15.65025	17.073	18.49575	19.9185	21.34125	22.764	24.18675	25.6095	27.03225	28.455	29.87775	31.3005	32.72325	34.146	35.56875	36.9915	38.41425	39.837	41.25975	42.6825	44.10525
Settlement due to wall installation	11.382	10.32917	9.27633	8.223495	7.17066	6.117825	5.377995	4.638165	3.898335	3.158505	2.418675	1.93494	1.451205	0.96747	0.483735	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	14.2275	13.69397	13.16044	12.62691	12.09338	11.55984	11.02631	10.49278	9.95925	9.425719	8.892187	8.358656	7.825125	7.291594	6.758062	6.224531	5.691	5.157469	4.623937	4.090406	3.556875	3.023344	2.489812	1.956281	1.42275	0.889219	0.355687	0	0	0	0	0	0
Total Settlement	25.6095	24.02313	22.43677	20.8504	19.26404	17.67767	16.40431	15.13095	13.85759	12.58422	11.31086	10.2936	9.27633	8.259064	7.241797	6.224531	5.691	5.157469	4.623937	4.090406	3.556875	3.023344	2.489812	1.956281	1.42275	0.889219	0.355687	0	0	0	0	0	0



Category Assessment (SECTION 1)

L	=	30 m	L ₁	=	7.5 m	L ₂	=	7.5 m	L ₃	=	7.5 m	L ₄	=	7.5 m	L ₁₊₂	=	15 m	L ₁₊₂₊₃	=	22.5 m
H	=	20 m	H ₁	=	20 m	H ₂	=	20 m	H ₃	=	20 m	H ₄	=	20 m	H ₁₊₂	=	20 m	H ₁₊₂₊₃	=	20 m
Δ	=	0.013279 m	Δ ₁	=	0.0036 m	Δ ₂	=	0.0049 m	Δ ₃	=	0.0034 m	Δ ₄	=	0.0013 m	Δ ₁₊₂	=	0.0085 m	Δ ₁₊₂₊₃	=	0.0119 m
δ	=	0.02561 m	δ ₁	=	0.0073 m	δ ₂	=	0.0057 m	δ ₃	=	0.0031 m	δ ₄	=	0.0029 m	δ ₁₊₂	=	0.013 m	δ ₁₊₂₊₃	=	0.0161 m
L/H	=	1.5	L ₁ /H ₁	=	0.375	L ₂ /H ₂	=	0.375	L ₃ /H ₃	=	0.375	L ₄ /H ₄	=	0.375	L ₁₊₂ /H ₁₊₂	=	0.75	L ₁₊₂₊₃ /H ₁₊₂₊₃	=	1.125
Δ/L	=	0.044263 %	Δ ₁ /L ₁	=	0.048 %	Δ ₂ /L ₂	=	0.065333 %	Δ ₃ /L ₃	=	0.045333 %	Δ ₄ /L ₄	=	0.017333 %	Δ ₁₊₂ /L ₁₊₂	=	0.056667 %	Δ ₁₊₂₊₃ /L ₁₊₂₊₃	=	0.052889 %
δ/L	=	0.085365 %	δ ₁ /L ₁	=	0.097333 %	δ ₂ /L ₂	=	0.076 %	δ ₃ /L ₃	=	0.041333 %	δ ₄ /L ₄	=	0.038667 %	δ ₁₊₂ /L ₁₊₂	=	0.086667 %	δ ₁₊₂₊₃ /L ₁₊₂₊₃	=	0.071556 %
From CIRIA C580 Figure 2.18:			From CIRIA C580 Figure 2.18:			From CIRIA C580 Figure 2.18:			From CIRIA C580 Figure 2.18:			From CIRIA C580 Figure 2.18:			From CIRIA C580 Figure 2.18:			From CIRIA C580 Figure 2.18:		
CATEGORY 2			CATEGORY 2			CATEGORY 2			CATEGORY 2			CATEGORY 1			CATEGORY 2			CATEGORY 2		

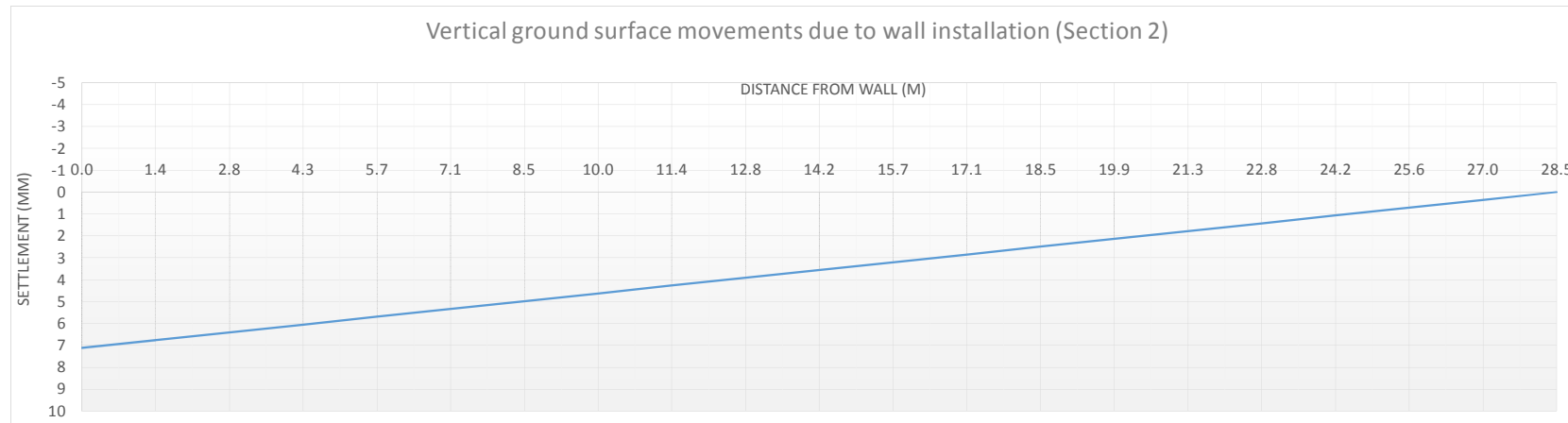


Settlement due to wall installation (SECTION 2)

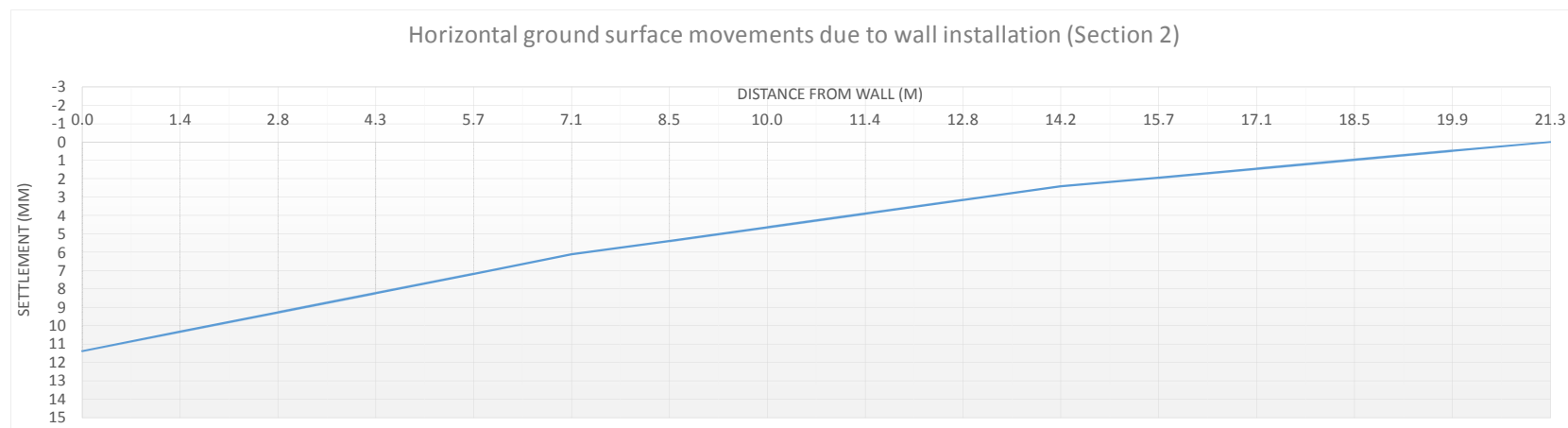
Excavation depth	=	9.485 m
Pile Length	=	14.2275 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6
Distance	0	1.42275	2.8455	4.26825	5.691	7.11375	8.5365	9.95925	11.382	12.80475	14.2275	15.65025	17.073	18.49575	19.9185	21.34125	22.764	24.18675	25.6095	27.03225	28.455	29.87775	31.3005	32.72325	34.146	35.56875	36.9915
%Settlement/Wall depth	0.05	0.0475	0.045	0.0425	0.04	0.0375	0.035	0.0325	0.03	0.0275	0.025	0.0225	0.02	0.0175	0.015	0.0125	0.01	0.0075	0.005	0.0025	0	0	0	0	0	0	0
Settlement	7.11375	6.758063	6.402375	6.046688	5.691	5.335313	4.979625	4.623938	4.26825	3.912563	3.556875	3.201188	2.8455	2.489813	2.134125	1.778438	1.42275	1.067063	0.711375	0.355688	0	0	0	0	0	0	0

[illegible]

HORIZONTAL

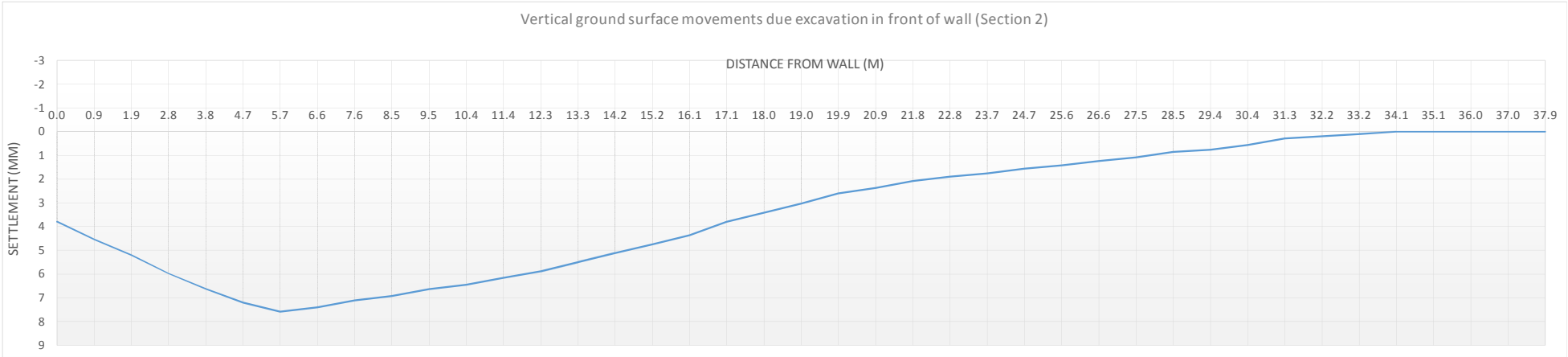
[illegible]

Settlement due to excavation in front of wall (SECTION 2)

Excavation depth	=	9.485 m
Pile Length	=	14.2275 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

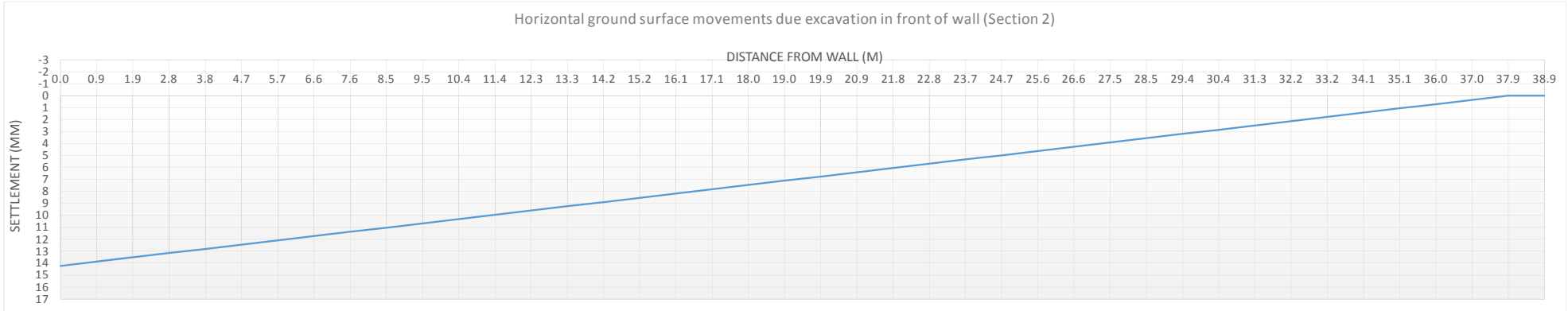
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	0.9485	1.897	2.8455	3.794	4.7425	5.691	6.6395	7.588	8.5365	9.485	10.4335	11.382	12.3305	13.279	14.2275	15.176	16.1245	17.073	18.0215	18.97	19.9185	20.867	21.8155	22.764	23.7125	24.661	25.6095	26.558	27.5065	28.455	29.4035	30.352	31.3005	32.249	33.1975	34.146	35.0945	36.043	36.9915	37.94	38.8885	39.837	40.7855	41.734
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	3.794	4.5528	5.21675	5.97555	6.6395	7.2086	7.588	7.3983	7.11375	6.92405	6.6395	6.4498	6.16525	5.8807	5.5013	5.1219	4.7425	4.3631	3.794	3.4146	3.0352	2.608375	2.37125	2.0867	1.897	1.754725	1.565025	1.42275	1.23305	1.090775	0.85365	0.7588	0.5691	0.28455	0.1897	0.09485	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1
Distance	0	0.9485	1.897	2.8455	3.794	4.7425	5.691	6.6395	7.588	8.5365	9.485	10.4335	11.382	12.3305	13.279	14.2275	15.176	16.1245	17.073	18.0215	18.97	19.9185	20.867	21.8155	22.764	23.7125	24.661	25.6095	26.558	27.5065	28.455	29.4035	30.352	31.3005	32.249	33.1975	34.146	35.0945	36.043	36.9915	37.94	38.8885
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0
Settlement	14.2275	13.87181	13.51613	13.16044	12.80475	12.44906	12.09338	11.73769	11.382	11.02631	10.67063	10.31494	9.95925	9.603563	9.247875	8.892188	8.5365	8.180812	7.825125	7.469437	7.11375	6.758062	6.402375	6.046687	5.691	5.335312	4.979625	4.623937	4.26825	3.912562	3.556875	3.201187	2.8455	2.489812	2.134125	1.778437	1.42275	1.067062	0.711375	0.355687	0	0



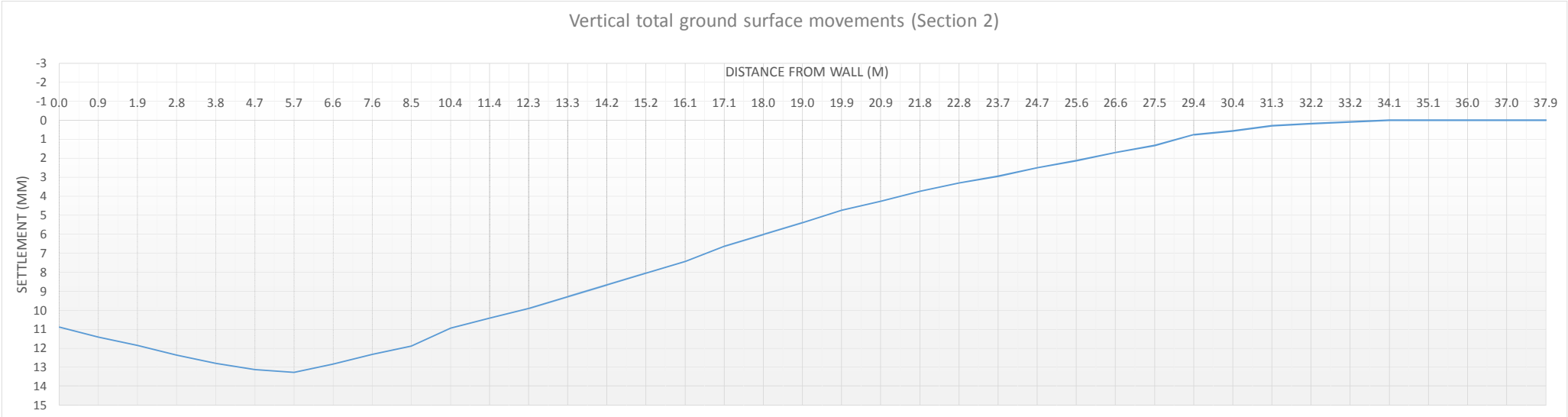
0.533531	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Settlement	14.2275	13.69397	13.16044	12.62691	12.09338	11.55984	11.02631	10.49278	9.95925	9.425719	8.892187	8.358656	7.825125	7.291594	6.758062	6.224531	5.691	5.157469	4.623937	4.090406	3.556875	3.023344	2.489812	1.956281	1.42275	0.889219	0.355687	0	0	0	0	0

Settlement due to wall installation and deflection (SECTION 2)

Excavation depth = 9.485 m
Pile Length = 14.2275 m
Pile diameter = 880 mm
EI = 565600 kN.m²/m

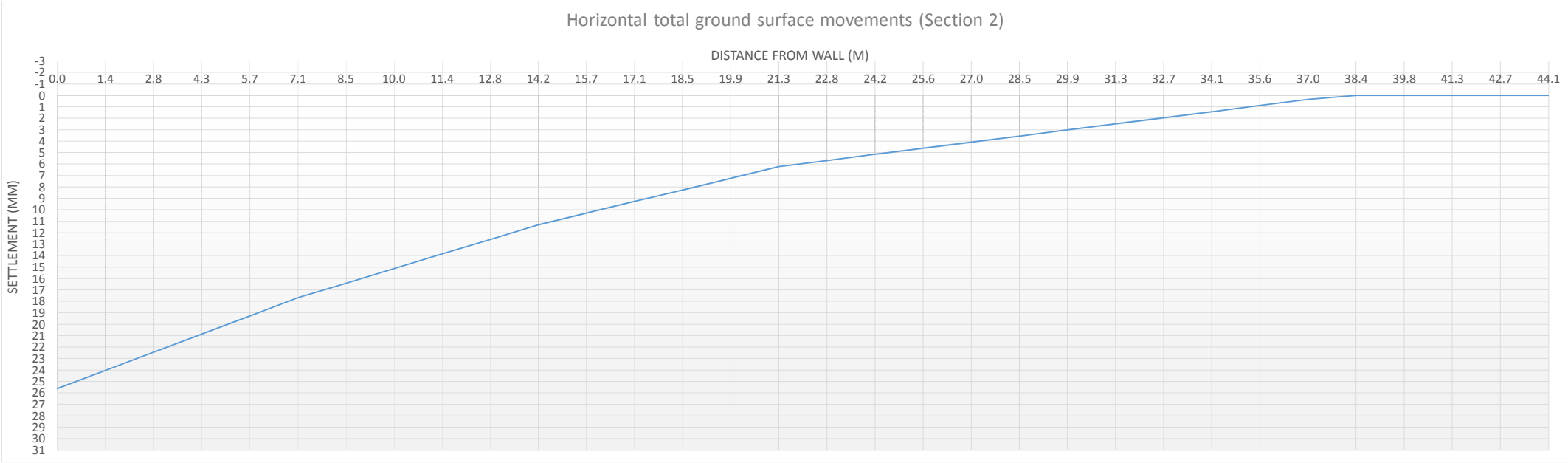
VERTICAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	
Distance	0	0.9485	1.897	2.8455	3.794	4.7425	5.691	6.6395	7.588	8.5365	9.485	10.4335	11.382	12.3305	13.279	14.2275	15.176	16.1245	17.073	18.0215	18.97	19.9185	20.867	21.8155	22.764	23.7125	24.661	25.6095	26.558	27.5065	28.455	29.4035	30.352	31.3005	32.249	33.1975	34.146	35.0945	36.043	36.9915	37.94	
Settlement due to wall installation	7.11375	6.876625	6.6395	6.402375	6.16525	5.928125	5.691	5.453875	5.21675	4.979625	4.7425	4.505375	4.26825	4.031125	3.794	3.556875	3.31975	3.082625	2.8455	2.608375	2.37125	2.134125	1.897	1.659875	1.42275	1.185625	0.9485	0.711375	0.47425	0.237125	0	0	0	0	0	0	0	0	0	0	0	
Settlement due to excavation in front of wall	3.794	4.5528	5.21675	5.97555	6.6395	7.2086	7.588	7.3983	7.11375	6.92405	6.6395	6.4498	6.16525	5.8807	5.5013	5.1219	4.7425	4.3631	3.794	3.4146	3.0352	2.608375	2.37125	2.0867	1.897	1.754725	1.565025	1.42275	1.23305	1.090775	0.85365	0.7588	0.5691	0.28455	0.1897	0.09485	0	0	0	0	0	0
Total Settlement	10.90775	11.42943	11.85625	12.37793	12.80475	13.13673	13.279	12.85218	12.3305	11.90368	11.382	10.95518	10.4335	9.911825	9.2953	8.678775	8.06225	7.445725	6.6395	6.022975	5.40645	4.7425	4.26825	3.746575	3.31975	2.94035	2.513525	2.134125	1.7073	1.3279	0.85365	0.7588	0.5691	0.28455	0.1897	0.09485	0	0	0	0	0	0



HORIZONTAL

	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	
	Distance	0	1.42275	2.845	4.26825	5.691	7.11375	8.5365	9.95925	11.382	12.80475	14.2275	15.65025	17.073	18.49575	19.9185	21.34125	22.764	24.18675	25.6095	27.03225	28.455	29.87775	31.3005	32.72325	34.146	35.56875	36.9915	38.41425	39.837	41.25975	42.6825	44.10525	
Settlement due to wall installation	11.382	10.32917	9.27633	8.223495	7.17066	6.117825	5.377995	4.638165	3.898335	3.158505	2.418675	1.93494	1.451205	0.96747	0.483735	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	14.2275	13.69397	13.16044	12.62691	12.09338	11.55984	11.02631	10.49278	9.95925	9.425719	8.892187	8.358656	7.825125	7.291594	6.758062	6.224531	5.691	5.157469	4.623937	4.090406	3.556875	3.023344	2.489812	1.956281	1.42275	0.889219	0.355687	0	0	0	0	0	0	0
Total Settlement	25.6095	24.02313	22.43677	20.8504	19.26404	17.67767	16.40431	15.13095	13.85759	12.58422	11.31086	10.2936	9.27633	8.259064	7.241797	6.224531	5.691	5.157469	4.623937	4.090406	3.556875	3.023344	2.489812	1.956281	1.42275	0.889219	0.355687	0	0	0	0	0	0	0



Category Assessment (SECTION 2)

L	=	-	m	L ₁	=	5	m	L ₂	=	5	m	L ₃	=	5	m	L ₄	=	5	m
H	=	5	m	H ₁	=	5	m	H ₂	=	5	m	H ₃	=	5	m	H ₄	=	5	m
Δ	=	-	m	Δ ₁	=	0.0022	m	Δ ₂	=	0.0034	m	Δ ₃	=	0.0034	m	Δ ₄	=	0.0011	m
δ	=	-	m	δ ₁	=	0.0048	m	δ ₂	=	0.0039	m	δ ₃	=	0.0021	m	δ ₄	=	0.002	m
L/H	=	-		L ₁ /H ₁	=	1		L ₂ /H ₂	=	1		L ₃ /H ₃	=	1		L ₄ /H ₄	=	1	
Δ/L	=	-	%	Δ ₁ /L ₁	=	0.044	%	Δ ₂ /L ₂	=	0.068	%	Δ ₃ /L ₃	=	0.068	%	Δ ₄ /L ₄	=	0.022	%
δ/L	=	-	%	δ ₁ /L ₁	=	0.096	%	δ ₂ /L ₂	=	0.078	%	δ ₃ /L ₃	=	0.042	%	δ ₄ /L ₄	=	0.04	%

From CIRIA C580 Figure 2.18:

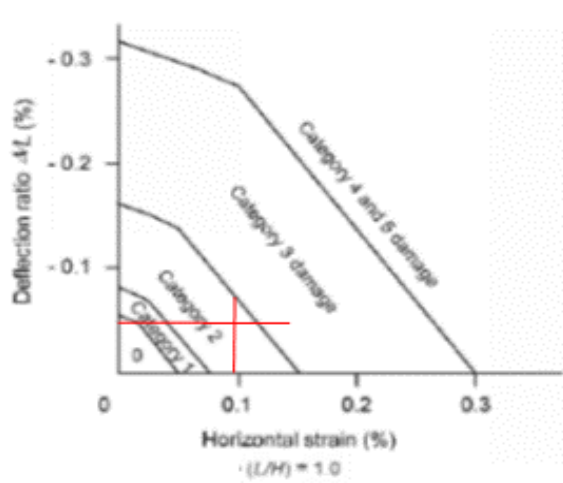
From CIRIA C580 Figure 2.18:

From CIRIA C580 Figure 2.18:

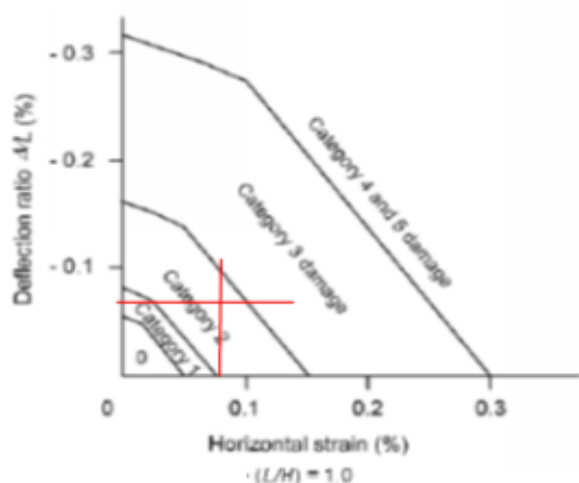
From CIRIA C580 Figure 2.18:

From CIRIA C580 Figure 2.18:

CATEGORY 2

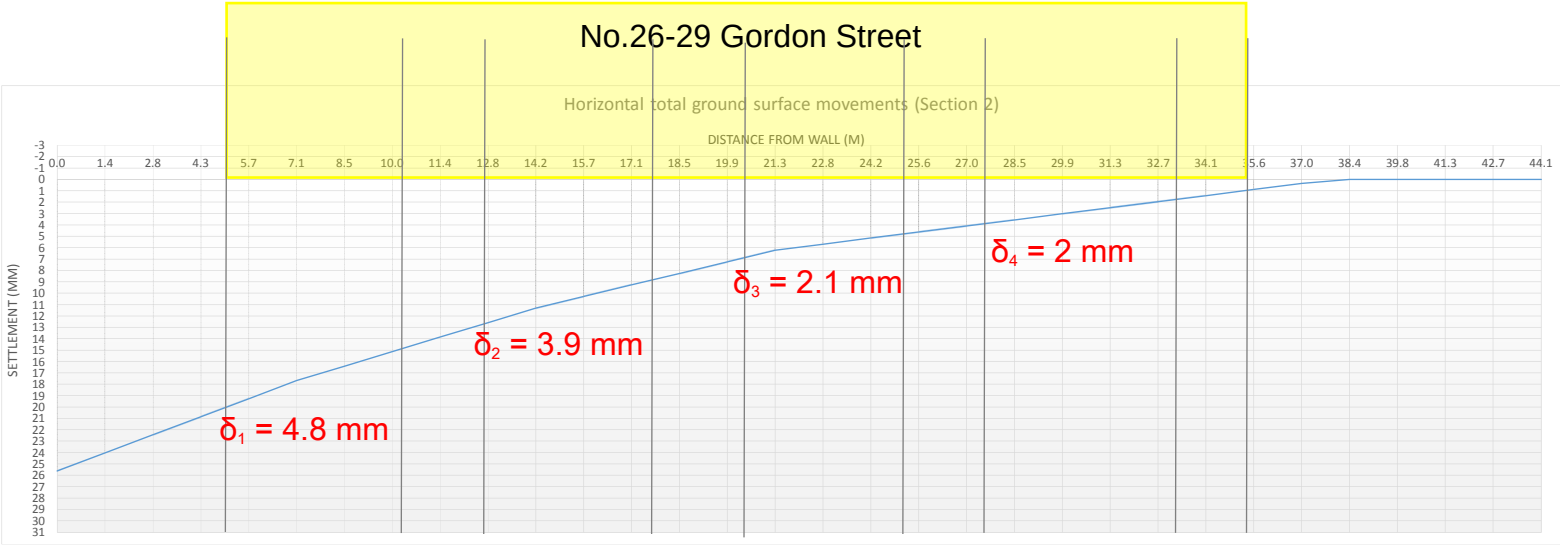
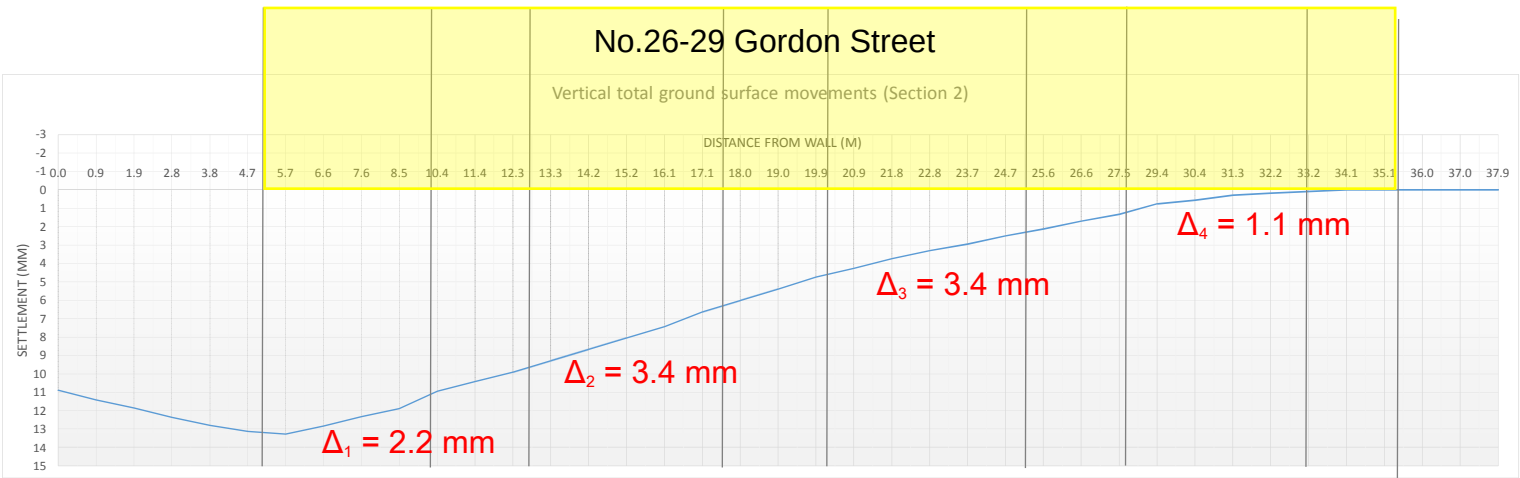


CATEGORY 2



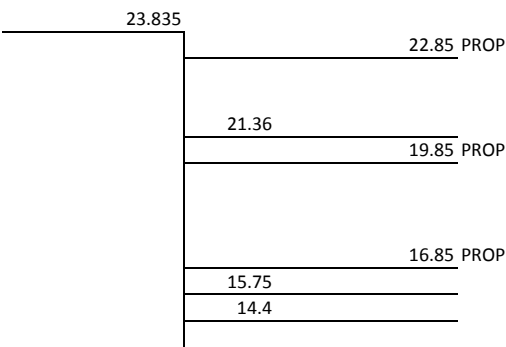
CATEGORY 2

CATEGORY 1



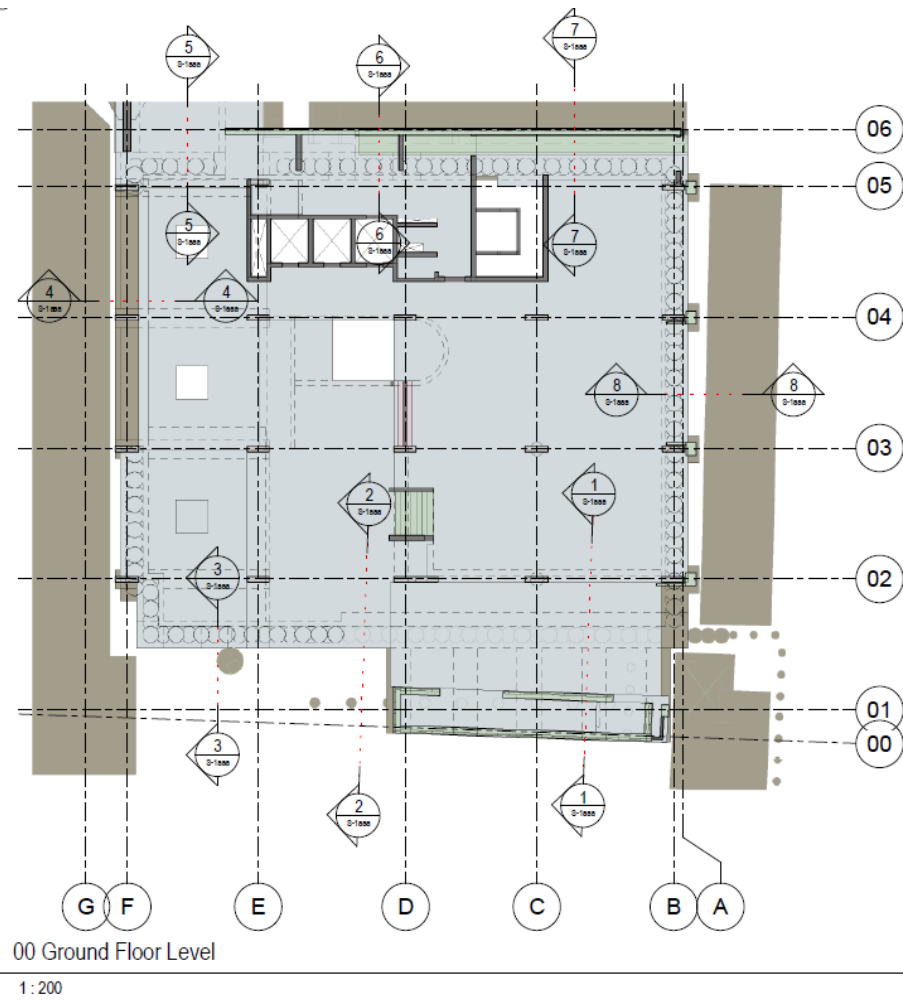
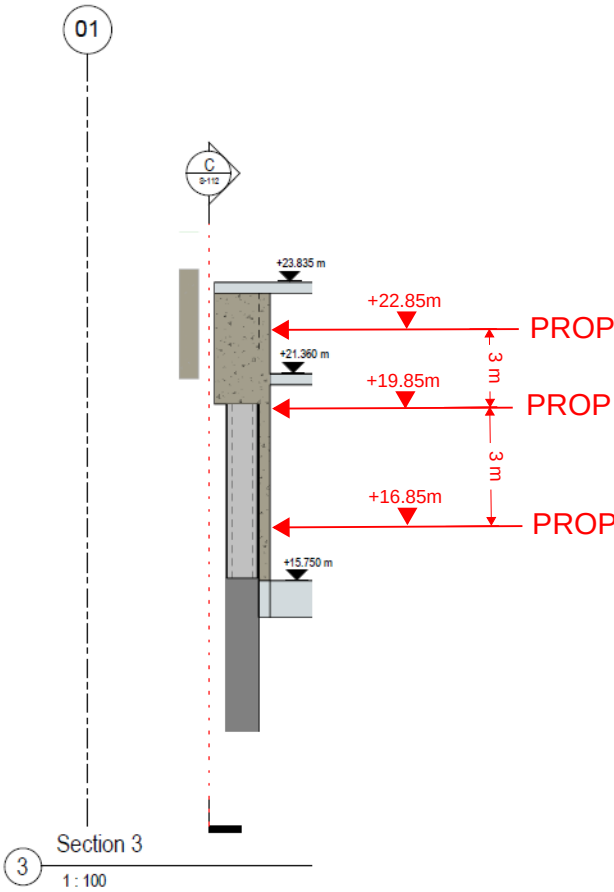
SECTION 3

Properties



SECANT PILING		
Excavation depth	= 9.435 m	
Pile Length	= 14.1525 m	= 1.5 x excavation depth
Pile diameter	= 880 mm	
EI	= 565600 kN.m ² /m	
h	= 3 m	= average depth between props

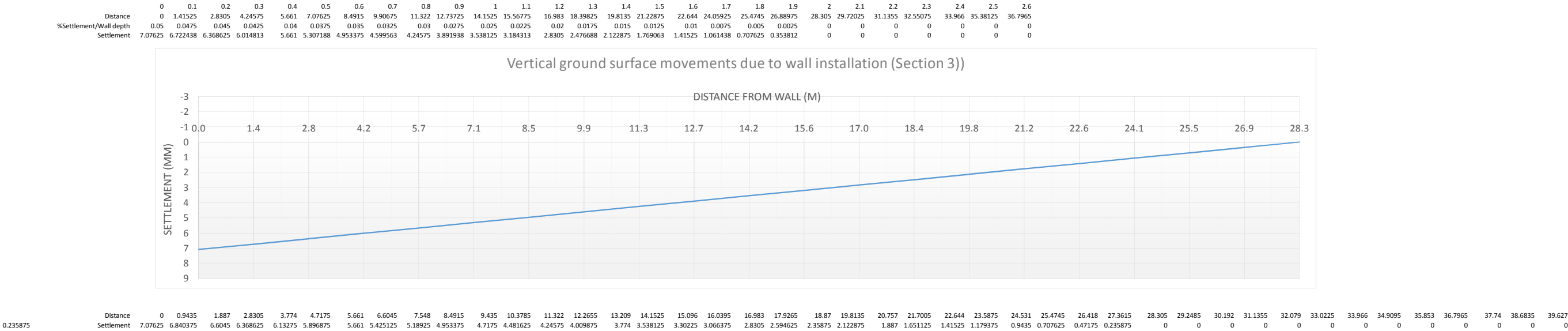
Damage Category 2 Wall



Settlement due to wall installation (SECTION 3)

Excavation depth	=	9.435 m
Pile Length	=	14.1525 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL



HORIZONTAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.41525	2.8305	4.24575	5.661	7.07625	8.4915	9.90675	11.322	12.73725	14.1525	15.56775	16.983	18.39825	19.8135	21.22875	22.644	24.05925	25.4745	26.88975	28.305	29.72025	31.1355	32.55075	33.966	35.38125	36.7965	38.21175	39.627	41.04225	42.4575	43.87275
%Settlement/Wall depth	0.08	0.0726	0.0652	0.0578	0.0504	0.043	0.0378	0.0326	0.0274	0.0222	0.017	0.0136	0.0102	0.0068	0.0034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement	11.322	10.27472	9.22743	8.180145	7.13286	6.085575	5.349645	4.613715	3.877785	3.141855	2.405925	1.92474	1.443555	0.96237	0.481185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Horizontal ground surface movements due to wall installation (Section 3)

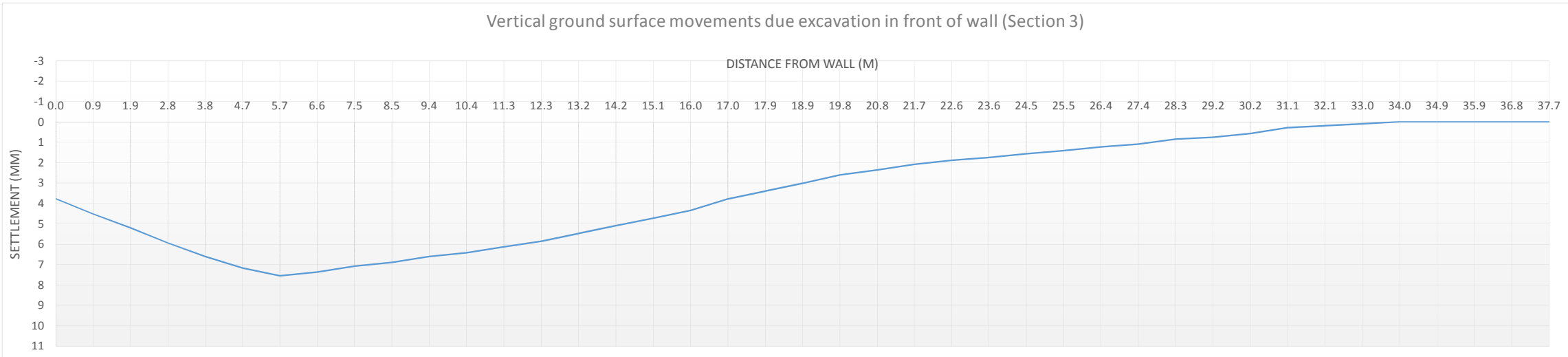
Distance (m)	Settlement (mm)
0.0	11.322
1.4	10.275
2.8	9.227
4.2	8.180
5.7	7.133
7.1	6.086
8.5	5.350
9.9	4.614
11.3	3.878
12.7	3.142
14.2	2.406
15.6	1.925
17.0	1.444
18.4	0.962
19.8	0.481
21.2	0

Settlement due to excavation in front of wall (SECTION 3)

Excavation depth	=	9.435 m
Pile Length	=	14.1525 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

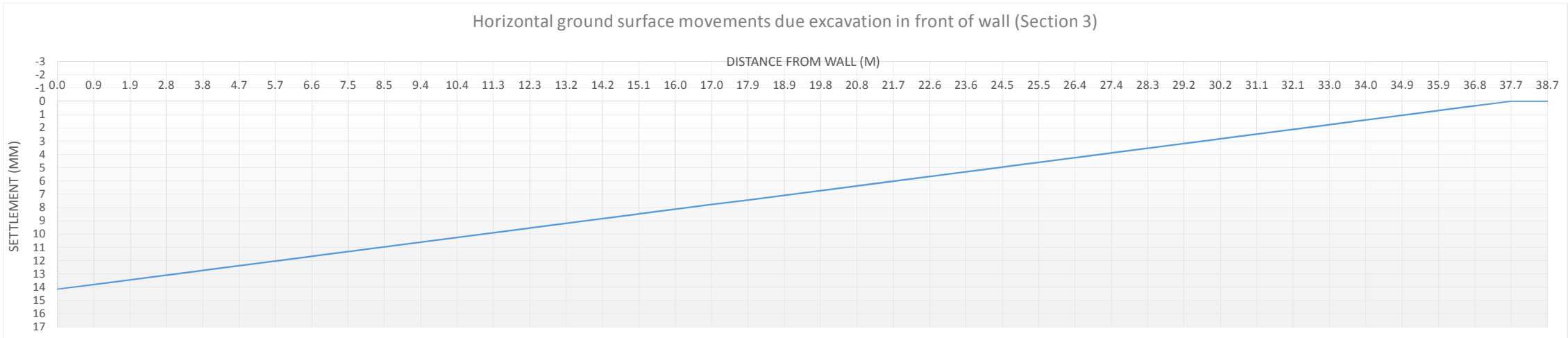
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	0.9435	1.887	2.8305	3.774	4.7175	5.661	6.6045	7.548	8.4915	9.435	10.3785	11.322	12.2655	13.209	14.1525	15.096	16.0395	16.983	17.9265	18.87	19.8135	20.757	21.7005	22.644	23.5875	24.531	25.4745	26.418	27.3615	28.305	29.2485	30.192	31.1355	32.079	33.0225	33.966	34.9095	35.853	36.7965	37.74	38.6835	39.627	40.5705	41.514
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	3.774	4.5288	5.18925	5.94405	6.6045	7.1706	7.548	7.3593	7.07625	6.88755	6.6045	6.4158	6.13275	5.8497	5.4723	5.0949	4.7175	4.3401	3.774	3.3966	3.0192	2.594625	2.35875	2.0757	1.887	1.745475	1.556775	1.41525	1.22655	1.085025	0.84915	0.7548	0.5661	0.28305	0.1887	0.09435	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1
Distance	0	0.9435	1.887	2.8305	3.774	4.7175	5.661	6.6045	7.548	8.4915	9.435	10.3785	11.322	12.2655	13.209	14.1525	15.096	16.0395	16.983	17.9265	18.87	19.8135	20.757	21.7005	22.644	23.5875	24.531	25.4745	26.418	27.3615	28.305	29.2485	30.192	31.1355	32.079	33.0225	33.966	34.9095	35.853	36.7965	37.74	38.6835
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0
Settlement	14.1525	13.79869	13.44488	13.09106	12.73725	12.38344	12.02963	11.67581	11.322	10.96819	10.61438	10.26056	9.90675	9.552938	9.199125	8.845313	8.4915	8.137687	7.783875	7.430062	7.07625	6.722437	6.368625	6.014812	5.661	5.307187	4.953375	4.599562	4.24575	3.891937	3.538125	3.184312	2.8305	2.476687	2.122875	1.769062	1.41525	1.061437	0.707625	0.353812	0	0



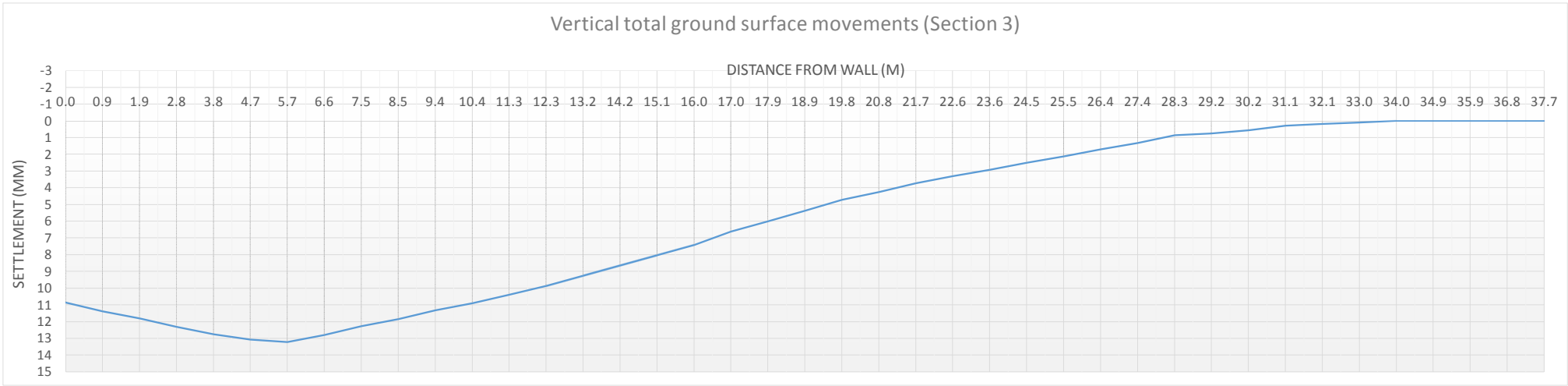
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.41525	2.8305	4.24575	5.661	7.07625	8.4915	9.90675	11.322	12.73725	14.1525	15.56775	16.983	18.39825	19.8135	21.22875	22.644	24.05925	25.4745	26.88975	28.305	29.72025	31.1355	32.55075	33.966	35.38125	36.7965	38.21175	39.627	41.04225	42.4575	43.87275
Settlement	14.1525	13.62178	13.09106	12.56034	12.02963	11.49891	10.96819	10.43747	9.90675	9.376031	8.845312	8.314594	7.783875	7.253156	6.722437	6.191719	5.661	5.130281	4.599562	4.068844	3.538125	3.007406	2.476687	1.945969	1.41525	0.884531	0.353812	0	0	0	0	0

Settlement due to wall installation and deflection (SECTION 3)

Excavation depth = 9.435 m
Pile Length = 14.1525 m
Pile diameter = 880 mm
EI = 565600 kN.m²/m

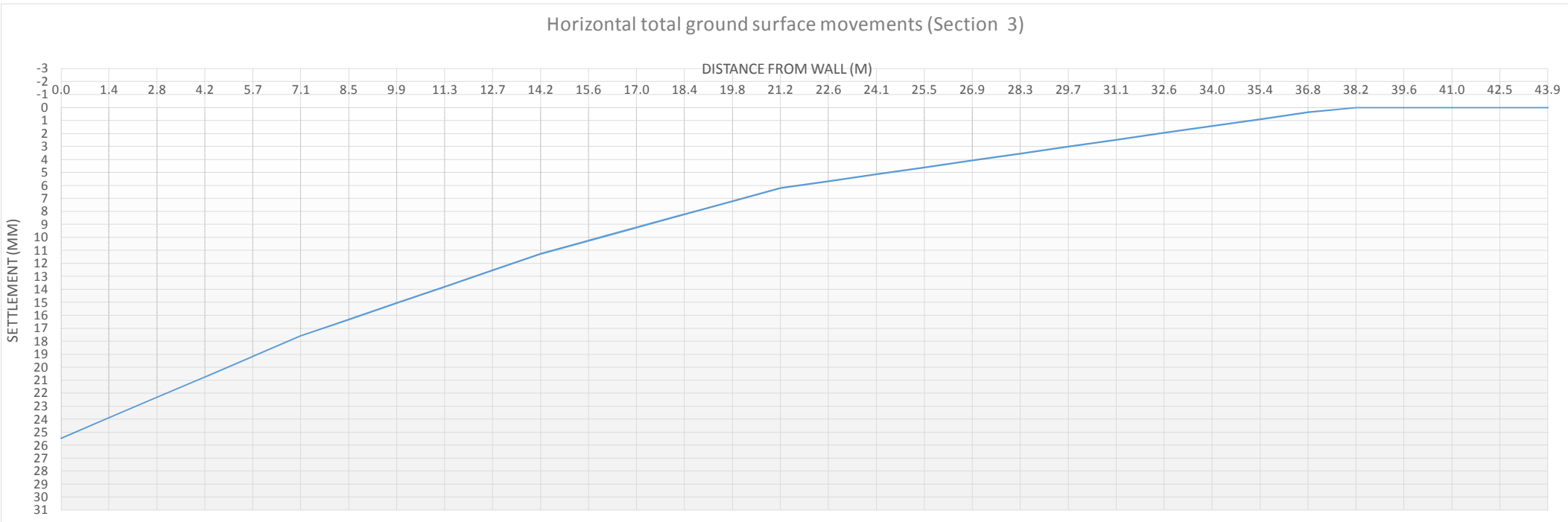
VERTICAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4		
Distance	0	0.9435	1.887	2.8305	3.774	4.7175	5.661	6.6045	7.548	8.4915	9.435	10.3785	11.322	12.2655	13.209	14.1525	15.096	16.0395	16.983	17.9265	18.87	19.8135	20.757	21.7005	22.644	23.5875	24.531	25.4745	26.418	27.3615	28.305	29.2485	30.192	31.1355	32.079	33.0225	33.966	34.9095	35.853	36.7965	37.74		
Settlement due to wall installation	7.07625	6.840375	6.6045	6.368625	6.13275	5.896875	5.661	5.425125	5.18925	4.953375	4.7175	4.481625	4.24575	4.009875	3.774	3.538125	3.30225	3.066375	2.8305	2.594625	2.35875	2.122875	1.887	1.651125	1.41525	1.179375	0.9435	0.707625	0.47175	0.235875	0	0	0	0	0	0	0	0	0	0	0	0	
Settlement due to excavation in front of wall	3.774	4.5288	5.18925	5.94405	6.6045	7.1706	7.548	7.3593	7.07625	6.88755	6.6045	6.4158	6.13275	5.8497	5.4723	5.0949	4.7175	4.3401	3.774	3.3966	3.0192	2.594625	2.35875	2.0757	1.887	1.745475	1.556775	1.41525	1.22655	1.085025	0.84915	0.7548	0.5661	0.28305	0.1887	0.09435	0	0	0	0	0	0	0
Total Settlement	10.85025	11.36918	11.79375	12.31268	12.73725	13.06748	13.209	12.78443	12.2655	11.84093	11.322	10.89743	10.3785	9.859575	9.2463	8.633025	8.01975	7.406475	6.6045	5.991225	5.37795	4.7175	4.24575	3.726825	3.30225	2.92485	2.500275	2.122875	1.6983	1.3209	0.84915	0.7548	0.5661	0.28305	0.1887	0.09435	0	0	0	0	0	0	



HORIZONTAL

	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	Distance	0	1.41525	2.8305	4.24575	5.661	7.07625	8.4915	9.90675	11.322	12.73725	14.1525	15.56775	16.983	18.39825	19.8135	21.22875	22.644	24.05925	25.4745	26.88975	28.305	29.72025	31.1355	32.55075	33.966	35.38125	36.7965	38.21175	39.627	41.04225	42.4575	43.87275
Settlement due to wall installation	11.322	10.27472	9.22743	8.180145	7.13286	6.085575	5.349645	4.613715	3.877785	3.141855	2.405925	1.92474	1.443555	0.96237	0.481185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	14.1525	13.62178	13.09106	12.56034	12.02963	11.49891	10.96819	10.43747	9.90675	9.376031	8.845312	8.314594	7.783875	7.253156	6.722437	6.191719	5.661	5.130281	4.599562	4.068844	3.538125	3.007406	2.476687	1.945969	1.41525	0.884531	0.353812	0	0	0	0	0	0
Total Settlement	25.4745	23.8965	22.31849	20.74049	19.16249	17.58448	16.31783	15.05118	13.78454	12.51789	11.25124	10.23933	9.22743	8.215526	7.203622	6.191719	5.661	5.130281	4.599562	4.068844	3.538125	3.007406	2.476687	1.945969	1.41525	0.884531	0.353812	0	0	0	0	0	0



Category Assessment (SECTION 3)

NO BUILDING

L	=	0	m
H	=	0	m

Δ	=	0.013209	m
δ	=	0.025475	m

L/H	=	-
-----	---	---

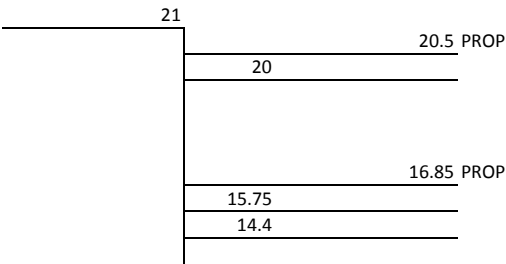
δ/L	=	-	%
Δ/L	=	-	%

From CIRIA C580 Figure 2.18:

CATEGORY 0

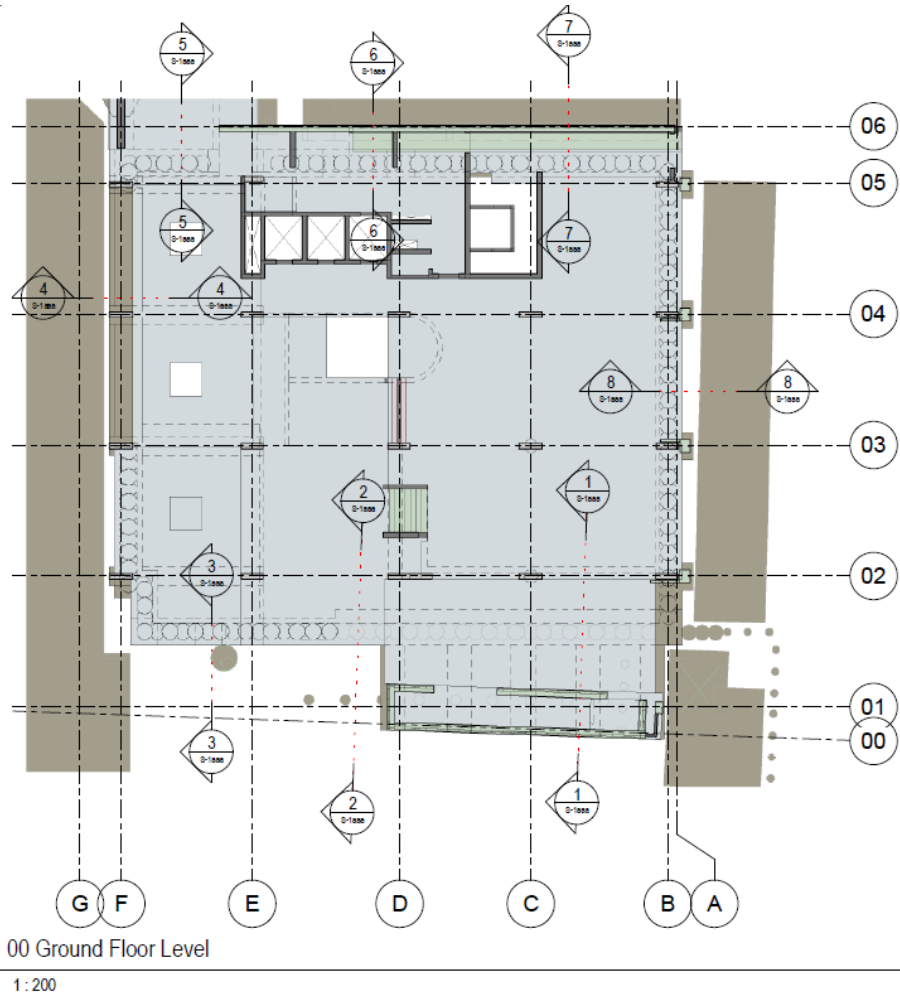
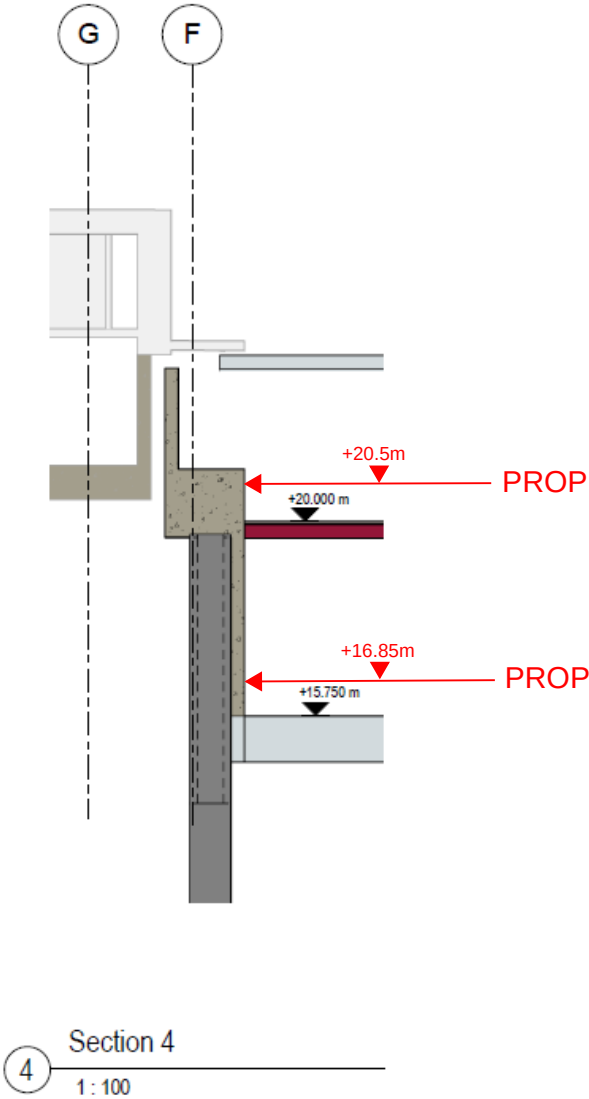
SECTION 4

Properties



SECANT PILING			
Excavation depth	=	6.6 m	
Pile Length	=	9.9 m	= 1.5 x excavation depth
Pile diameter	=	880 mm	
EI	=	565600 kN.m ² /m	
h	=	3.65 m	= average depth between props

Damage Category 2 Wall

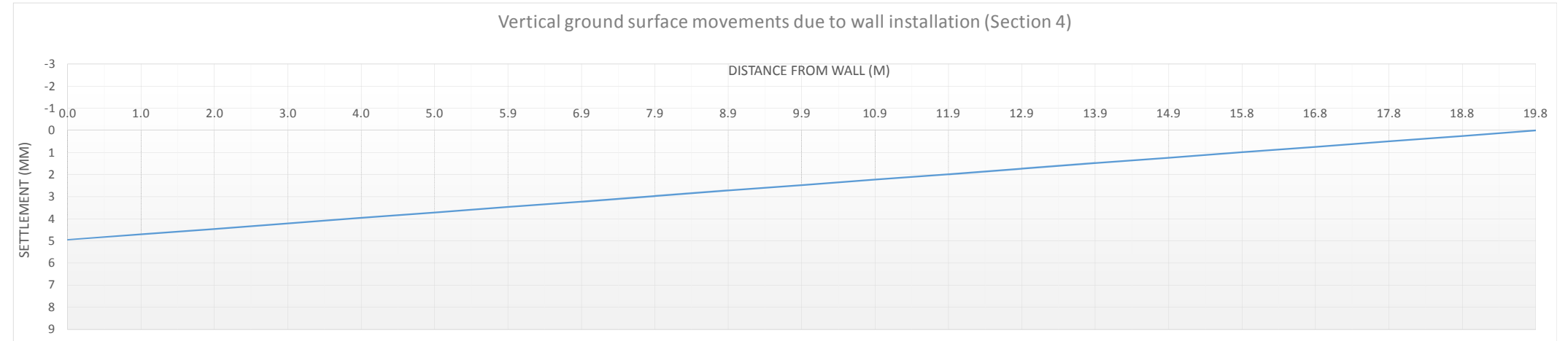


Settlement due to wall installation (SECTION 4)

Excavation depth	=	6.6 m
Pile Length	=	9.9 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL

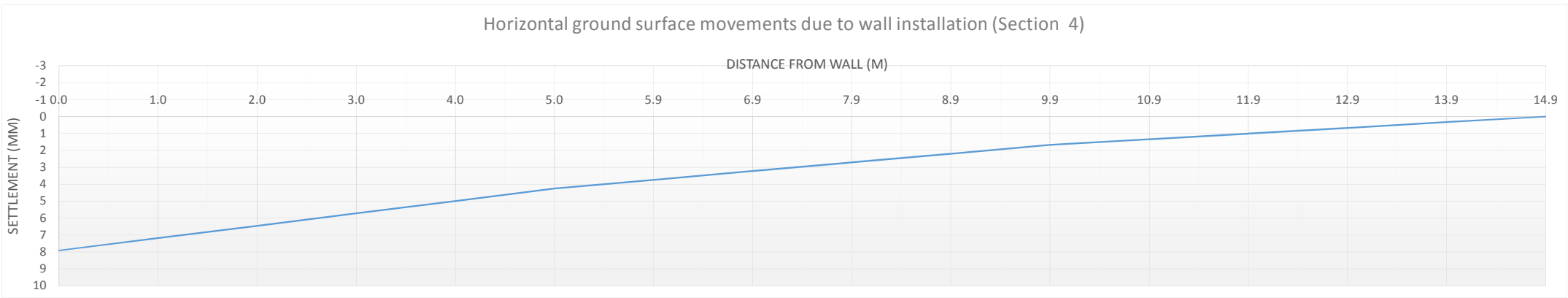
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6
Distance	0	0.99	1.98	2.97	3.96	4.95	5.94	6.93	7.92	8.91	9.9	10.89	11.88	12.87	13.86	14.85	15.84	16.83	17.82	18.81	19.8	20.79	21.78	22.77	23.76	24.75	25.74
%Settlement/Wall depth	0.05	0.0475	0.045	0.0425	0.04	0.0375	0.035	0.0325	0.03	0.0275	0.025	0.0225	0.02	0.0175	0.015	0.0125	0.01	0.0075	0.005	0.0025	0	0	0	0	0	0	0
Settlement	4.95	4.7025	4.455	4.2075	3.96	3.7125	3.465	3.2175	2.97	2.7225	2.475	2.2275	1.98	1.7325	1.485	1.2375	0.99	0.7425	0.495	0.2475	0	0	0	0	0	0	0



0.165	Distance	0	0.66	1.32	1.98	2.64	3.3	3.96	4.62	5.28	5.94	6.6	7.26	7.92	8.58	9.24	9.9	10.56	11.22	11.88	12.54	13.2	13.86	14.52	15.18	15.84	16.5	17.16	17.82	18.48	19.14	19.8	20.46	21.12	21.78	22.44	23.1	23.76	24.42	25.08	25.74	26.4	27.06	27.72
	Settlement	4.95	4.785	4.62	4.455	4.29	4.125	3.96	3.795	3.63	3.465	3.3	3.135	2.97	2.805	2.64	2.475	2.31	2.145	1.98	1.815	1.65	1.485	1.32	1.155	0.99	0.825	0.66	0.495	0.33	0.165	0	0	0	0	0	0	0	0	0	0	0	0	0

HORIZONTAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	0.99	1.98	2.97	3.96	4.95	5.94	6.93	7.92	8.91	9.9	10.89	11.88	12.87	13.86	14.85	15.84	16.83	17.82	18.81	19.8	20.79	21.78	22.77	23.76	24.75	25.74	26.73	27.72	28.71	29.7	30.69
%Settlement/Wall depth	0.08	0.0726	0.0652	0.0578	0.0504	0.043	0.0378	0.0326	0.0274	0.0222	0.017	0.0136	0.0102	0.0068	0.0034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement	7.92	7.1874	6.4548	5.7222	4.9896	4.257	3.7422	3.2274	2.7126	2.1978	1.683	1.3464	1.0098	0.6732	0.3366	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

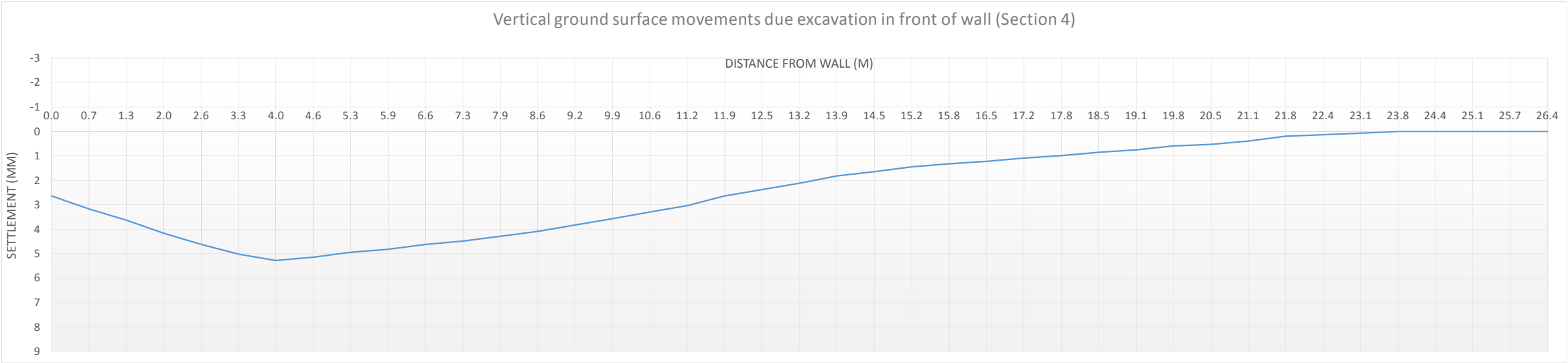


Settlement due to excavation in front of wall (SECTION 4)

Excavation depth	=	6.6 m
Pile Length	=	9.9 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

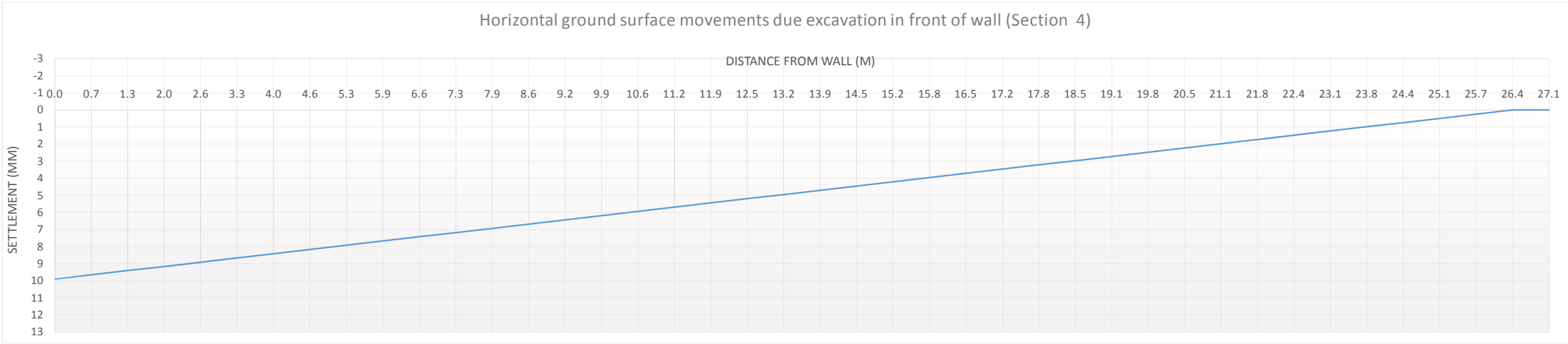
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	0.66	1.32	1.98	2.64	3.3	3.96	4.62	5.28	5.94	6.6	7.26	7.92	8.58	9.24	9.9	10.56	11.22	11.88	12.54	13.2	13.86	14.52	15.18	15.84	16.5	17.16	17.82	18.48	19.14	19.8	20.46	21.12	21.78	22.44	23.1	23.76	24.42	25.08	25.74	26.4	27.06	27.72	28.38	29.04
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	2.64	3.168	3.63	4.158	4.62	5.016	5.28	5.148	4.95	4.818	4.62	4.488	4.29	4.092	3.828	3.564	3.3	3.036	2.64	2.376	2.112	1.815	1.65	1.452	1.32	1.221	1.089	0.99	0.858	0.759	0.594	0.528	0.396	0.198	0.132	0.066	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1
Distance	0	0.66	1.32	1.98	2.64	3.3	3.96	4.62	5.28	5.94	6.6	7.26	7.92	8.58	9.24	9.9	10.56	11.22	11.88	12.54	13.2	13.86	14.52	15.18	15.84	16.5	17.16	17.82	18.48	19.14	19.8	20.46	21.12	21.78	22.44	23.1	23.76	24.42	25.08	25.74	26.4	27.06
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0
Settlement	9.9	9.6525	9.405	9.1575	8.91	8.6625	8.415	8.1675	7.92	7.6725	7.425	7.1775	6.93	6.6825	6.435	6.1875	5.94	5.6925	5.445	5.1975	4.95	4.7025	4.455	4.2075	3.96	3.7125	3.465	3.2175	2.97	2.7225	2.475	2.2275	1.98	1.7325	1.485	1.2375	0.99	0.7425	0.495	0.2475	0	0



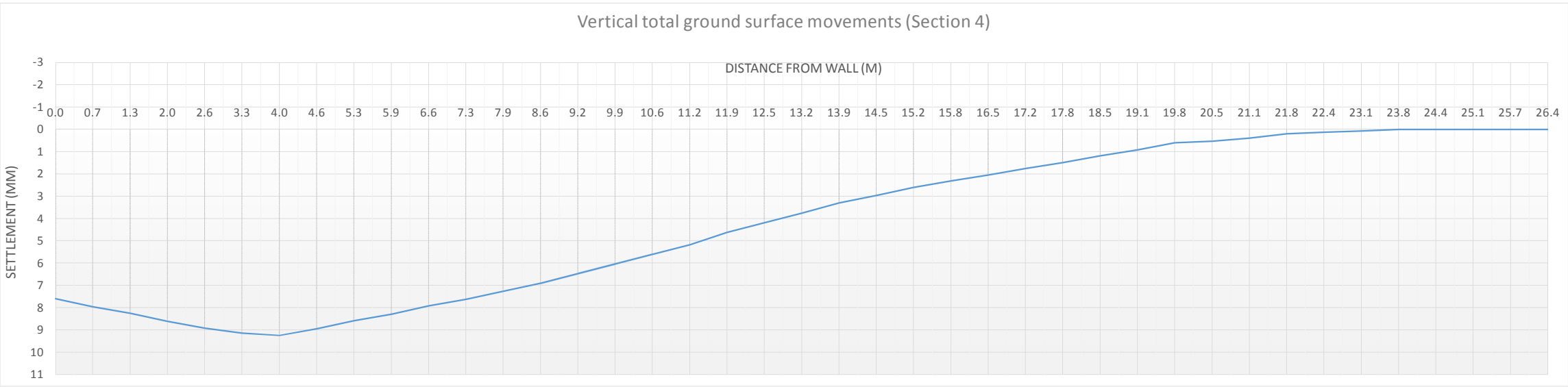
0.37125	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Settlement	9.9	9.52875	9.1575	8.78625	8.415	8.04375	7.6725	7.30125	6.93	6.55875	6.1875	5.81625	5.445	5.07375	4.7025	4.33125	3.96	3.58875	3.2175	2.84625	2.475	2.10375	1.7325	1.36125	0.99	0.61875	0.2475	0	0	0	0	0

Settlement due to wall installation and deflection (SECTION 4)

Excavation depth	=	6.6 m
Pile Length	=	9.9 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

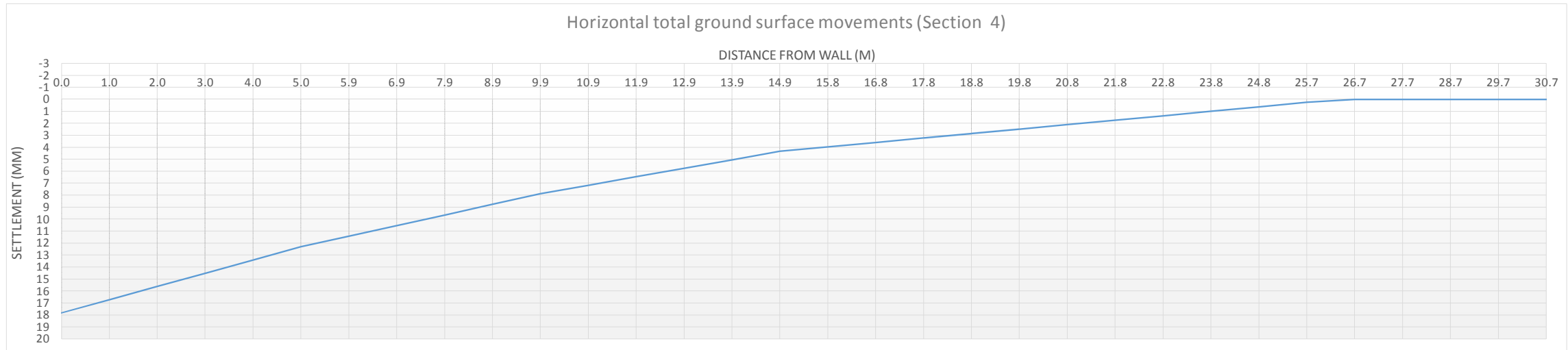
VERTICAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	
Distance	0	0.66	1.32	1.98	2.64	3.3	3.96	4.62	5.28	5.94	6.6	7.26	7.92	8.58	9.24	9.9	10.56	11.22	11.88	12.54	13.2	13.86	14.52	15.18	15.84	16.5	17.16	17.82	18.48	19.14	19.8	20.46	21.12	21.78	22.44	23.1	23.76	24.42	25.08	25.74	26.4	
Settlement due to wall installation	4.95	4.785	4.62	4.455	4.29	4.125	3.96	3.795	3.63	3.465	3.3	3.135	2.97	2.805	2.64	2.475	2.31	2.145	1.98	1.815	1.65	1.485	1.32	1.155	0.99	0.825	0.66	0.495	0.33	0.165	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	2.64	3.168	3.63	4.158	4.62	5.016	5.28	5.148	4.95	4.818	4.62	4.488	4.29	4.092	3.828	3.564	3.3	3.036	2.64	2.376	2.112	1.815	1.65	1.452	1.32	1.221	1.089	0.99	0.858	0.759	0.594	0.528	0.396	0.198	0.132	0.066	0	0	0	0	0	0
Total Settlement	7.59	7.953	8.25	8.613	8.91	9.141	9.24	8.943	8.58	8.283	7.92	7.623	7.26	6.897	6.468	6.039	5.61	5.181	4.62	4.191	3.762	3.3	2.97	2.607	2.31	2.046	1.749	1.485	1.188	0.924	0.594	0.528	0.396	0.198	0.132	0.066	0	0	0	0	0	0



HORIZONTAL

	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Distance	0	0.99	1.98	2.97	3.96	4.95	5.94	6.93	7.92	8.91	9.9	10.89	11.88	12.87	13.86	14.85	15.84	16.83	17.82	18.81	19.8	20.79	21.78	22.77	23.76	24.75	25.74	26.73	27.72	28.71	29.7	30.69
Settlement due to wall installation	7.92	7.1874	6.4548	5.7222	4.9896	4.257	3.7422	3.2274	2.7126	2.1978	1.683	1.3464	1.0098	0.6732	0.3366	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	9.9	9.52875	9.1575	8.78625	8.415	8.04375	7.6725	7.30125	6.93	6.55875	6.1875	5.81625	5.445	5.07375	4.7025	4.33125	3.96	3.58875	3.2175	2.84625	2.475	2.10375	1.7325	1.36125	0.99	0.61875	0.2475	0	0	0	0	0	0
Total Settlement	17.82	16.71615	15.6123	14.50845	13.4046	12.30075	11.4147	10.52865	9.6426	8.75655	7.8705	7.16265	6.4548	5.74695	5.0391	4.33125	3.96	3.58875	3.2175	2.84625	2.475	2.10375	1.7325	1.36125	0.99	0.61875	0.2475	0	0	0	0	0	0

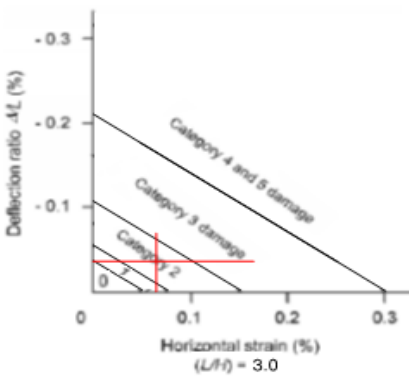


Category Assessment (SECTION 4)

L	=	28 m	L ₁	=	7 m	L ₂	=	7 m	L ₃	=	7 m	L ₄	=	7 m	L ₁₊₂	=	14 m	L ₁₊₂₊₃	=	21 m
H	=	9.3 m	H ₁	=	9.3 m	H ₂	=	9.3 m	H ₃	=	9.3 m	H ₁₊₂	=	9.3 m	H ₁₊₂	=	9.3 m	H ₁₊₂₊₃	=	9.3 m
Δ	=	0.00924 m	Δ ₁	=	0.0021 m	Δ ₂	=	0.0046 m	Δ ₃	=	0.0024 m	Δ ₄	=	0.0001 m	Δ ₁₊₂	=	0.0067 m	Δ ₁₊₂₊₃	=	0.0091 m
δ	=	0.01782 m	δ ₁	=	0.007 m	δ ₂	=	0.0054 m	δ ₃	=	0.0026 m	δ ₄	=	0.0014 m	δ ₁₊₂	=	0.0124 m	δ ₁₊₂₊₃	=	0.015 m
L/H	=	3.010753	L ₁ /H ₁	=	0.752688	L ₂ /H ₂	=	0.752688	L ₃ /H ₃	=	0.752688	L ₄ /H ₄	=	0.752688	L ₁₊₂ /H ₁₊₂	=	1.505376	L ₁₊₂₊₃ /H ₁₊₂₊	=	2.258065
δ/L	=	0.063643 %	δ ₁ /L ₁	=	0.1 %	δ ₂ /L ₂	=	0.077143 %	δ ₃ /L ₃	=	0.037143 %	δ ₄ /L ₄	=	0.02 %	δ ₁₊₂ /L ₁₊₂	=	0.088571 %	δ ₁₊₂₊₃ /L ₁₊₂₊	=	0.071429 %
Δ/L	=	0.033 %	Δ ₁ /L ₁	=	0.03 %	Δ ₂ /L ₂	=	0.065714 %	Δ ₃ /L ₃	=	0.034286 %	Δ ₄ /L ₄	=	0.001429 %	Δ ₁₊₂ /L ₁₊₂	=	0.047857 %	Δ ₁₊₂₊₃ /L ₁₊₂₊	=	0.043333 %

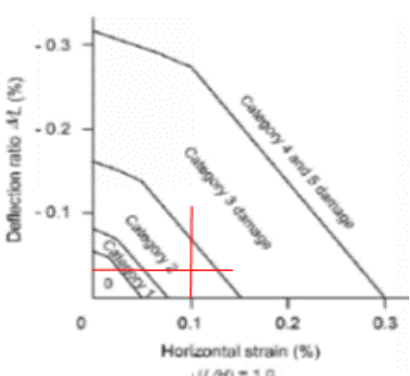
From CIRIA C580 Figure 2.18:

CATEGORY 2



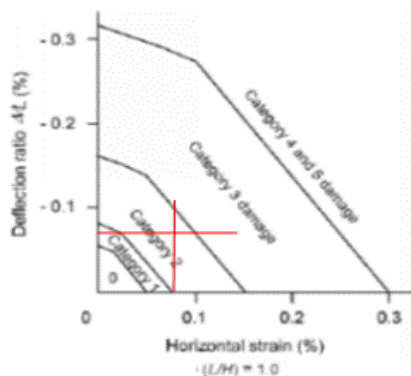
From CIRIA C580 Figure 2.18:

CATEGORY 2



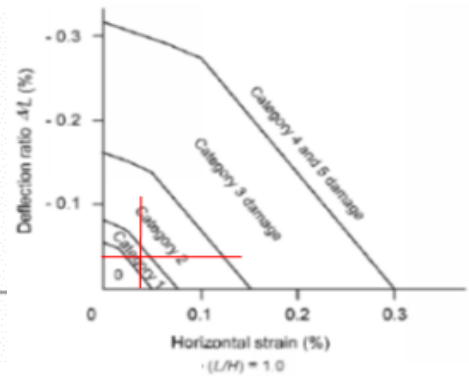
From CIRIA C580 Figure 2.18:

CATEGORY 2



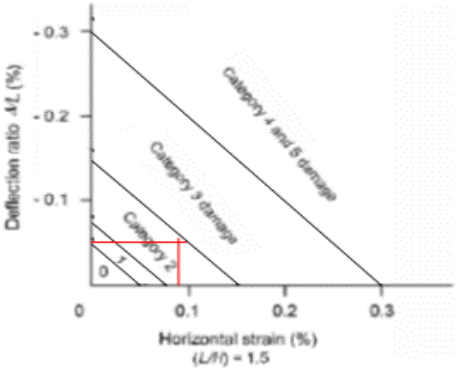
From CIRIA C580 Figure 2.18:

CATEGORY 1



From CIRIA C580 Figure 2.18:

CATEGORY 0

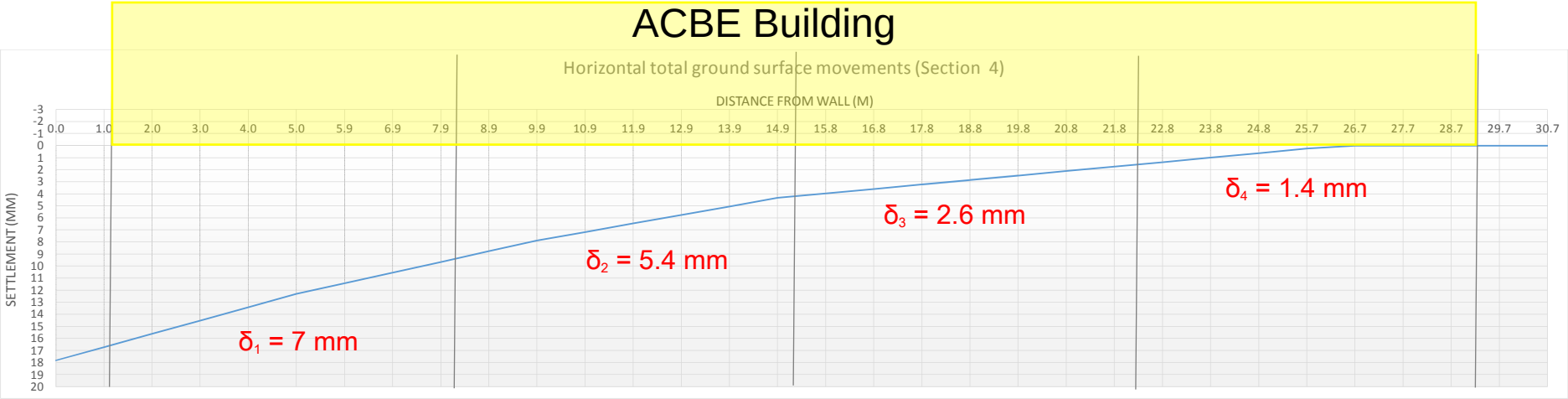
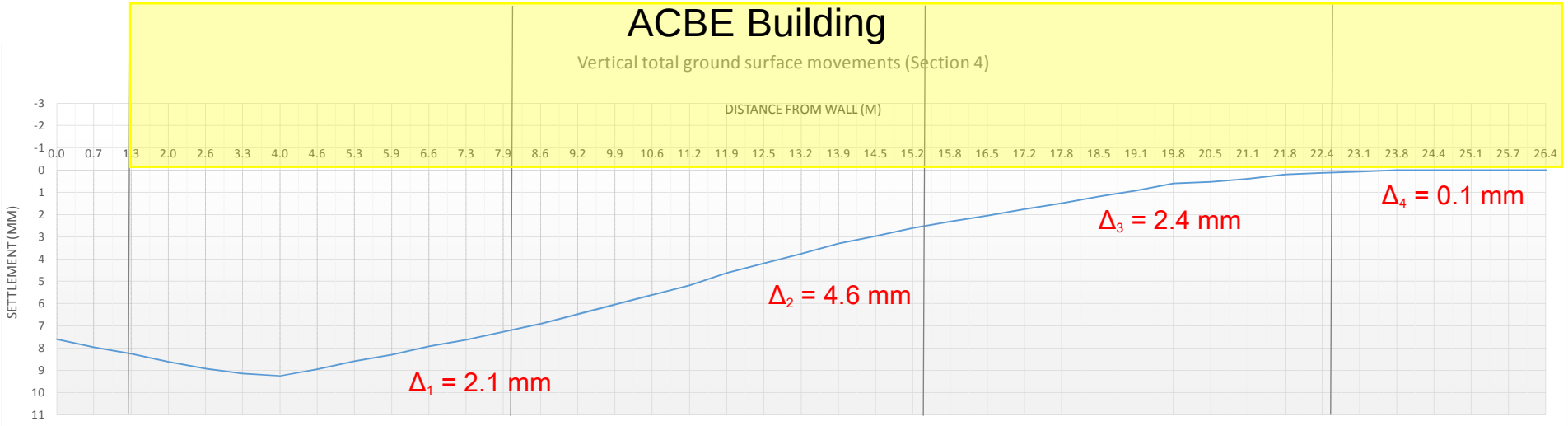


From CIRIA C580 Figure 2.18:

CATEGORY 2

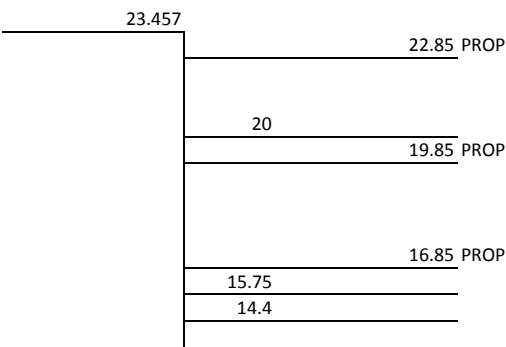
From CIRIA C580 Figure 2.18:

CATEGORY 2



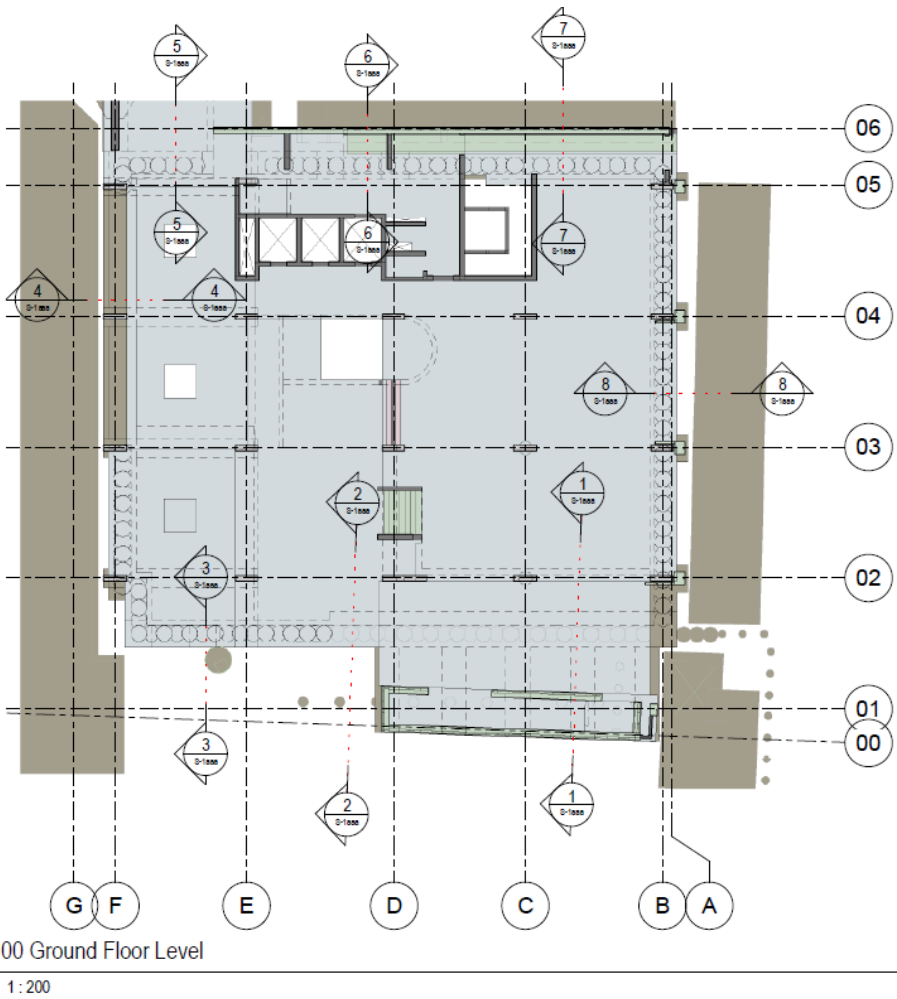
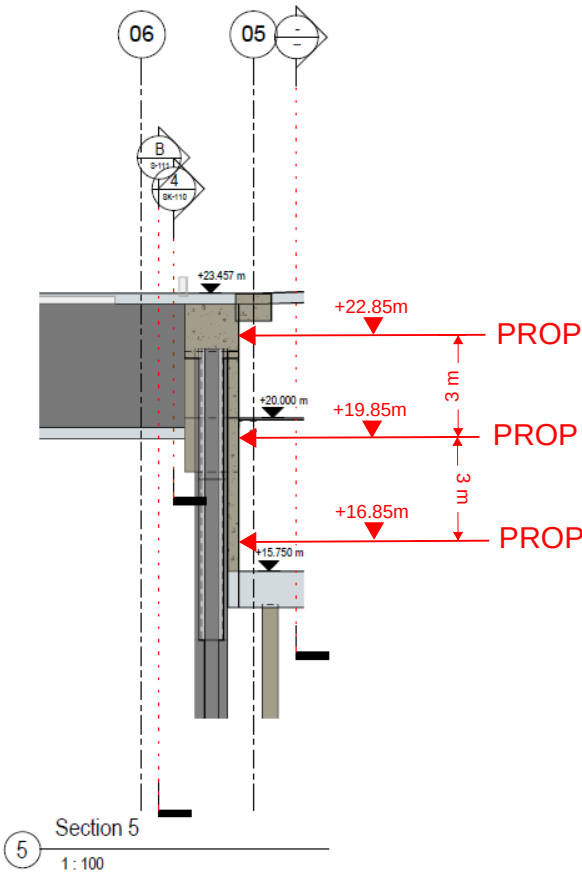
SECTION 5

Properties



SECANT PILING		
Excavation depth	= 9.057 m	
Pile Length	= 13.5855 m	= 1.5 x excavation depth
Pile diameter	= 880 mm	
EI	= 565600 kN.m ² /m	
h	= 3 m	= average depth between props

Damage Category 2 Wall

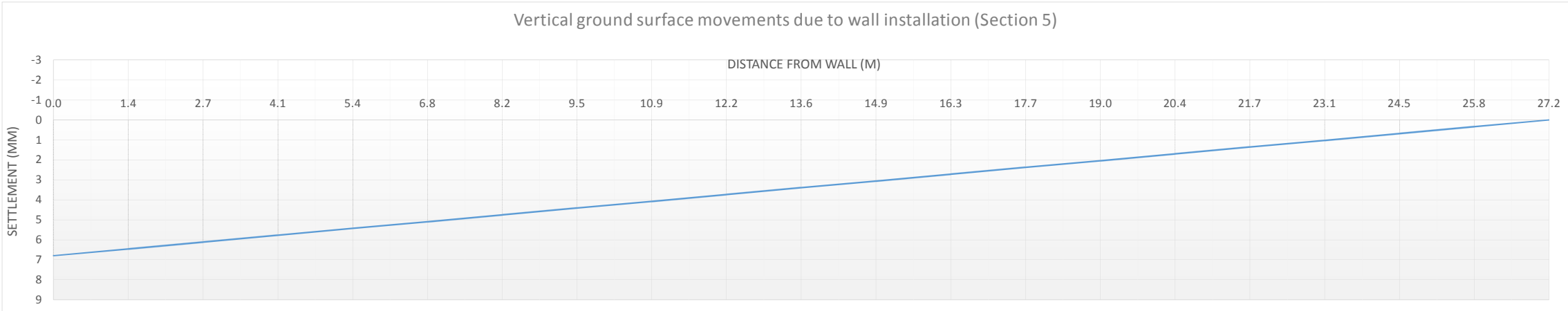


Settlement due to wall installation (SECTION 5)

Excavation depth	=	9.057 m
Pile Length	=	13.5855 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL

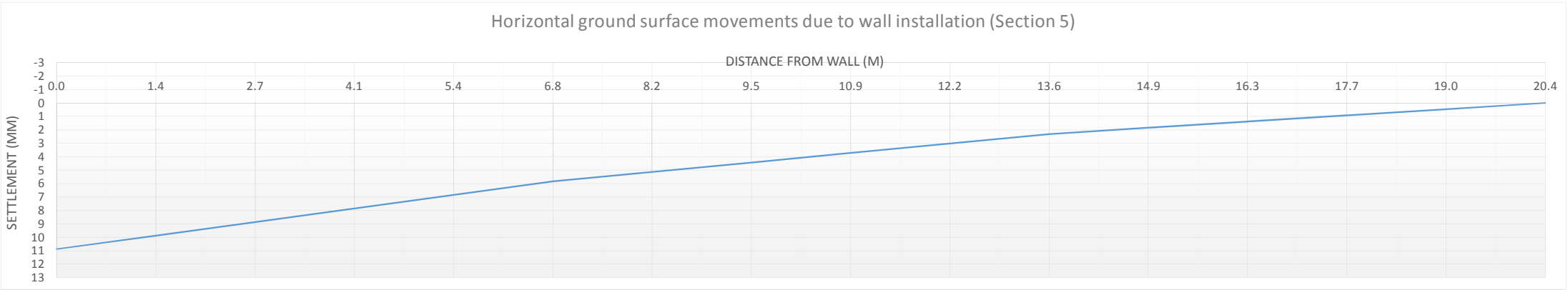
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6
Distance	0	1.35855	2.7171	4.07565	5.4342	6.79275	8.1513	9.50985	10.8684	12.22695	13.5855	14.94405	16.3026	17.66115	19.0197	20.37825	21.7368	23.09535	24.4539	25.81245	27.171	28.52955	29.8881	31.24665	32.6052	33.96375	35.3223
%Settlement/Wall depth	0.05	0.0475	0.045	0.0425	0.04	0.0375	0.035	0.0325	0.03	0.0275	0.025	0.0225	0.02	0.0175	0.015	0.0125	0.01	0.0075	0.005	0.0025	0	0	0	0	0	0	0
Settlement	6.79275	6.453113	6.113475	5.773838	5.4342	5.094563	4.754925	4.415288	4.07565	3.736013	3.396375	3.056738	2.7171	2.377463	2.037825	1.698188	1.35855	1.018913	0.679275	0.339637	0	0	0	0	0	0	0



Distance	0	0.9057	1.8114	2.7171	3.6228	4.5285	5.4342	6.3399	7.2456	8.1513	9.057	9.9627	10.8684	11.7741	12.6798	13.5855	14.4912	15.3969	16.3026	17.2083	18.114	19.0197	19.9254	20.8311	21.7368	22.6425	23.5482	24.4539	25.3596	26.2653	27.171	28.0767	28.9824	29.8881	30.7938	31.6995	32.6052	33.5109	34.4166	35.3223	36.228	37.1337	38.0394
Settlement	6.79275	6.566325	6.3399	6.113475	5.88705	5.660625	5.4342	5.207775	4.98135	4.754925	4.5285	4.302075	4.07565	3.849225	3.6228	3.396375	3.16995	2.943525	2.7171	2.490675	2.26425	2.037825	1.8114	1.584975	1.35855	1.132125	0.9057	0.679275	0.45285	0.226425	0	0	0	0	0	0	0	0	0	0	0	0	0

HORIZONTAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.35855	2.7171	4.07565	5.4342	6.79275	8.1513	9.50985	10.8684	12.22695	13.5855	14.94405	16.3026	17.66115	19.0197	20.37825	21.7368	23.09535	24.4539	25.81245	27.171	28.52955	29.8881	31.24665	32.6052	33.96375	35.3223	36.68085	38.0394	39.39795	40.7565	42.11505
%Settlement/Wall depth	0.08	0.0726	0.0652	0.0578	0.0504	0.043	0.0378	0.0326	0.0274	0.0222	0.017	0.0136	0.0102	0.0068	0.0034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Settlement	10.8684	9.863073	8.857746	7.852419	6.847092	5.841765	5.135319	4.428873	3.722427	3.015981	2.309535	1.847628	1.385721	0.923814	0.461907	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

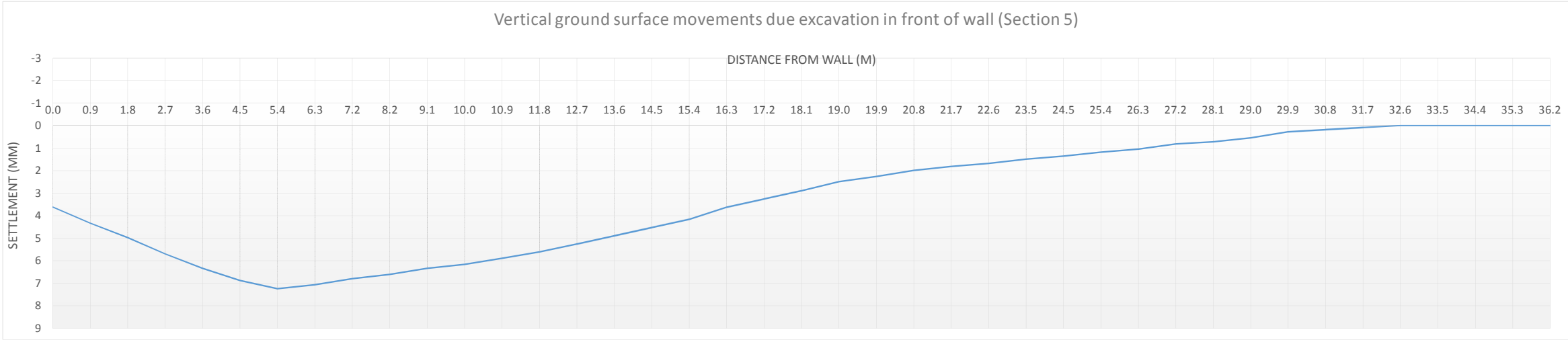


Settlement due to excavation in front of wall (SECTION 5)

Excavation depth	=	9.057 m
Pile Length	=	13.5855 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

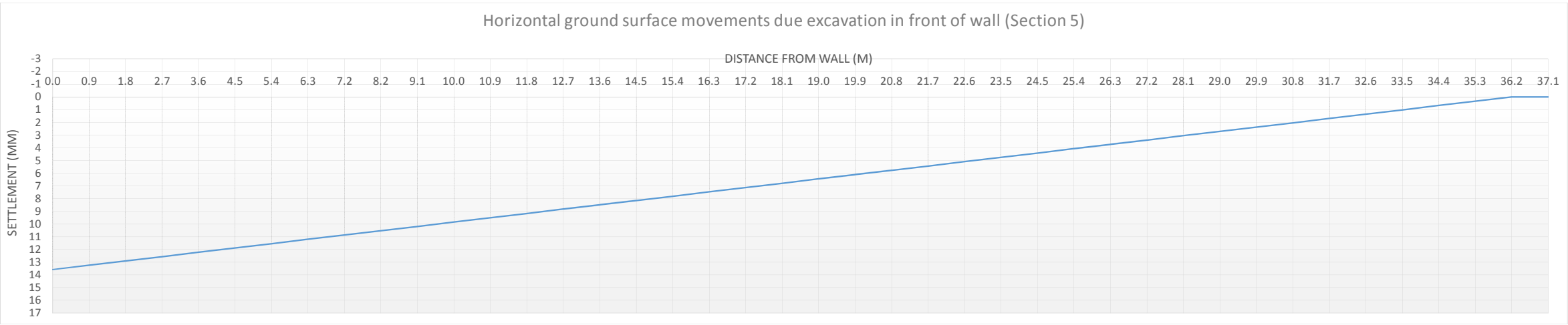
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	0.9057	1.8114	2.7171	3.6228	4.5285	5.4342	6.3399	7.2456	8.1513	9.057	9.9627	10.8684	11.7741	12.6798	13.5855	14.4912	15.3969	16.3026	17.2083	18.114	19.0197	19.9254	20.8311	21.7368	22.6425	23.5482	24.4539	25.3596	26.2653	27.171	28.0767	28.9824	29.8881	30.7938	31.6995	32.6052	33.5109	34.4166	35.3223	36.228	37.1337	38.0394	38.9451	39.8508
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	3.6228	4.34736	4.98135	5.70591	6.3399	6.88332	7.2456	7.06446	6.79275	6.61161	6.3399	6.15876	5.88705	5.61534	5.25306	4.89078	4.5285	4.16622	3.6228	3.26052	2.89824	2.490675	2.26425	1.99254	1.8114	1.675545	1.494405	1.35855	1.17741	1.041555	0.81513	0.72456	0.54342	0.27171	0.18114	0.09057	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	
Distance	0	0.9057	1.8114	2.7171	3.6228	4.5285	5.4342	6.3399	7.2456	8.1513	9.057	9.9627	10.8684	11.7741	12.6798	13.5855	14.4912	15.3969	16.3026	17.2083	18.114	19.0197	19.9254	20.8311	21.7368	22.6425	23.5482	24.4539	25.3596	26.2653	27.171	28.0767	28.9824	29.8881	30.7938	31.6995	32.6052	33.5109	34.4166	35.3223	36.228	37.1337	
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0	
Settlement	13.5855	13.24586	12.90623	12.56659	12.22695	11.88731	11.54768	11.20804	10.8684	10.52876	10.18913	9.849488	9.50985	9.170213	8.830575	8.490938	8.1513	7.811663	7.472025	7.132387	6.79275	6.453112	6.113475	5.773837	5.4342	5.094562	4.754925	4.415287	4.07565	3.736012	3.396375	3.056737	2.7171	2.377462	2.037825	1.698187	1.35855	1.018912	0.679275	0.339637	0	0	



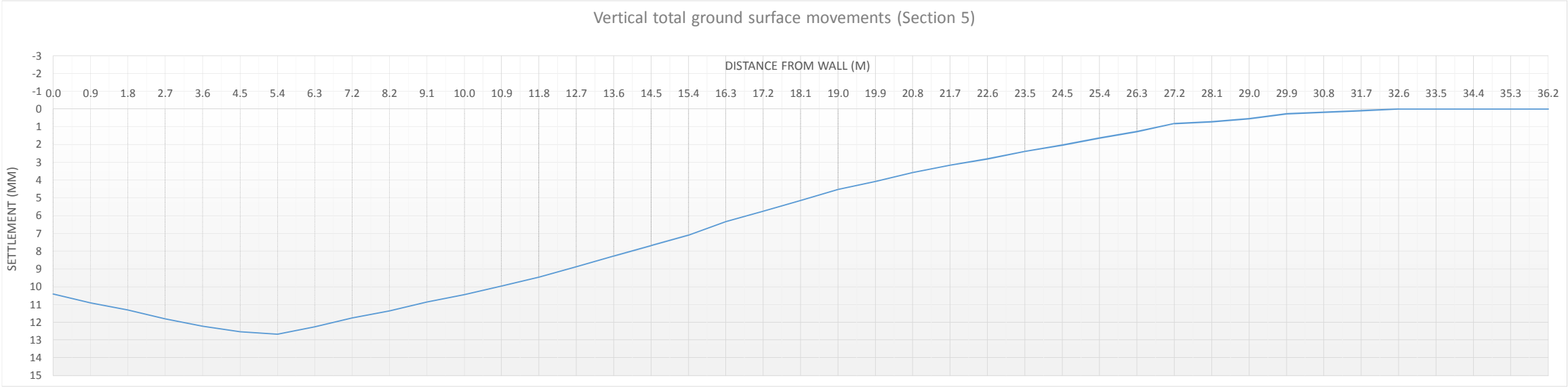
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.35855	2.7171	4.07565	5.4342	6.79275	8.1513	9.50985	10.8684	12.22695	13.5855	14.94405	16.3026	17.66115	19.0197	20.37825	21.7368	23.09535	24.4539	25.81245	27.171	28.52955	29.8881	31.24665	32.6052	33.96375	35.3223	36.68085	38.0394	39.39795	40.7565	42.11505
Settlement	13.5855	13.07604	12.56659	12.05713	11.54768	11.03822	10.52876	10.01931	9.50985	9.000394	8.490938	7.981481	7.472025	6.962569	6.453113	5.943656	5.4342	4.924744	4.415288	3.905831	3.396375	2.886919	2.377463	1.868006	1.35855	0.849094	0.339637	0	0	0	0	0

Settlement due to wall installation and deflection (SECTION 5)

Excavation depth = 9.057 m
Pile Length = 13.5855 m
Pile diameter = 880 mm
EI = 565600 kN.m²/m

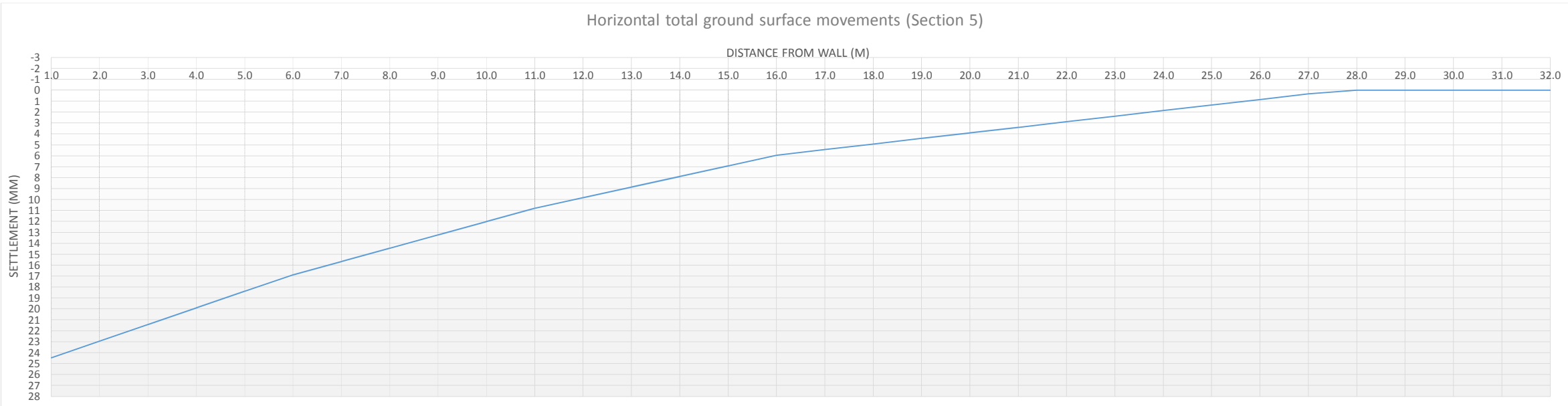
VERTICAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	
Distance	0	0.9057	1.8114	2.7171	3.6228	4.5285	5.4342	6.3399	7.2456	8.1513	9.057	9.9627	10.8684	11.7741	12.6798	13.5855	14.4912	15.3969	16.3026	17.2083	18.114	19.0197	19.9254	20.8311	21.7368	22.6425	23.5482	24.4539	25.3596	26.2653	27.171	28.0767	28.9824	29.8881	30.7938	31.6995	32.6052	33.5109	34.4166	35.3223	36.228	
Settlement due to wall installation	6.79275	6.566325	6.3399	6.113475	5.88705	5.660625	5.4342	5.207775	4.98135	4.754925	4.5285	4.302075	4.07565	3.849225	3.6228	3.396375	3.16995	2.943525	2.7171	2.490675	2.26425	2.037825	1.8114	1.584975	1.35855	1.132125	0.9057	0.679275	0.45285	0.226425	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	3.6228	4.34736	4.98135	5.70591	6.3399	6.88332	7.2456	7.06446	6.79275	6.61161	6.3399	6.15876	5.88705	5.61534	5.25306	4.89078	4.5285	4.16622	3.6228	3.26052	2.89824	2.490675	2.26425	1.99254	1.8114	1.675545	1.494405	1.35855	1.17741	1.041555	0.81513	0.72456	0.54342	0.27171	0.18114	0.09057	0	0	0	0	0	0
Total Settlement	10.41555	10.91369	11.32125	11.81939	12.22695	12.54395	12.6798	12.72224	11.7741	11.36654	10.8684	10.46084	9.9627	9.464565	8.87586	8.287155	7.69845	7.109745	6.3399	5.751195	5.16249	4.5285	4.07565	3.577515	3.16995	2.80767	2.400105	2.037825	1.63026	1.26798	0.81513	0.72456	0.54342	0.27171	0.18114	0.09057	0	0	0	0	0	0



HORIZONTAL

	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Distance	0	1.35855	2.7171	4.07565	5.4342	6.79275	8.1513	9.50985	10.8684	12.22695	13.5855	14.94405	16.3026	17.66115	19.0197	20.37825	21.7368	23.09535	24.4539	25.81245	27.171	28.52955	29.8881	31.24665	32.6052	33.96375	35.3223	36.68085	38.0394	39.39795	40.7565	42.11505
Settlement due to wall installation	10.8684	9.863073	8.857746	7.852419	6.847092	5.841765	5.135319	4.428873	3.722427	3.015981	2.309535	1.847628	1.385721	0.923814	0.461907	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	13.5855	13.07604	12.56659	12.05713	11.54768	11.03822	10.52876	10.01931	9.50985	9.000394	8.490938	7.981481	7.472025	6.962569	6.453113	5.943656	5.4342	4.924744	4.415288	3.905831	3.396375	2.886919	2.377463	1.868006	1.35855	0.849094	0.339637	0	0	0	0	0	0
Total Settlement	24.4539	22.93912	21.42433	19.90955	18.39477	16.87998	15.66408	14.44818	13.23228	12.01637	10.80047	9.829109	8.857746	7.886383	6.91502	5.943656	5.4342	4.924744	4.415288	3.905831	3.396375	2.886919	2.377463	1.868006	1.35855	0.849094	0.339637	0	0	0	0	0	0



Category Assessment (SECTION 5)

NO BUILDING

L	=	0	m
H	=	0	m

Δ	=	0.01268	m
δ	=	0.024454	m

L/H	=	-
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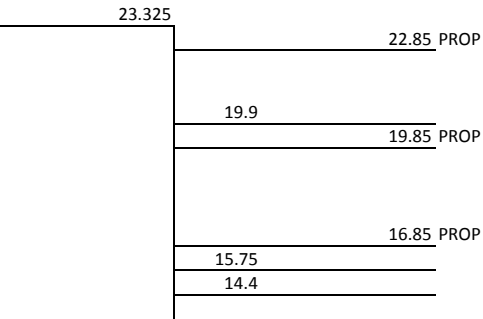
δ/L	=	-	%
Δ/L	=	-	%

From CIRIA C580 Figure 2.18:

CATEGORY 0

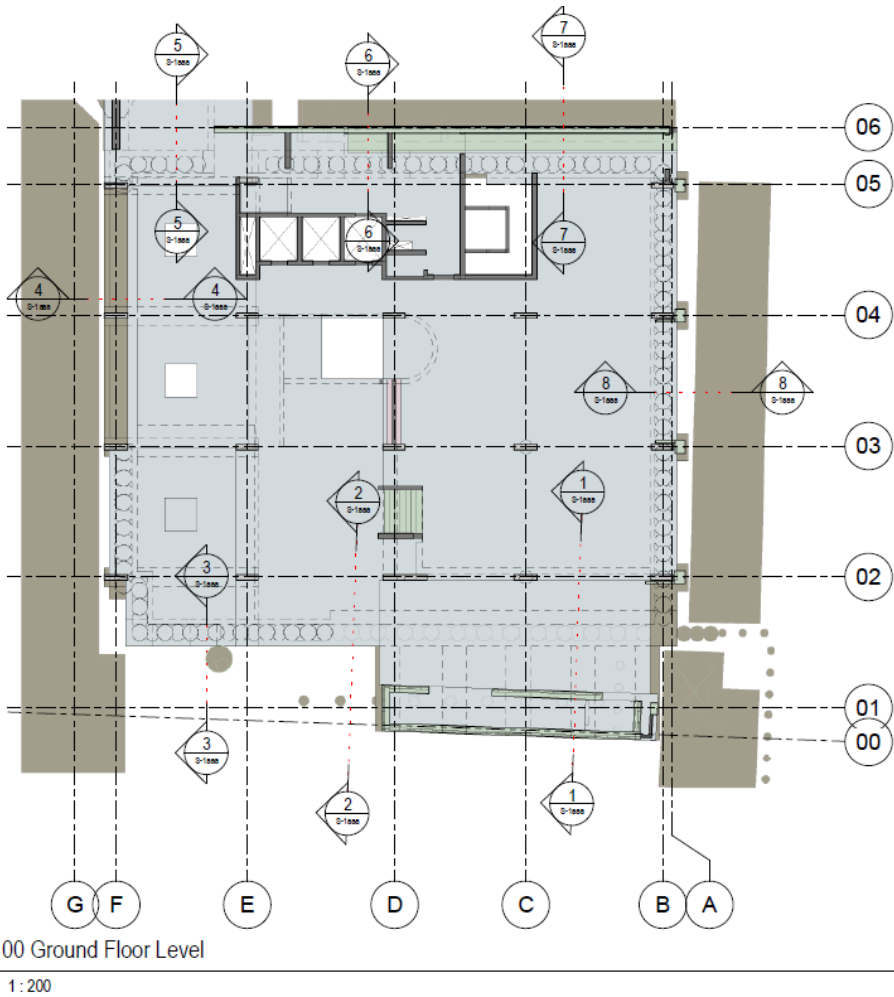
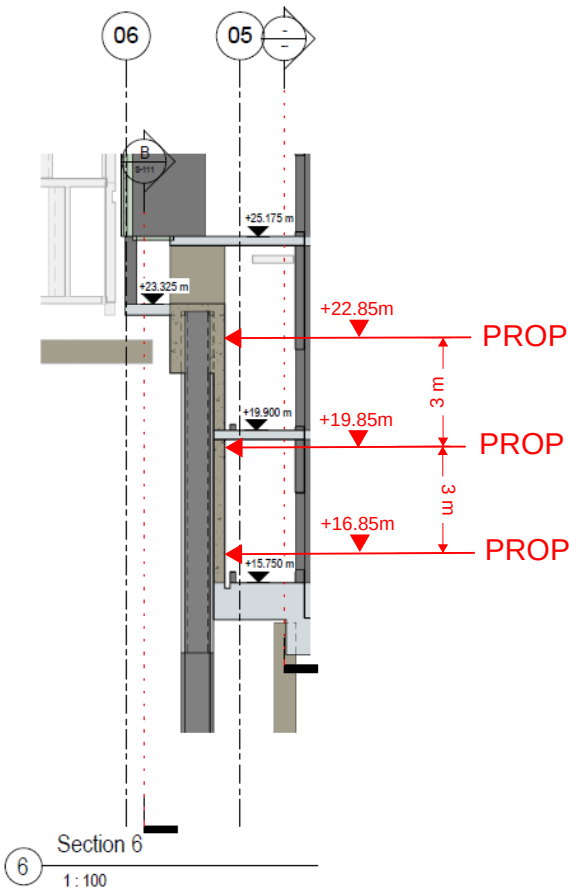
SECTION 6

Properties



SECANT PILING			
Excavation depth	=	8.925 m	
Pile Length	=	13.3875 m	= 1.5 x excavation depth
Pile diameter	=	880 mm	
EI	=	565600 kN.m ² /m	
h	=	3 m	= average depth between props

Damage Category 2 Wall

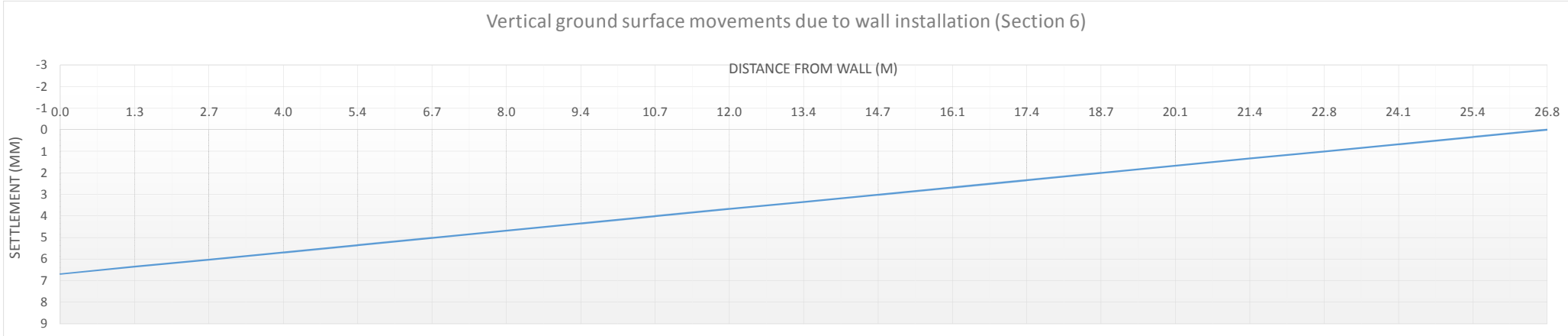


Settlement due to wall installation (SECTION 6)

Excavation depth	=	8.925 m
Pile Length	=	13.3875 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL

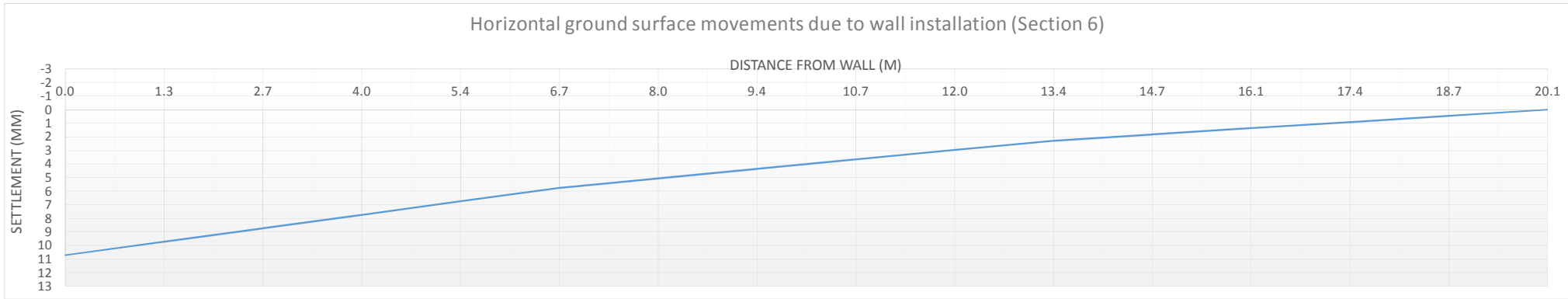
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6
Distance	0	1.33875	2.6775	4.01625	5.355	6.69375	8.0325	9.37125	10.71	12.04875	13.3875	14.72625	16.065	17.40375	18.7425	20.08125	21.42	22.75875	24.0975	25.43625	26.775	28.11375	29.4525	30.79125	32.13	33.46875	34.8075
%Settlement/Wall depth	0.05	0.0475	0.045	0.0425	0.04	0.0375	0.035	0.0325	0.03	0.0275	0.025	0.0225	0.02	0.0175	0.015	0.0125	0.01	0.0075	0.005	0.0025	0	0	0	0	0	0	0
Settlement	6.69375	6.359063	6.024375	5.689688	5.355	5.020313	4.685625	4.350938	4.01625	3.681563	3.346875	3.012188	2.6775	2.342813	2.008125	1.673438	1.33875	1.004063	0.669375	0.334687	0	0	0	0	0	0	0



0.223125	Distance	0	0.8925	1.785	2.6775	3.57	4.4625	5.355	6.2475	7.14	8.0325	8.925	9.8175	10.71	11.6025	12.495	13.3875	14.28	15.1725	16.065	16.9575	17.85	18.7425	19.635	20.5275	21.42	22.3125	23.205	24.0975	24.99	25.8825	26.775	27.6675	28.56	29.4525	30.345	31.2375	32.13	33.0225	33.915	34.8075	35.7	36.5925	37.485
	Settlement	6.69375	6.470625	6.2475	6.024375	5.80125	5.578125	5.355	5.131875	4.90875	4.685625	4.4625	4.239375	4.01625	3.793125	3.57	3.346875	3.12375	2.900625	2.6775	2.454375	2.23125	2.008125	1.785	1.561875	1.33875	1.115625	0.8925	0.669375	0.44625	0.223125	0	0	0	0	0	0	0	0	0	0	0	0	0

HORIZONTAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.33875	2.6775	4.01625	5.355	6.69375	8.0325	9.37125	10.71	12.04875	13.3875	14.72625	16.065	17.40375	18.7425	20.08125	21.42	22.75875	24.0975	25.43625	26.775	28.11375	29.4525	30.79125	32.13	33.46875	34.8075	36.14625	37.485	38.82375	40.1625	41.50125
%Settlement/Wall depth	0.08	0.0726	0.0652	0.0578	0.0504	0.043	0.0378	0.0326	0.0274	0.0222	0.017	0.0136	0.0102	0.0068	0.0034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement	10.71	9.719325	8.72865	7.737975	6.7473	5.756625	5.060475	4.364325	3.668175	2.972025	2.275875	1.8207	1.365525	0.91035	0.455175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

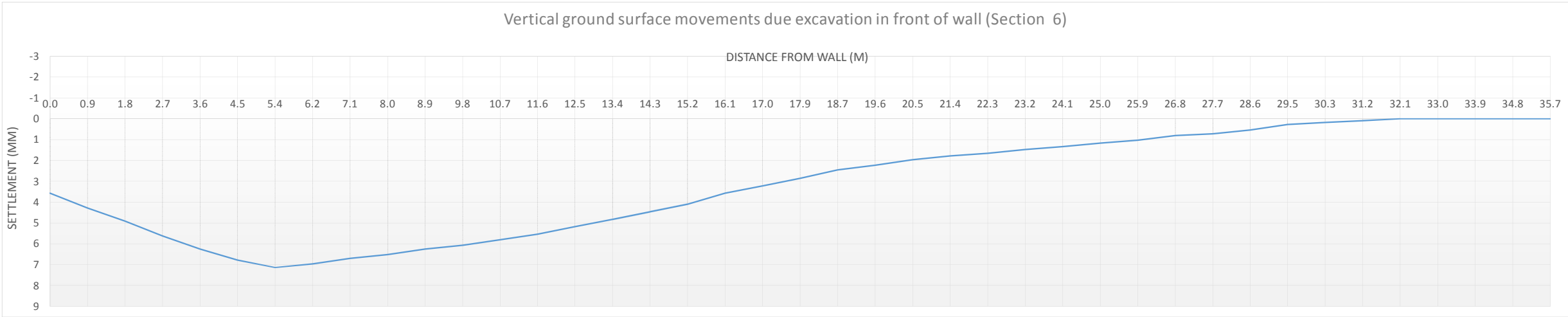


Settlement due to excavation in front of wall (SECTION 6)

Excavation depth	=	8.925 m
Pile Length	=	13.3875 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

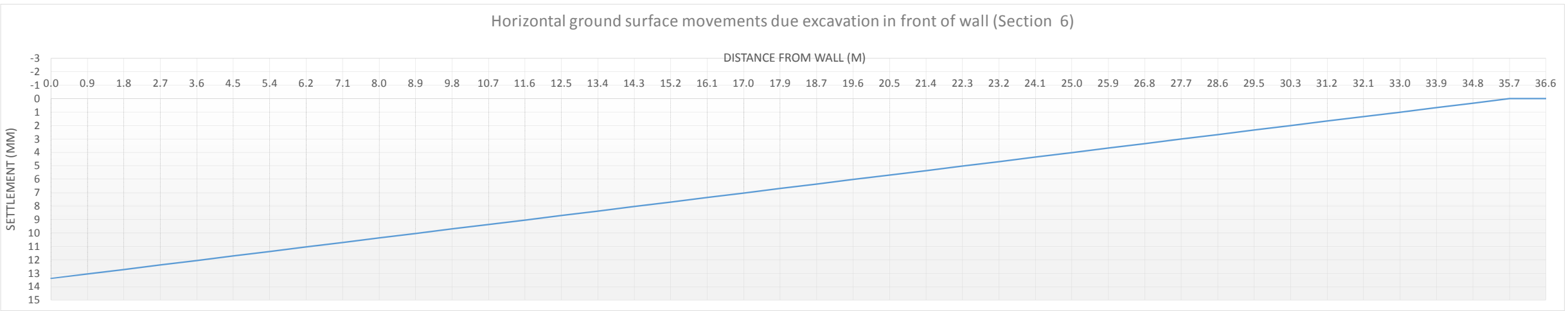
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	0.8925	1.785	2.6775	3.57	4.4625	5.355	6.2475	7.14	8.0325	8.925	9.8175	10.71	11.6025	12.495	13.3875	14.28	15.1725	16.065	16.9575	17.85	18.7425	19.635	20.5275	21.42	22.3125	23.205	24.0975	24.99	25.8825	26.775	27.6675	28.56	29.4525	30.345	31.2375	32.13	33.0225	33.915	34.8075	35.7	36.5925	37.485	38.3775	39.27
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	3.57	4.284	4.90875	5.62275	6.2475	6.783	7.14	6.9615	6.69375	6.51525	6.2475	6.069	5.80125	5.5335	5.1765	4.8195	4.4625	4.1055	3.57	3.213	2.856	2.454375	2.23125	1.9635	1.785	1.651125	1.472625	1.33875	1.16025	1.026375	0.80325	0.714	0.5355	0.26775	0.1785	0.08925	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1
Distance	0	0.8925	1.785	2.6775	3.57	4.4625	5.355	6.2475	7.14	8.0325	8.925	9.8175	10.71	11.6025	12.495	13.3875	14.28	15.1725	16.065	16.9575	17.85	18.7425	19.635	20.5275	21.42	22.3125	23.205	24.0975	24.99	25.8825	26.775	27.6675	28.56	29.4525	30.345	31.2375	32.13	33.0225	33.915	34.8075	35.7	36.5925
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0
Settlement	13.3875	13.05281	12.71813	12.38344	12.04875	11.71406	11.37938	11.04469	10.71	10.37531	10.04063	9.705937	9.37125	9.036563	8.701875	8.367187	8.0325	7.697812	7.363125	7.028437	6.69375	6.359062	6.024375	5.689687	5.355	5.020312	4.685625	4.350937	4.01625	3.681562	3.346875	3.012187	2.6775	2.342812	2.008125	1.673437	1.33875	1.004062	0.669375	0.334687	0	0



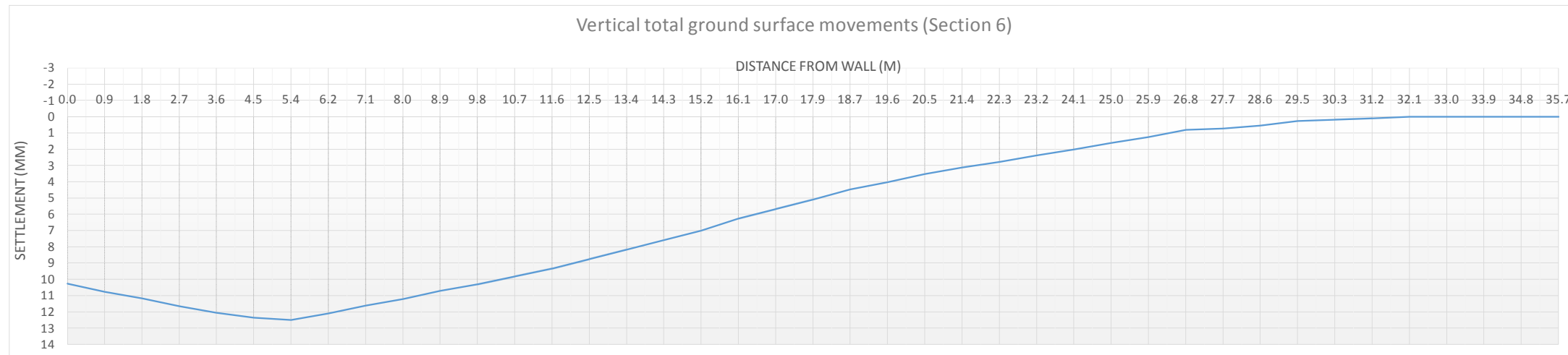
		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Distance	0	1.33875	2.6775	4.01625	5.355	6.69375	8.0325	9.37125	10.71	12.04875	13.3875	14.72625	16.065	17.40375	18.7425	20.08125	21.42	22.75875	24.0975	25.43625	26.775	28.11375	29.4525	30.79125	32.13	33.46875	34.8075	36.14625	37.485	38.82375	40.1625	41.50125
0.502031	Settlement	13.3875	12.88547	12.38344	11.88141	11.37938	10.87734	10.37531	9.873281	9.37125	8.869219	8.367187	7.865156	7.363125	6.861094	6.359062	5.857031	5.355	4.852969	4.350937	3.848906	3.346875	2.844844	2.342812	1.840781	1.33875	0.836719	0.334687	0	0	0	0	0

Settlement due to wall installation and deflection (SECTION 6)

Excavation depth	=	8.925 m
Pile Length	=	13.3875 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

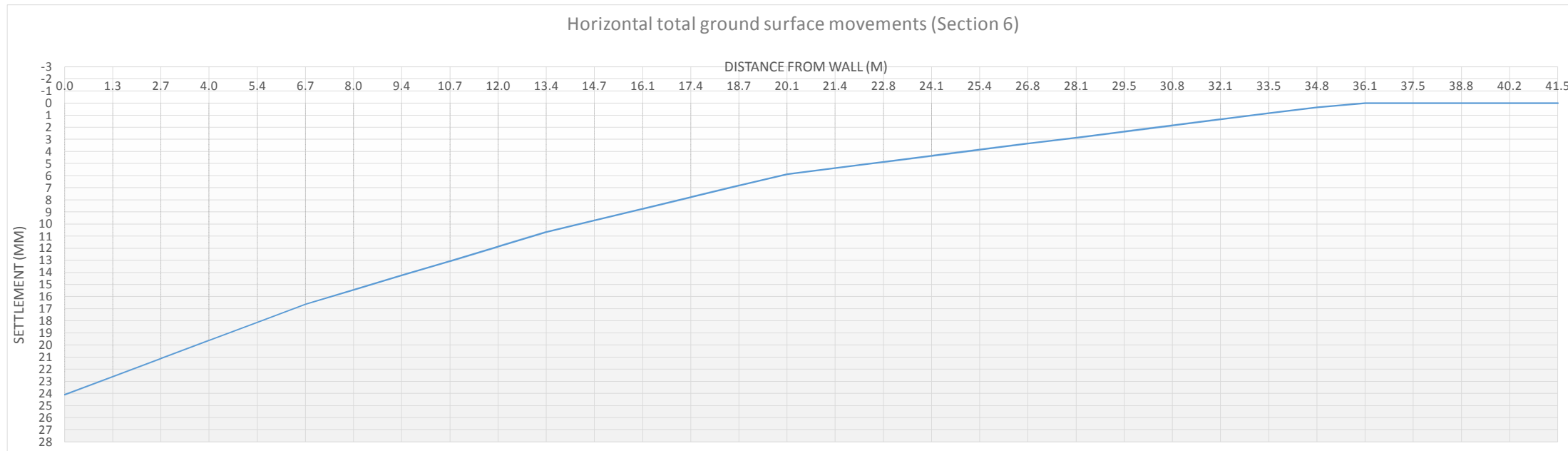
VERTICAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	
Distance	0	0.8925	1.785	2.6775	3.57	4.4625	5.355	6.2475	7.14	8.0325	8.925	9.8175	10.71	11.6025	12.495	13.3875	14.28	15.1725	16.065	16.9575	17.85	18.7425	19.635	20.5275	21.42	22.3125	23.205	24.0975	24.99	25.8825	26.775	27.6675	28.56	29.4525	30.345	31.2375	32.13	33.0225	33.915	34.8075	35.7	
Settlement due to wall installation	6.69375	6.470625	6.2475	6.024375	5.80125	5.578125	5.355	5.131875	4.90875	4.685625	4.4625	4.239375	4.01625	3.793125	3.57	3.346875	3.12375	2.900625	2.6775	2.454375	2.23125	2.008125	1.785	1.561875	1.33875	1.115625	0.8925	0.669375	0.44625	0.223125	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	3.57	4.284	4.90875	5.62275	6.2475	6.783	7.14	6.9615	6.69375	6.51525	6.2475	6.069	5.80125	5.5335	5.1765	4.8195	4.4625	4.1055	3.57	3.213	2.856	2.454375	2.23125	1.9635	1.785	1.651125	1.472625	1.33875	1.16025	1.026375	0.80325	0.714	0.5355	0.26775	0.1785	0.08925	0	0	0	0	0	0
Total Settlement	10.26375	10.75463	11.15625	11.64713	12.04875	12.36113	12.495	12.09338	11.6025	11.20088	10.71	10.30838	9.8175	9.326625	8.7465	8.166375	7.58625	7.006125	6.2475	5.667375	5.08725	4.4625	4.01625	3.525375	3.12375	2.76675	2.365125	2.008125	1.6065	1.2495	0.80325	0.714	0.5355	0.26775	0.1785	0.08925	0	0	0	0	0	0



HORIZONTAL

Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.33875	2.6775	4.01625	5.355	6.69375	8.0325	9.37125	10.71	12.04875	13.3875	14.72625	16.065	17.40375	18.7425	20.08125	21.42	22.75875	24.0975	25.43625	26.775	28.11375	29.4525	30.79125	32.13	33.46875	34.8075	36.14625	37.485	38.82375	40.1625	41.50125
Settlement due to wall installation	10.71	9.719325	8.72865	7.737975	6.7473	5.756625	5.060475	4.364325	3.668175	2.972025	2.275875	1.8207	1.365525	0.91035	0.455175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	13.3875	12.88547	12.38344	11.88141	11.37938	10.87734	10.37531	9.873281	9.37125	8.869219	8.367187	7.865156	7.363125	6.861094	6.359062	5.857031	5.355	4.852969	4.350937	3.848906	3.346875	2.844844	2.342812	1.840781	1.33875	0.836719	0.334687	0	0	0	0	0
Total Settlement	24.0975	22.60479	21.11209	19.61938	18.12668	16.63397	15.43579	14.23761	13.03943	11.84124	10.64306	9.685856	8.72865	7.771444	6.814237	5.857031	5.355	4.852969	4.350937	3.848906	3.346875	2.844844	2.342812	1.840781	1.33875	0.836719	0.334687	0	0	0	0	0

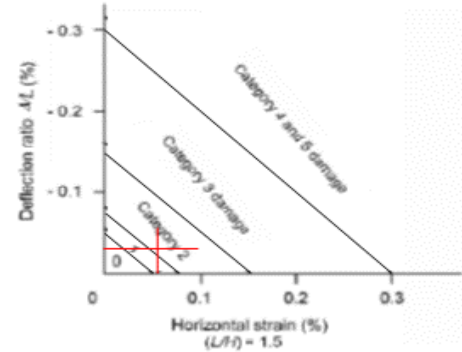
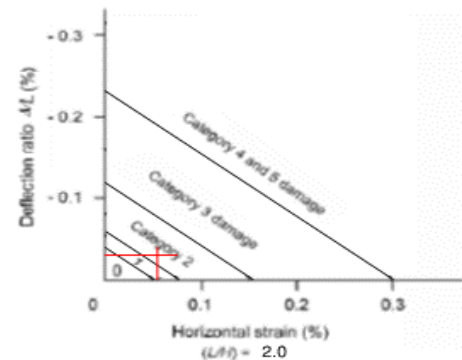


Category Assessment (SECTION 6)

L	=	45 m
H	=	27 m
Δ	=	0.012495 m
δ	=	0.024098 m
L/H	=	1.666667
δ/L	=	0.05355 %
Δ/L	=	0.027767 %

From CIRIA C580 Figure 2.18:

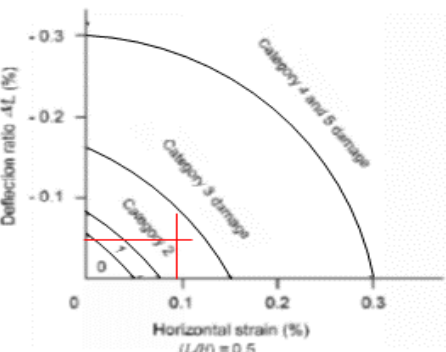
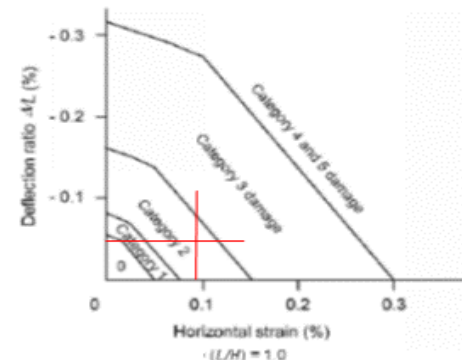
CATEGORY 2



L ₁	=	15 m
H ₁	=	27 m
Δ ₁	=	0.0067 m
δ ₁	=	0.0139 m
L ₁ /H ₁	=	0.555556
δ ₁ /L ₁	=	0.092667 %
Δ ₁ /L ₁	=	0.044667 %

From CIRIA C580 Figure 2.18:

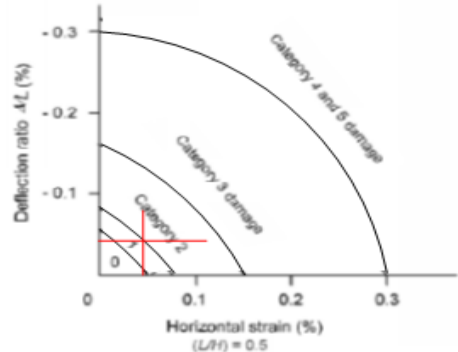
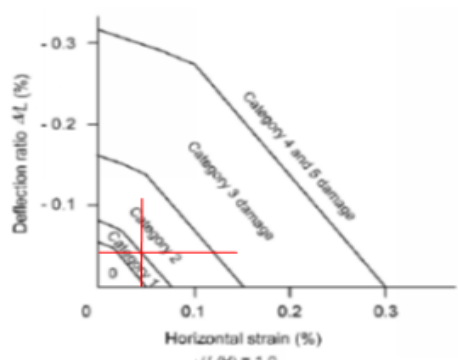
CATEGORY 2



L ₂	=	15 m
H ₂	=	27 m
Δ ₂	=	0.0058 m
δ ₂	=	0.0066 m
L ₂ /H ₂	=	0.555556
δ ₂ /L ₂	=	0.044 %
Δ ₂ /L ₂	=	0.038667 %

From CIRIA C580 Figure 2.18:

CATEGORY 1



L ₃	=	15 m
H ₃	=	27 m
Δ ₃	=	0 m
δ ₃	=	0.0015 m
L ₃ /H ₃	=	0.555556
δ ₃ /L ₃	=	0.01 %
Δ ₃ /L ₃	=	0 %

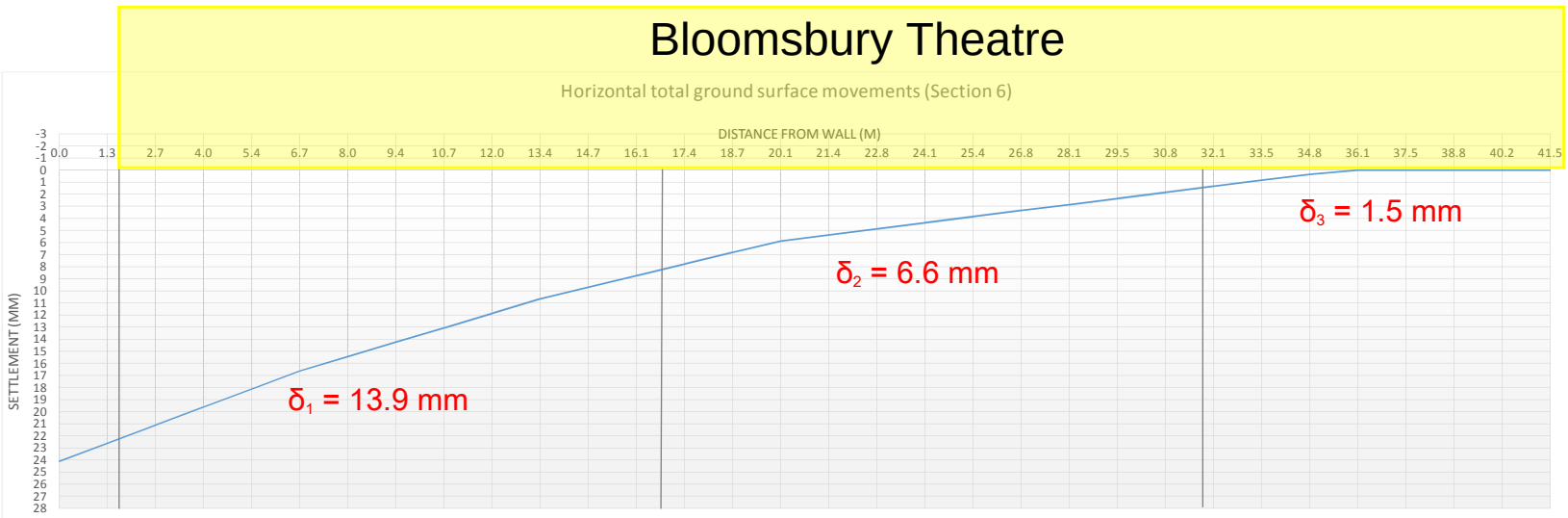
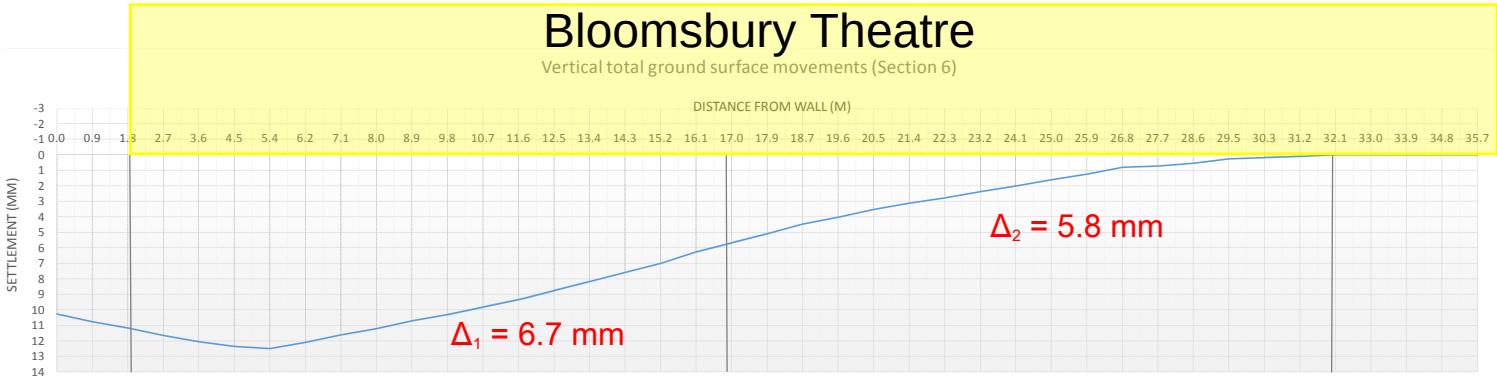
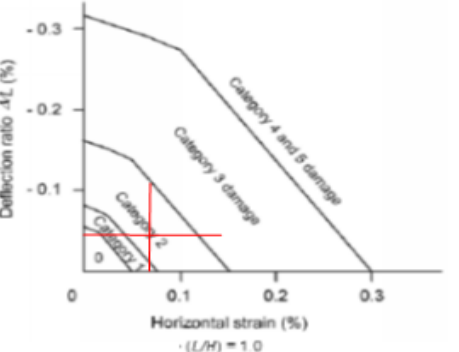
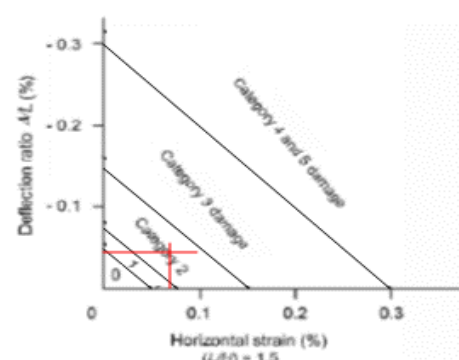
From CIRIA C580 Figure 2.18:

CATEGORY 0

L ₁₊₂	=	30 m
H ₁₊₂	=	27 m
Δ ₁₊₂	=	0.0125 m
δ ₁₊₂	=	0.0205 m
L ₁₊₂ /H ₁₊₂	=	1.111111
δ ₁₊₂ /L ₁₊₂	=	0.068333 %
Δ ₁₊₂ /L ₁₊₂	=	0.041667 %

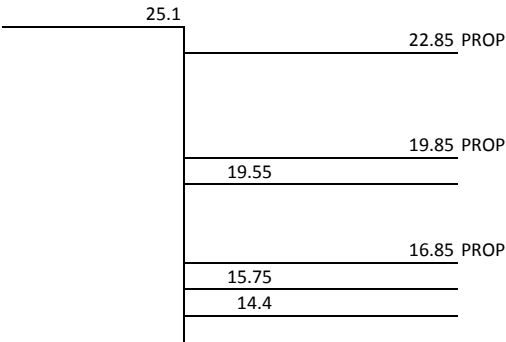
From CIRIA C580 Figure 2.18:

CATEGORY 2



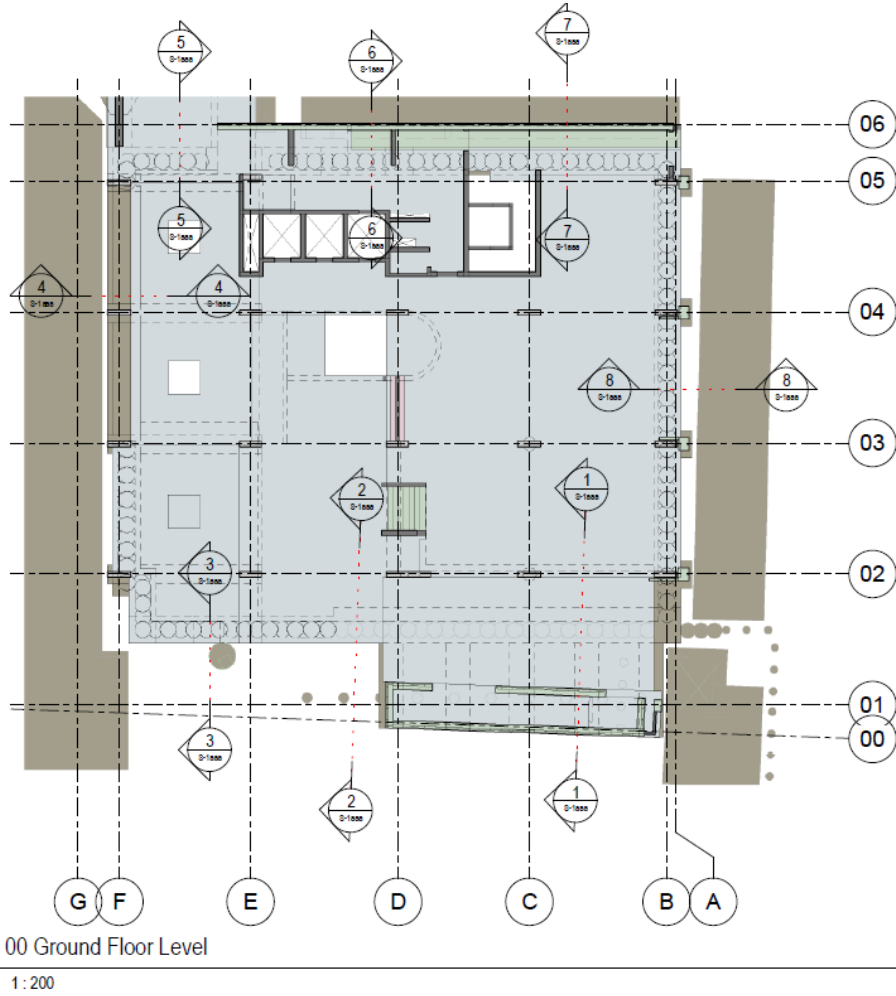
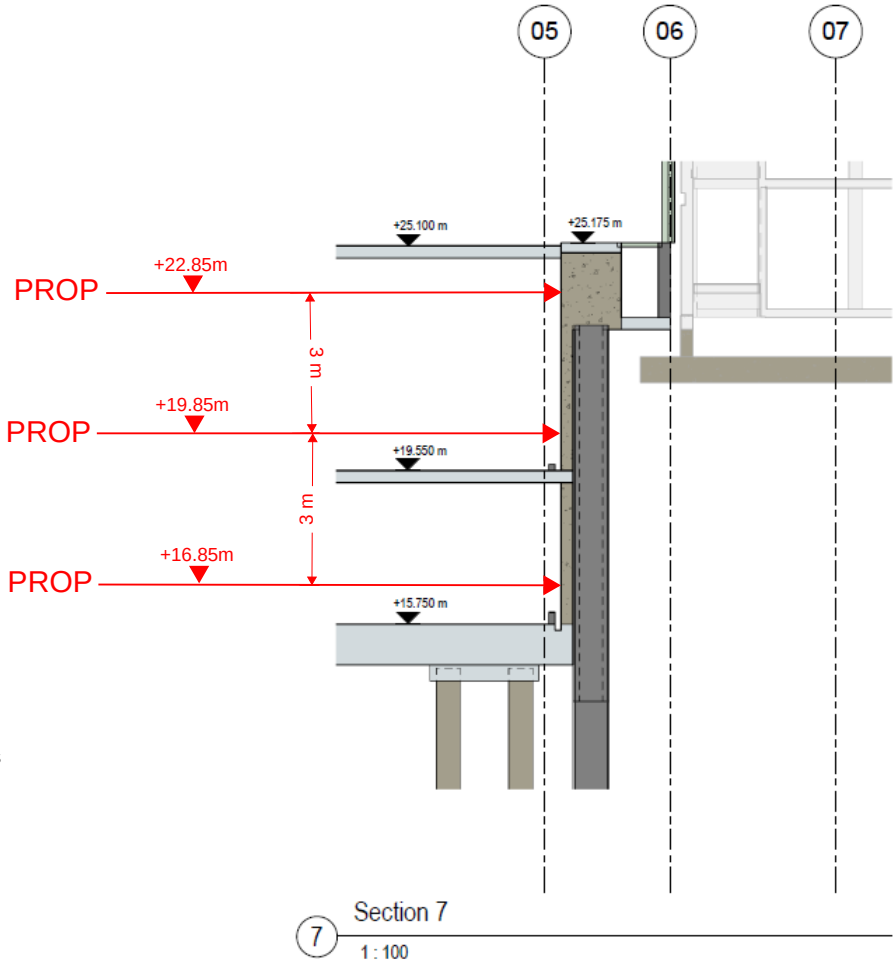
SECTION 7

Properties



SECANT PILING		
Excavation depth	=	10.7 m
Pile Length	=	16.05 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m
h	=	3 m

Damage Category 2 Wall

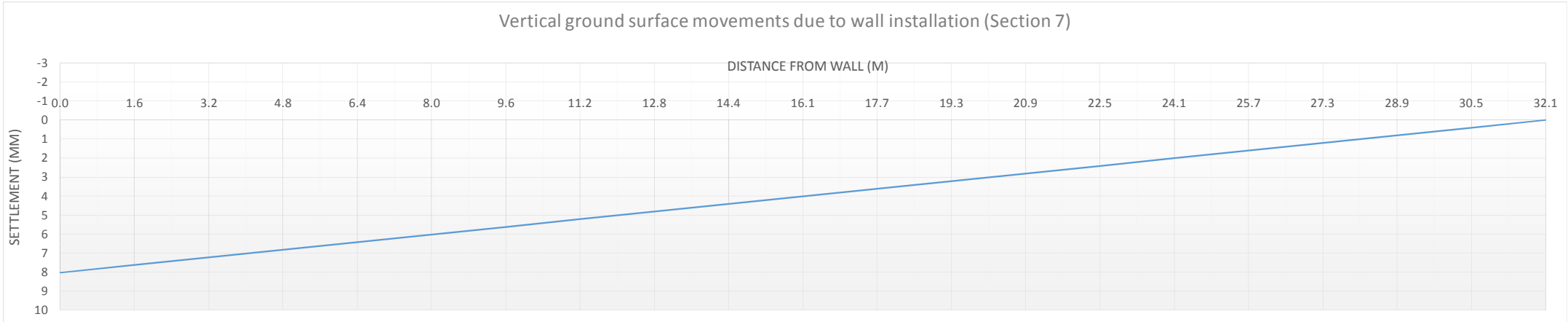


Settlement due to wall installation (SECTION 7)

Excavation depth	=	10.7 m
Pile Length	=	16.05 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL

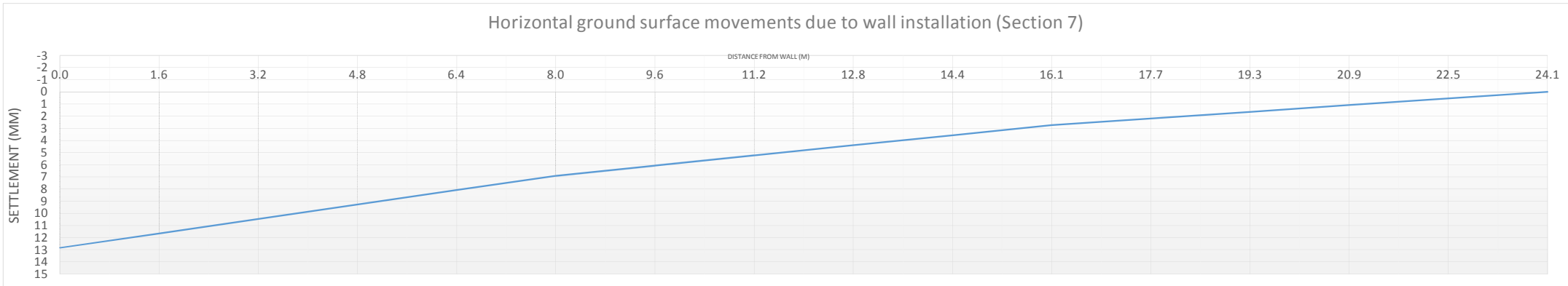
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6
Distance	0	1.605	3.21	4.815	6.42	8.025	9.63	11.235	12.84	14.445	16.05	17.655	19.26	20.865	22.47	24.075	25.68	27.285	28.89	30.495	32.1	33.705	35.31	36.915	38.52	40.125	41.73
%Settlement/Wall depth	0.05	0.0475	0.045	0.0425	0.04	0.0375	0.035	0.0325	0.03	0.0275	0.025	0.0225	0.02	0.0175	0.015	0.0125	0.01	0.0075	0.005	0.0025	0	0	0	0	0	0	0
Settlement	8.025	7.62375	7.2225	6.82125	6.42	6.01875	5.6175	5.21625	4.815	4.41375	4.0125	3.61125	3.21	2.80875	2.4075	2.00625	1.605	1.20375	0.8025	0.40125	0	0	0	0	0	0	0



	Distance	0	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.56	9.63	10.7	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.4	22.47	23.54	24.61	25.68	26.75	27.82	28.89	29.96	31.03	32.1	33.17	34.24	35.31	36.38	37.45	38.52	39.59	40.66	41.73	42.8	43.87	44.94
0.2675	Settlement	8.025	7.7575	7.49	7.2225	6.955	6.6875	6.42	6.1525	5.885	5.6175	5.35	5.0825	4.815	4.5475	4.28	4.0125	3.745	3.4775	3.21	2.9425	2.675	2.4075	2.14	1.8725	1.605	1.3375	1.07	0.8025	0.535	0.2675	0	0	0	0	0	0	0	0	0	0	0	0	0

HORIZONTAL

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.605	3.21	4.815	6.42	8.025	9.63	11.235	12.84	14.445	16.05	17.655	19.26	20.865	22.47	24.075	25.68	27.285	28.89	30.495	32.1	33.705	35.31	36.915	38.52	40.125	41.73	43.335	44.94	46.545	48.15	49.755
%Settlement/Wall depth	0.08	0.0726	0.0652	0.0578	0.0504	0.043	0.0378	0.0326	0.0274	0.0222	0.017	0.0136	0.0102	0.0068	0.0034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement	12.84	11.6523	10.4646	9.2769	8.0892	6.9015	6.0669	5.2323	4.3977	3.5631	2.7285	2.1828	1.6371	1.0914	0.5457	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

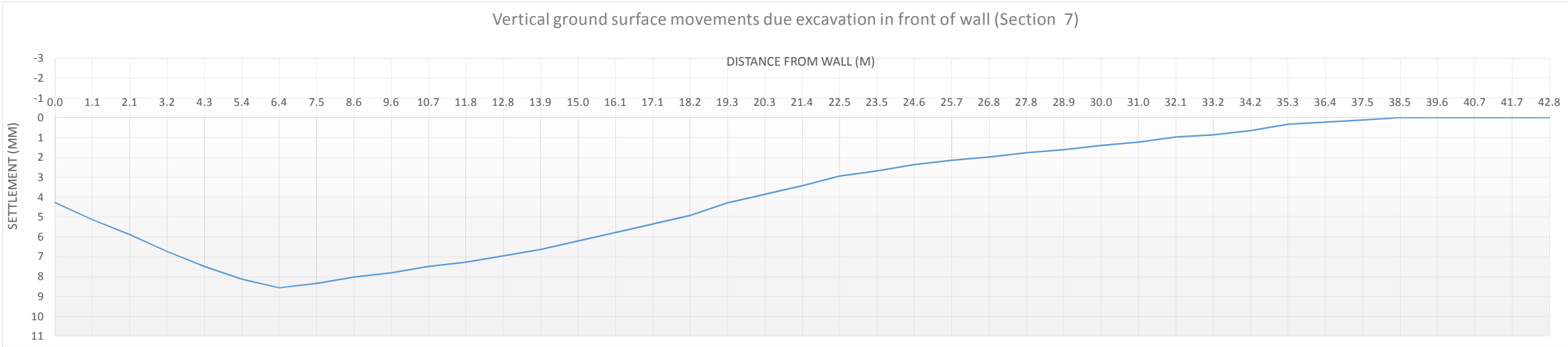


Settlement due to excavation in front of wall (SECTION 7)

Excavation depth	=	10.7 m
Pile Length	=	16.05 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

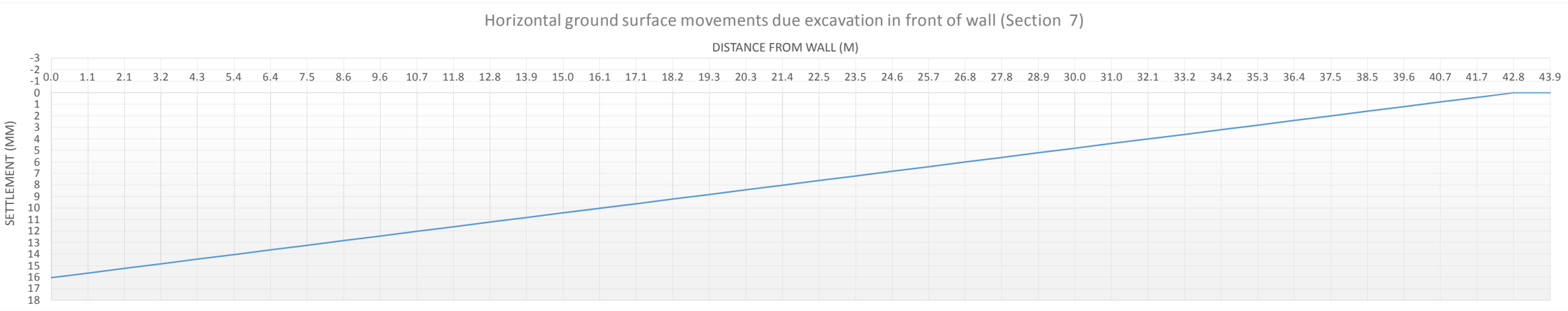
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.56	9.63	10.7	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.4	22.47	23.54	24.61	25.68	26.75	27.82	28.89	29.96	31.03	32.1	33.17	34.24	35.31	36.38	37.45	38.52	39.59	40.66	41.73	42.8	43.87	44.94	46.01	47.08
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	4.28	5.136	5.885	6.741	7.49	8.132	8.56	8.346	8.025	7.811	7.49	7.276	6.955	6.634	6.206	5.778	5.35	4.922	4.28	3.852	3.424	2.9425	2.675	2.354	2.14	1.9795	1.7655	1.605	1.391	1.2305	0.963	0.856	0.642	0.321	0.214	0.107	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1
Distance	0	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.56	9.63	10.7	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.4	22.47	23.54	24.61	25.68	26.75	27.82	28.89	29.96	31.03	32.1	33.17	34.24	35.31	36.38	37.45	38.52	39.59	40.66	41.73	42.8	43.87
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0
Settlement	16.05	15.64875	15.2475	14.84625	14.445	14.04375	13.6425	13.24125	12.84	12.43875	12.0375	11.63625	11.235	10.83375	10.4325	10.03125	9.63	9.22875	8.8275	8.42625	8.025	7.62375	7.2225	6.82125	6.42	6.01875	5.6175	5.21625	4.815	4.41375	4.0125	3.61125	3.21	2.80875	2.4075	2.00625	1.605	1.20375	0.8025	0.40125	0	0



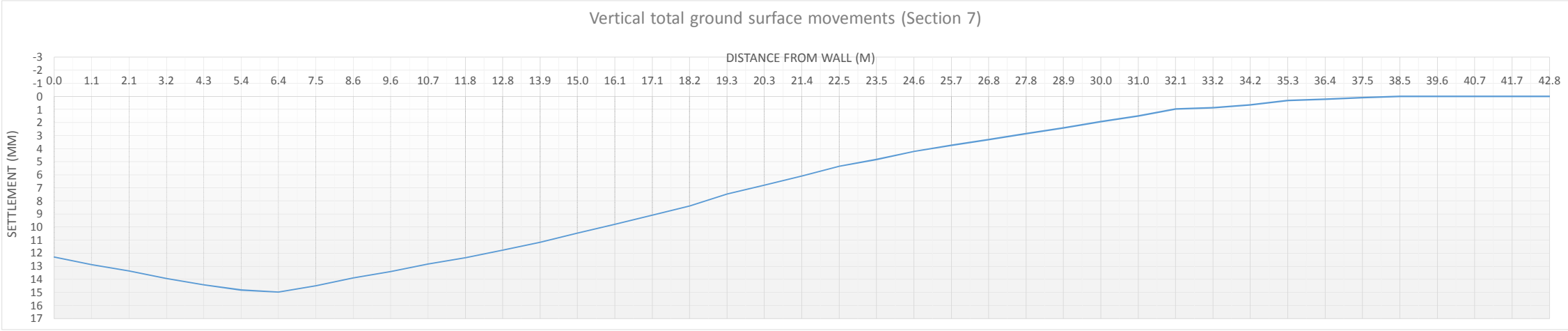
0.601875	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Settlement	16.05	15.44813	14.84625	14.24438	13.6425	13.04063	12.43875	11.83688	11.235	10.63313	10.03125	9.429375	8.8275	8.225625	7.62375	7.021875	6.42	5.818125	5.21625	4.614375	4.0125	3.410625	2.80875	2.206875	1.605	1.003125	0.40125	0	0	0	0	0

Settlement due to wall installation and deflection (SECTION 7)

Excavation depth = 10.7 m
Pile Length = 16.05 m
Pile diameter = 880 mm
EI = 565600 kN.m²/m

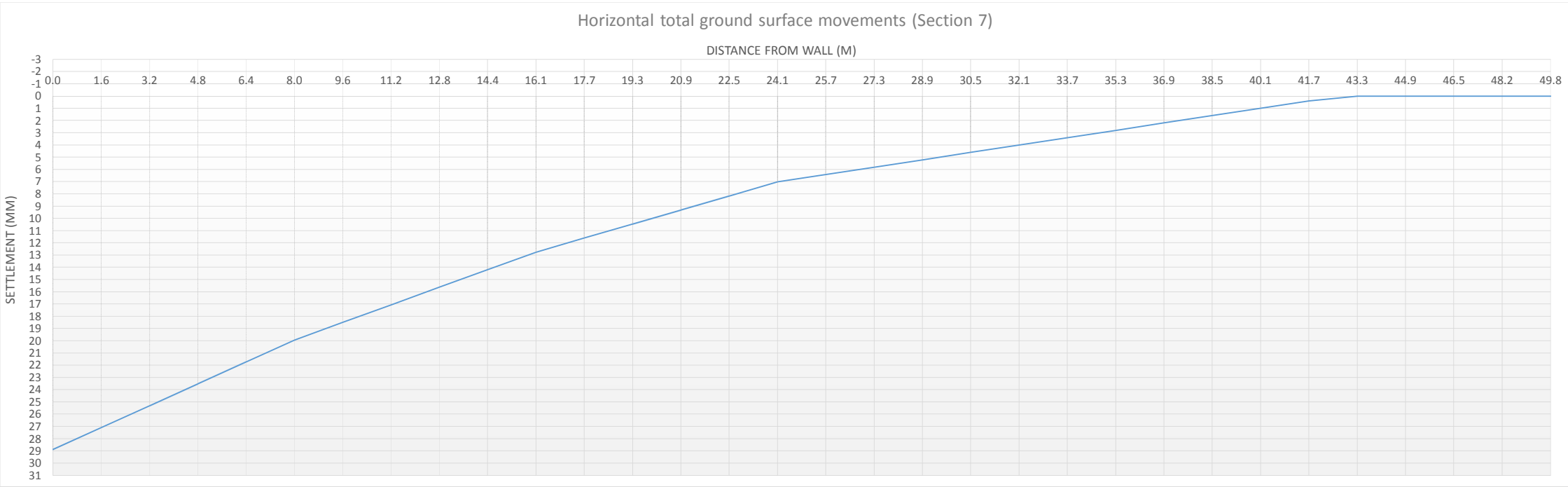
VERTICAL

Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	
	0	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.56	9.63	10.7	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.4	22.47	23.54	24.61	25.68	26.75	27.82	28.89	29.96	31.03	32.1	33.17	34.24	35.31	36.38	37.45	38.52	39.59	40.66	41.73	42.8	
Settlement due to wall installation	8.025	7.7575	7.49	7.2225	6.955	6.6875	6.42	6.1525	5.885	5.6175	5.35	5.0825	4.815	4.5475	4.28	4.0125	3.745	3.4775	3.21	2.9425	2.675	2.4075	2.14	1.8725	1.605	1.3375	1.07	0.8025	0.535	0.2675	0	0	0	0	0	0	0	0	0	0	0	
Settlement due to excavation in front of wall	4.28	5.136	5.885	6.741	7.49	8.132	8.56	8.346	8.025	7.811	7.49	7.276	6.955	6.634	6.206	5.778	5.35	4.922	4.28	3.852	3.424	2.9425	2.675	2.354	2.14	1.9795	1.7655	1.605	1.391	1.2305	0.963	0.856	0.642	0.321	0.214	0.107	0	0	0	0	0	0
Total Settlement	12.305	12.8935	13.375	13.9635	14.445	14.8195	14.98	14.4985	13.91	13.4285	12.84	12.3585	11.77	11.1815	10.486	9.7905	9.095	8.3995	7.49	6.7945	6.099	5.35	4.815	4.2265	3.745	3.317	2.8355	2.4075	1.926	1.498	0.963	0.856	0.642	0.321	0.214	0.107	0	0	0	0	0	0



HORIZONTAL

Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
Distance	0	1.605	3.21	4.815	6.42	8.025	9.63	11.235	12.84	14.445	16.05	17.655	19.26	20.865	22.47	24.075	25.68	27.285	28.89	30.495	32.1	33.705	35.31	36.915	38.52	40.125	41.73	43.335	44.94	46.545	48.15	49.755
Settlement due to wall installation	12.84	11.6523	10.4646	9.2769	8.0892	6.9015	6.0669	5.2323	4.3977	3.5631	2.7285	2.1828	1.6371	1.0914	0.5457	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	16.05	15.44813	14.84625	14.24438	13.6425	13.04063	12.43875	11.83688	11.235	10.63313	10.03125	9.429375	8.8275	8.225625	7.62375	7.021875	6.42	5.818125	5.21625	4.614375	4.0125	3.410625	2.80875	2.206875	1.605	1.003125	0.40125	0	0	0	0	0
Total Settlement	28.89	27.10043	25.31085	23.52128	21.7317	19.94213	18.50565	17.06918	15.6327	14.19623	12.75975	11.61218	10.4646	9.317025	8.16945	7.021875	6.42	5.818125	5.21625	4.614375	4.0125	3.410625	2.80875	2.206875	1.605	1.003125	0.40125	0	0	0	0	0

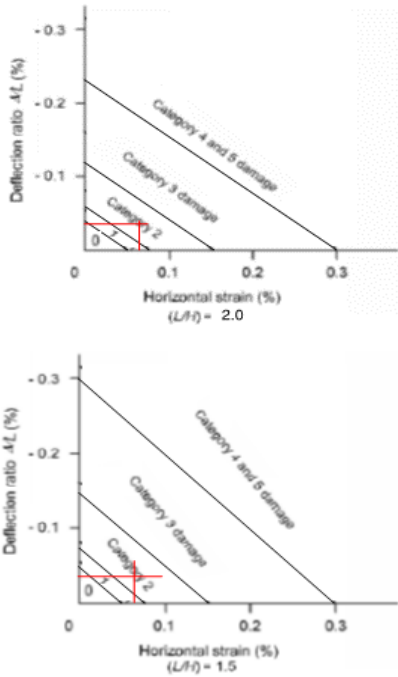


Category Assessment (SECTION 7)

L	=	45 m
H	=	27 m
Δ	=	0.01498 m
δ	=	0.02889 m
L/H	=	1.666667
δ/L	=	0.0642 %
Δ/L	=	0.033289 %

From CIRIA C580 Figure 2.18:

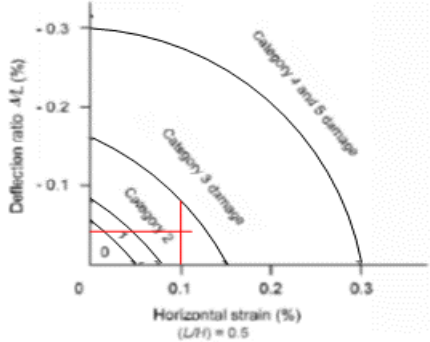
CATEGORY 2



L_1	=	15 m
H_1	=	27 m
Δ_1	=	0.0058 m
δ_1	=	0.0147 m
L_1/H_1	=	0.555556
δ_1/L_1	=	0.098 %
Δ_1/L_1	=	0.038667 %

From CIRIA C580 Figure 2.18:

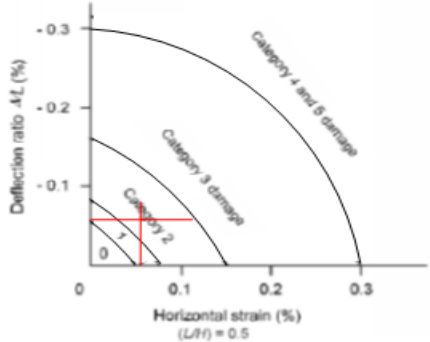
CATEGORY 2



L_2	=	15 m
H_2	=	27 m
Δ_2	=	0.0081 m
δ_2	=	0.0081 m
L_2/H_2	=	0.555556
δ_2/L_2	=	0.054 %
Δ_2/L_2	=	0.054 %

From CIRIA C580 Figure 2.18:

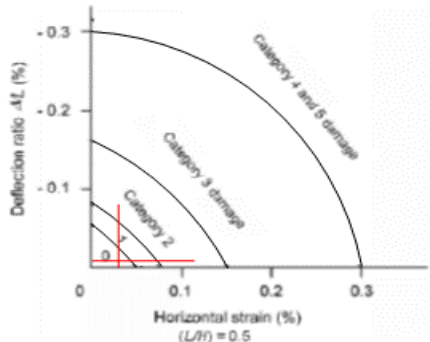
CATEGORY 2



L_3	=	15 m
H_3	=	27 m
Δ_3	=	0.0011 m
δ_3	=	0.0042 m
L_3/H_3	=	0.555556
δ_3/L_3	=	0.028 %
Δ_3/L_3	=	0.007333 %

From CIRIA C580 Figure 2.18:

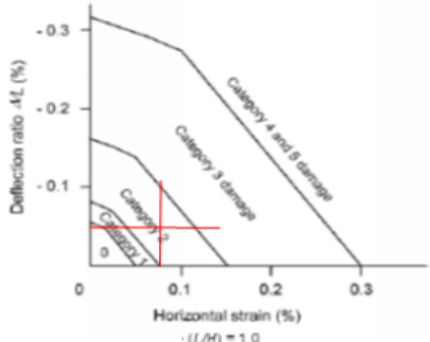
CATEGORY 0



L_{1+2}	=	30 m
H_{1+2}	=	27 m
Δ_{1+2}	=	0.0139 m
δ_{1+2}	=	0.0228 m
L_{1+2}/H_{1+2}	=	1.111111
δ_{1+2}/L_{1+2}	=	0.076 %
Δ_{1+2}/L_{1+2}	=	0.046333 %

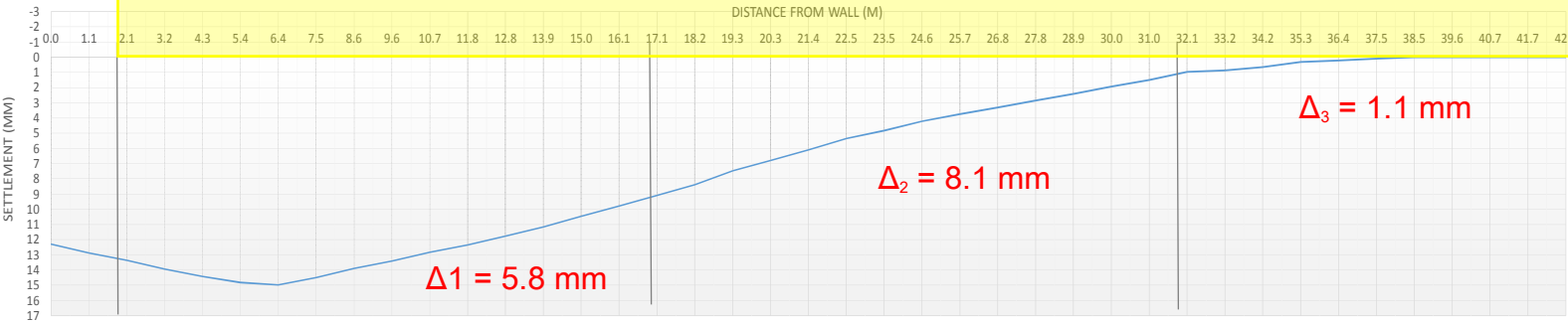
From CIRIA C580 Figure 2.18:

CATEGORY 2



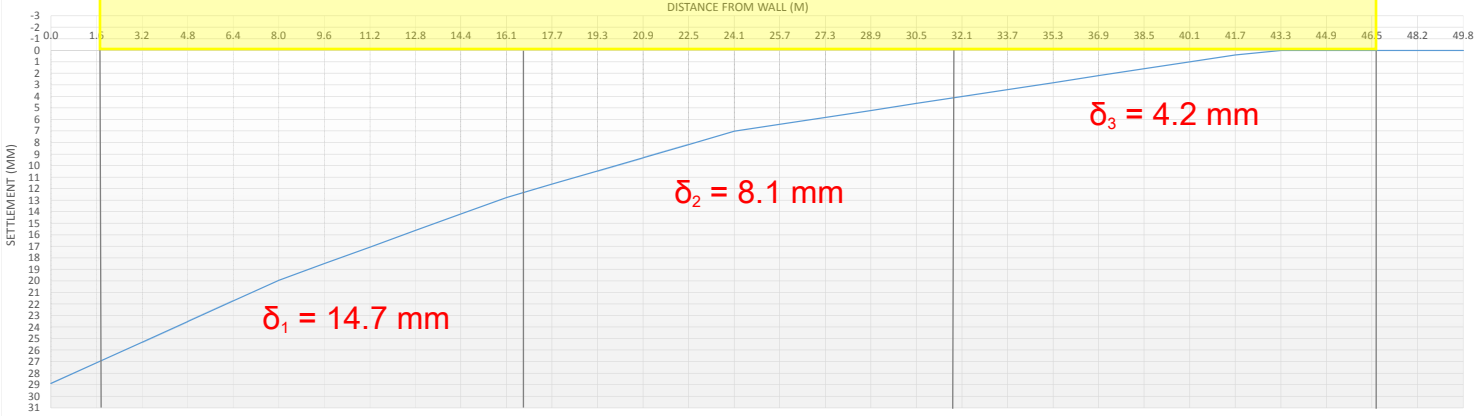
Bloomsbury Theatre

Vertical total ground surface movements (Section 7)



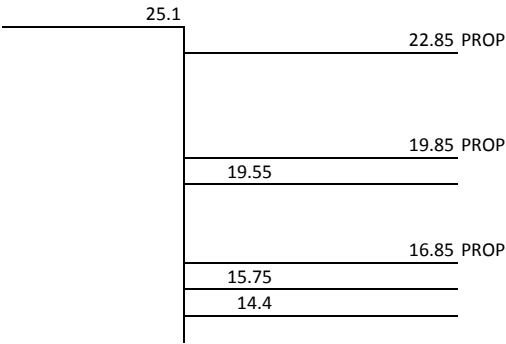
Bloomsbury Theatre

Horizontal total ground surface movements (Section 7)



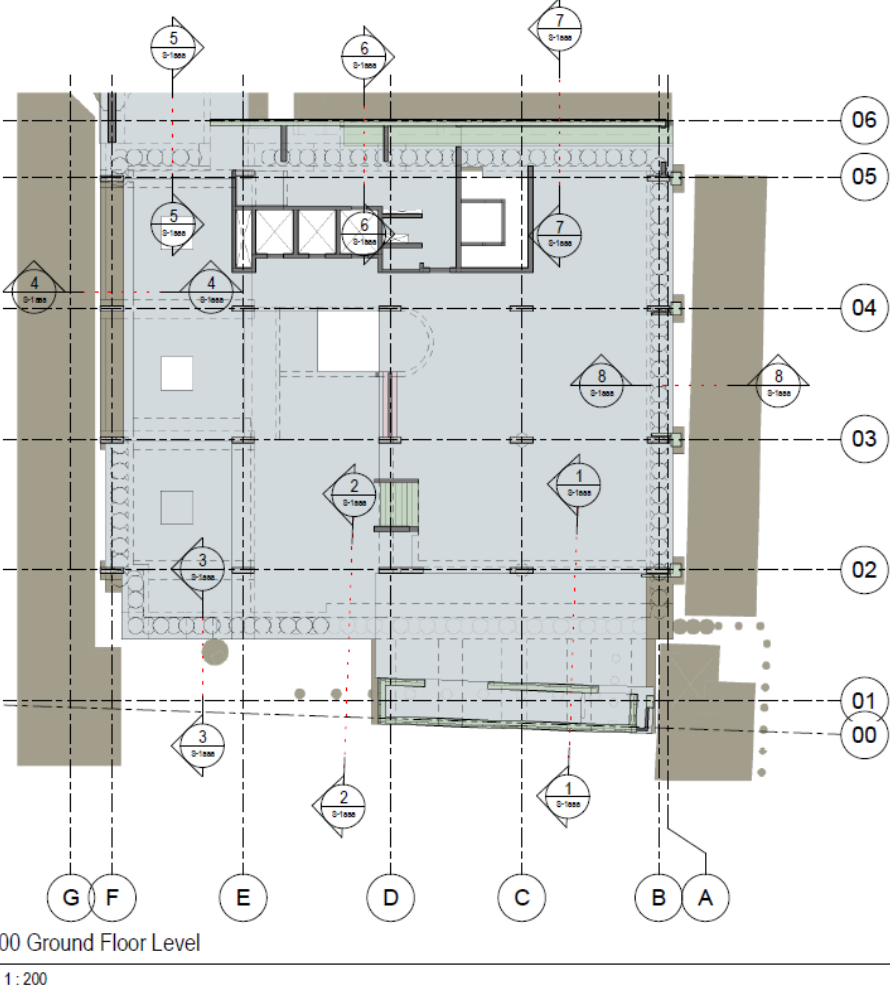
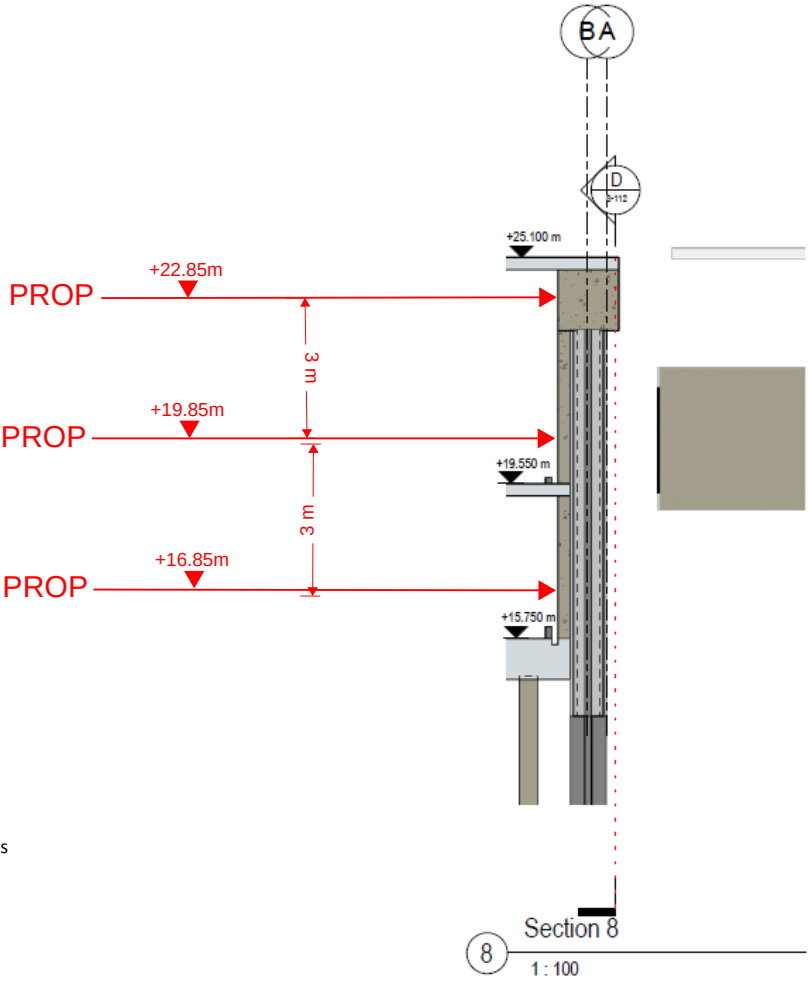
SECTION 8

Properties



SECANT PILING		
Excavation depth	=	10.7 m
Pile Length	=	16.05 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m
h	=	3 m

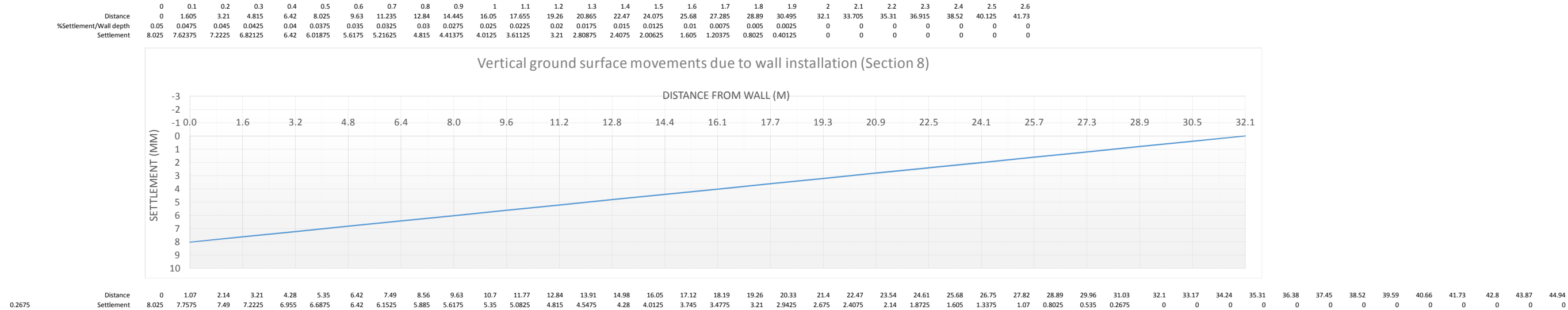
Damage Category 2 Wall



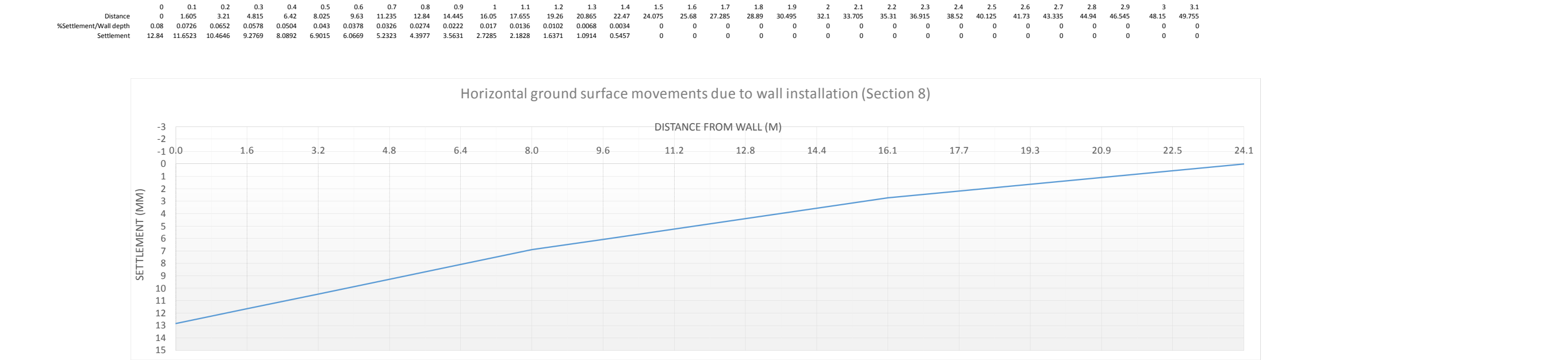
Settlement due to wall installation (SECTION 8)

Excavation depth	=	10.7 m
Pile Length	=	16.05 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

VERTICAL



HORIZONTAL

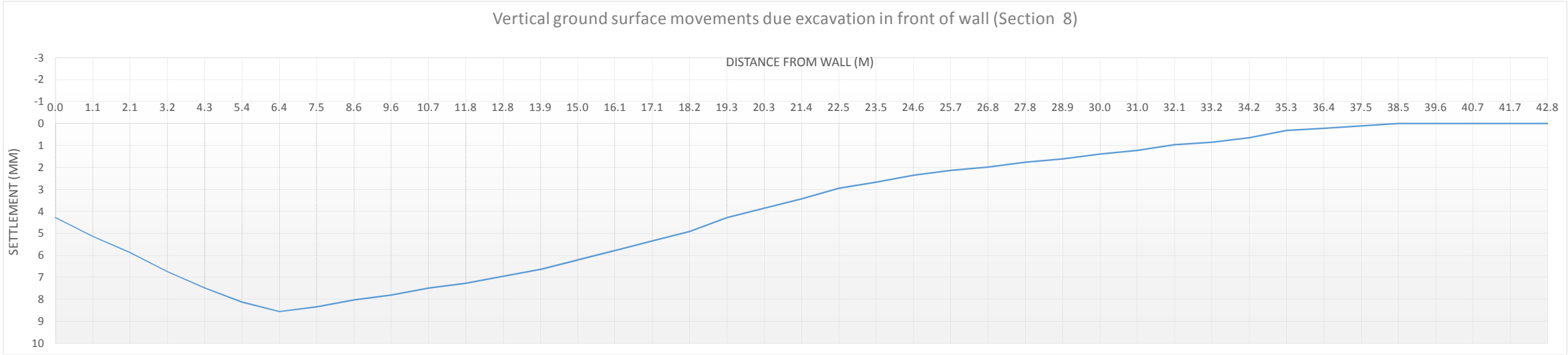


Settlement due to excavation in front of wall (SECTION 8)

Excavation depth	=	10.7 m
Pile Length	=	16.05 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

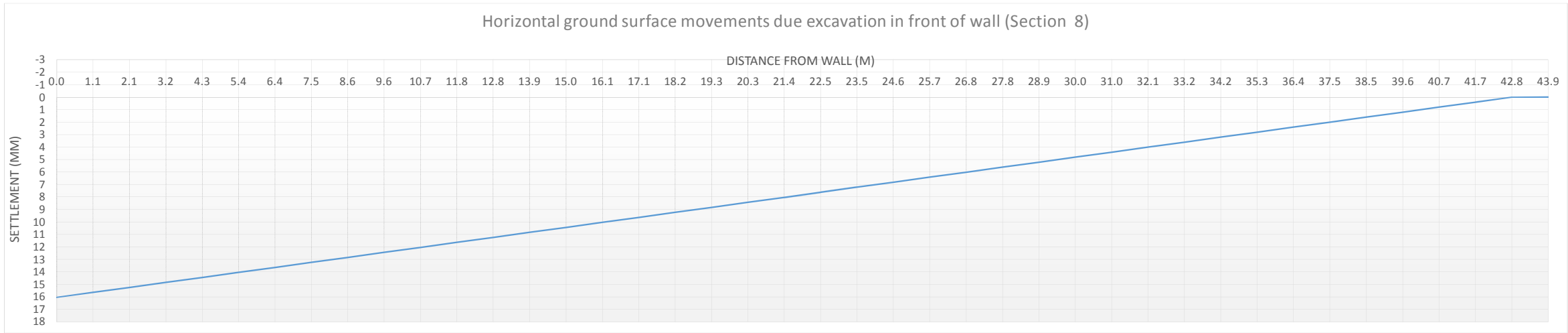
VERTICAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4
Distance	0	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.56	9.63	10.7	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.4	22.47	23.54	24.61	25.68	26.75	27.82	28.89	29.96	31.03	32.1	33.17	34.24	35.31	36.38	37.45	38.52	39.59	40.66	41.73	42.8	43.87	44.94	46.01	47.08
Settlement/Wall depth	0.04	0.048	0.055	0.063	0.07	0.076	0.08	0.078	0.075	0.073	0.07	0.068	0.065	0.062	0.058	0.054	0.05	0.046	0.04	0.036	0.032	0.0275	0.025	0.022	0.02	0.0185	0.0165	0.015	0.013	0.0115	0.009	0.008	0.006	0.003	0.002	0.001	0	0	0	0	0	0	0	0	
Settlement	4.28	5.136	5.885	6.741	7.49	8.132	8.56	8.346	8.025	7.811	7.49	7.276	6.955	6.634	6.206	5.778	5.35	4.922	4.28	3.852	3.424	2.9425	2.675	2.354	2.14	1.9795	1.7655	1.605	1.391	1.2305	0.963	0.856	0.642	0.321	0.214	0.107	0	0	0	0	0	0	0	0	



HORIZONTAL

Distance/Excavation depth	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4	4.1
Distance	0	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.56	9.63	10.7	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.4	22.47	23.54	24.61	25.68	26.75	27.82	28.89	29.96	31.03	32.1	33.17	34.24	35.31	36.38	37.45	38.52	39.59	40.66	41.73	42.8	43.87
Settlement/Wall depth	0.15	0.14625	0.1425	0.13875	0.135	0.13125	0.1275	0.12375	0.12	0.11625	0.1125	0.10875	0.105	0.10125	0.0975	0.09375	0.09	0.08625	0.0825	0.07875	0.075	0.07125	0.0675	0.06375	0.06	0.05625	0.0525	0.04875	0.045	0.04125	0.0375	0.03375	0.03	0.02625	0.0225	0.01875	0.015	0.01125	0.0075	0.00375	0	0
Settlement	16.05	15.64875	15.2475	14.84625	14.445	14.04375	13.6425	13.24125	12.84	12.43875	12.0375	11.63625	11.235	10.83375	10.4325	10.03125	9.63	9.22875	8.8275	8.42625	8.025	7.62375	7.2225	6.82125	6.42	6.01875	5.6175	5.21625	4.815	4.41375	4.0125	3.61125	3.21	2.80875	2.4075	2.00625	1.605	1.20375	0.8025	0.40125	0	0



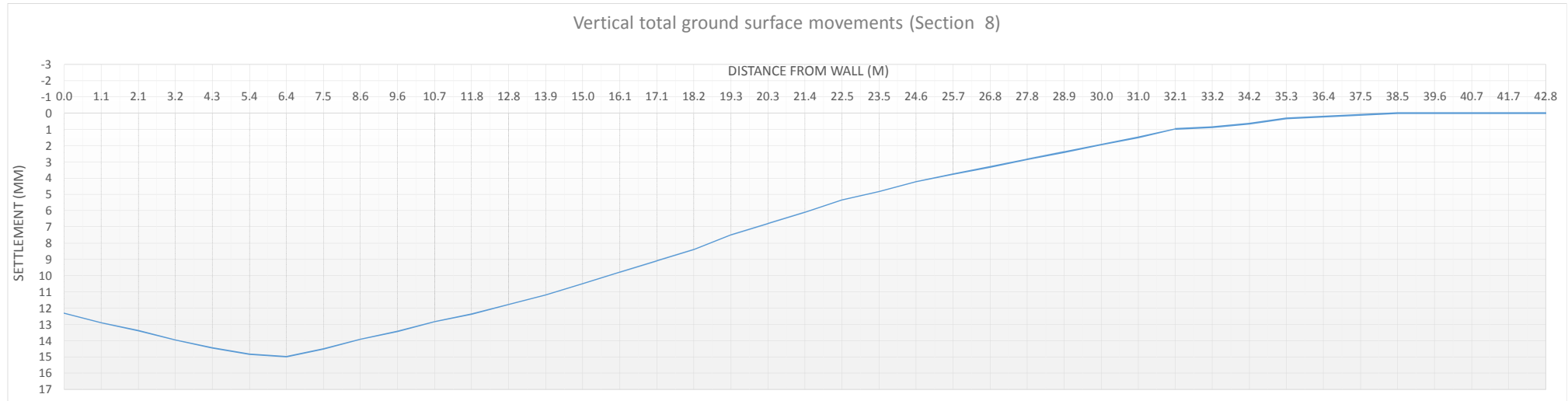
0.601875	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Settlement	16.05	15.44813	14.84625	14.24438	13.6425	13.04063	12.43875	11.83688	11.235	10.63313	10.03125	9.429375	8.8275	8.225625	7.62375	7.021875	6.42	5.818125	5.21625	4.614375	4.0125	3.410625	2.80875	2.206875	1.605	1.003125	0.40125	0	0	0	0	0

Settlement due to wall installation and deflection (SECTION 8)

Excavation depth	=	10.7 m
Pile Length	=	16.05 m
Pile diameter	=	880 mm
EI	=	565600 kN.m ² /m

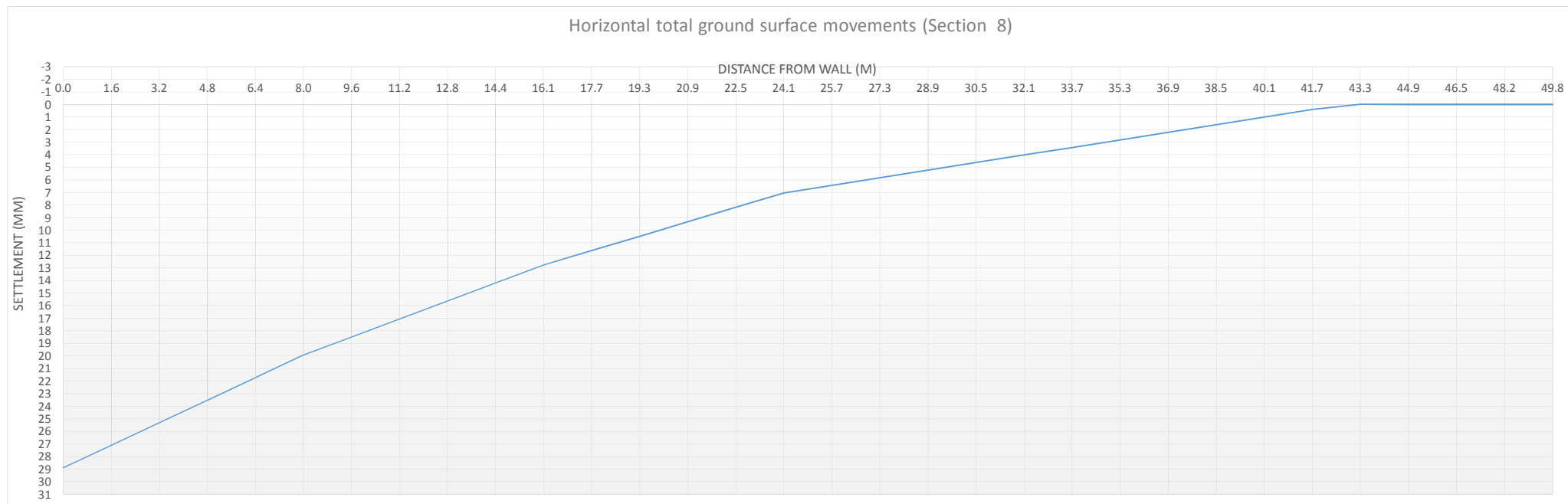
VERTICAL

	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4		
		0	1.07	2.14	3.21	4.28	5.35	6.42	7.49	8.56	9.63	10.7	11.77	12.84	13.91	14.98	16.05	17.12	18.19	19.26	20.33	21.4	22.47	23.54	24.61	25.68	26.75	27.82	28.89	29.96	31.03	32.1	33.17	34.24	35.31	36.38	37.45	38.52	39.59	40.66	41.73	42.8		
Settlement due to wall installation		8.025	7.7575	7.49	7.2225	6.955	6.6875	6.42	6.1525	5.885	5.6175	5.35	5.0825	4.815	4.5475	4.28	4.0125	3.745	3.4775	3.21	2.9425	2.675	2.4075	2.14	1.8725	1.605	1.3375	1.07	0.8025	0.535	0.2675	0	0	0	0	0	0	0	0	0	0	0	0	
Settlement due to excavation in front of wall		4.28	5.136	5.885	6.741	7.49	8.132	8.56	8.346	8.025	7.811	7.49	7.276	6.955	6.634	6.206	5.778	5.35	4.922	4.28	3.852	3.424	2.9425	2.675	2.354	2.14	1.9795	1.7655	1.605	1.391	1.2305	0.963	0.856	0.642	0.321	0.214	0.107	0	0	0	0	0	0	0
Total Settlement		12.305	12.8935	13.375	13.9635	14.445	14.8195	14.98	14.4985	13.91	13.4285	12.84	12.3585	11.77	11.1815	10.486	9.7905	9.095	8.3995	7.49	6.7945	6.099	5.35	4.815	4.2265	3.745	3.317	2.8355	2.4075	1.926	1.498	0.963	0.856	0.642	0.321	0.214	0.107	0	0	0	0	0	0	0



HORIZONTAL

	Distance	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3.1
	Distance	0	1.605	3.21	4.815	6.42	8.025	9.63	11.235	12.84	14.445	16.05	17.655	19.26	20.865	22.47	24.075	25.68	27.285	28.89	30.495	32.1	33.705	35.31	36.915	38.52	40.125	41.73	43.335	44.94	46.545	48.15	49.755
Settlement due to wall installation	12.84	11.6523	10.4646	9.2769	8.0892	6.9015	6.0669	5.2323	4.3977	3.5631	2.7285	2.1828	1.6371	1.0914	0.5457	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Settlement due to excavation in front of wall	16.05	15.44813	14.84625	14.24438	13.6425	13.04063	12.43875	11.83688	11.235	10.63313	10.03125	9.429375	8.8275	8.225625	7.62375	7.021875	6.42	5.818125	5.21625	4.614375	4.0125	3.410625	2.80875	2.206875	1.605	1.003125	0.40125	0	0	0	0	0	0
Total Settlement	28.89	27.10043	25.31085	23.52128	21.7317	19.94213	18.50565	17.06918	15.6327	14.19623	12.75975	11.61218	10.4646	9.317025	8.16945	7.021875	6.42	5.818125	5.21625	4.614375	4.0125	3.410625	2.80875	2.206875	1.605	1.003125	0.40125	0	0	0	0	0	0



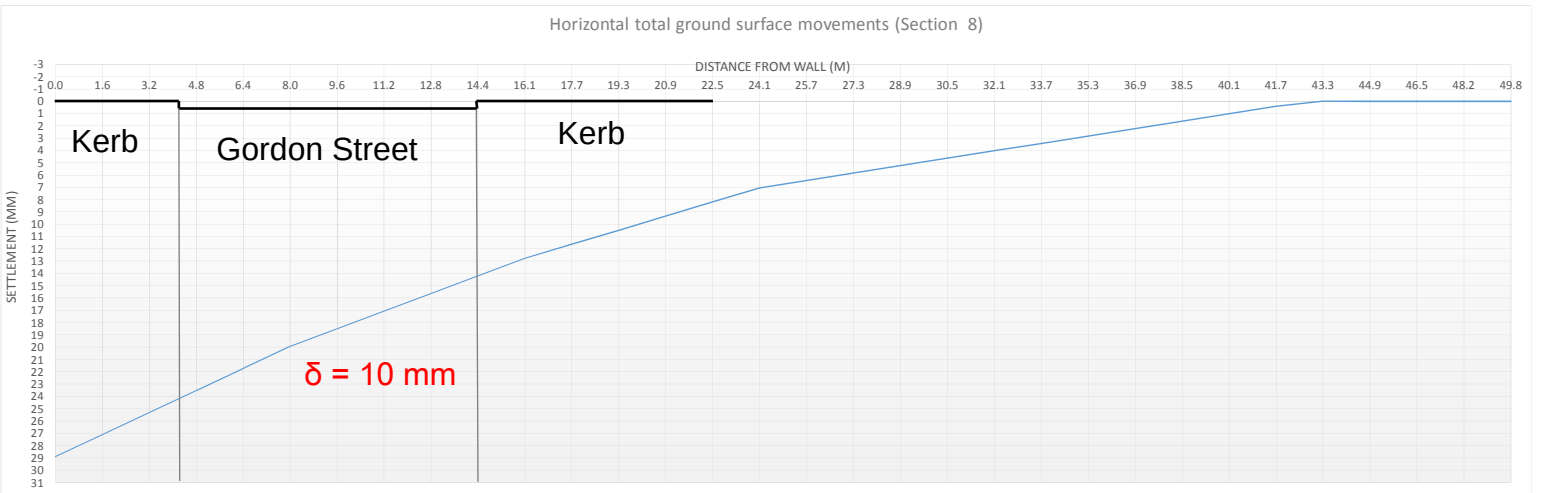
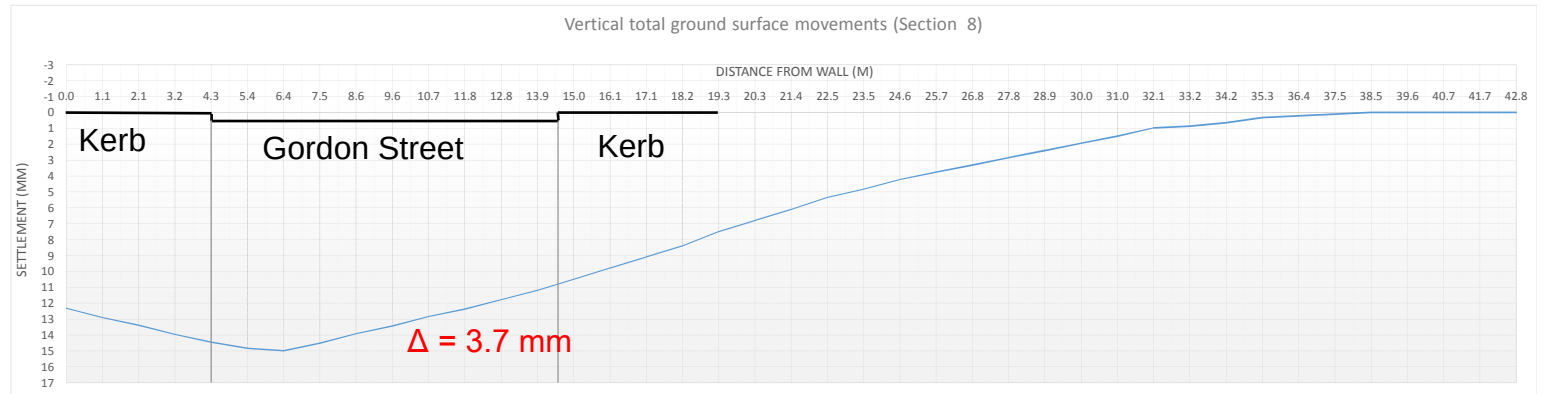
Category Assessment (SECTION 8)

ROAD - GORDON STREET

L	=	10 m
H	=	0 m
Δ	=	0.0037 m
δ	=	0.01 m
L/H	=	-
δ/L	=	0.1 %
Δ/L	=	0.037 %

From CIRIA C580 Figure 2.18:

CATEGORY 0

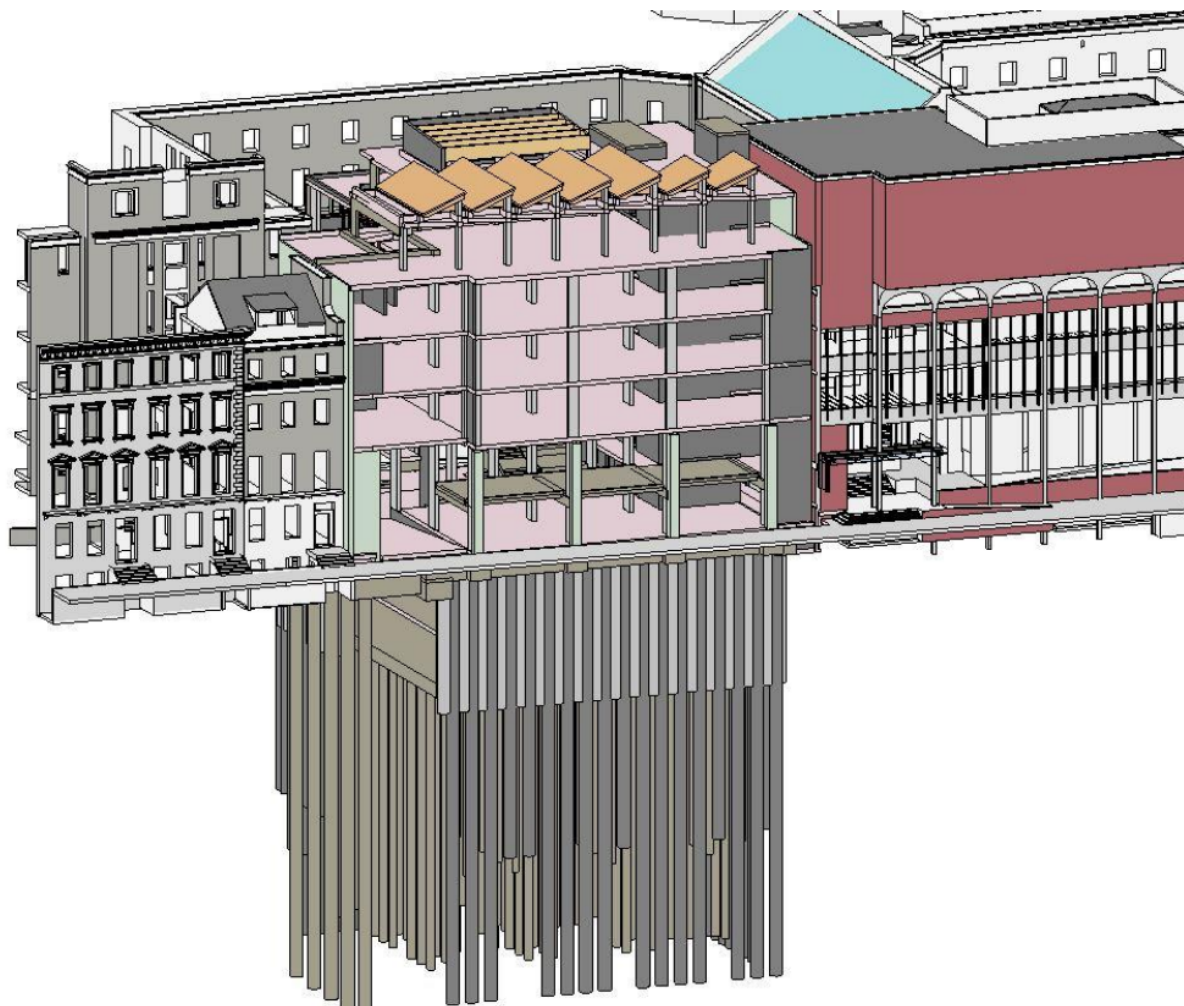


Basement Impact Assessment Stage 4



University College London
New Student Centre

By Curtins Consulting Ltd
21st August 2015



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Basement Impact Assessment

Stage 4

Rev	Description	Issued by	Checked	Date
01	First Issue	SE	SS	15/07/2015
02	Updated to include geotechnical review, non-technical summaries and construction sequence	SE	SS-CR	04/08/2015
03	Proposed basement level updated	JJ	SS	21/08/2015

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Reviewed - Structural	Date
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Reviewed – Subterranean (Groundwater) Flow	Date
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1.0 Introduction

- 1.1 Proposed Development
- 1.2 Site History

2.0 Stage 1 - Screening

3.0 Stage 2 - Scoping

4.0 Stage 3 – Site Investigations

- 4.1 Desk study
- 4.2 Intrusive testing
- 4.3 Monitoring
- 4.4 Interpretation

5.0 Stage 4 – Impact Assessment

- 5.1 Surface flow
- 5.2 Subterranean flow
- 5.3 Site geology and geological properties
- 5.4 Ground movement analysis
- 5.5 Damage category assessment
- 5.6 Conclusions

6.0 Non-structural Implications

- 6.1 Amenity to neighbours
- 6.2 Loss of open space or trees of townscape or amenity value
- 6.3 Appearance
- 6.4 Archaeology

Appendices

- A Planning Application BIA prepared by Curtins and dated March 2015
- B Construction method statement
- C Ground movement and damage category assessment
- D Monitoring proposals
- E Flood risk assessment
- F Phase 2 Intrusive Ground Condition Investigation dated July 2013 by Curtins Consulting
- G Factual report on Ground Investigations dated March 2007 by Soil Mechanics
- H Crossrail line 1 Assessment of Water Impacts produced by Mott MacDonald

1.0 Introduction

In accordance with London Borough of Camden Development Policy DP27 – Basements and Lightwells and the recent LB Camden guidance document entitled “Camden geological, hydrogeological and hydrological study – Guidance for subterranean development” (Issue 01 – November 2010), a risk-based impact assessment with regard to hydrology, hydrogeology and land stability is being undertaken for the basement development on this project.

1.1 Proposed Development

The site is currently partially occupied by a 4 storey temporary building with an access road to the side and back leading to a service yard behind the neighbouring terraces on Gordon Street. The site is bounded by buildings with single storey basements on three sides and disused coal stores on the street side, similar to the neighbouring terraced houses.

The current proposal is for a 6 storey high building to be used as a student centre, built as a reinforced concrete (RC) frame with 3000mm thick flat slabs. The building will have a two storey secant piled wall basement, up to a depth of approximate of 10m, around the perimeter of the new build footprint.

The foundations to the columns and walls supporting the superstructure will be supported on the capping beam over the secant pile wall, on the internal piled raft and on some pilecaps and ground beams adjacent to the basement, where required.

The stair to the back of the adjacent Bloomsbury Theatre is to be demolished and the building extended in its footprint with a new tunnel linking the plantroom in the new basement with the existing plantroom and network of tunnels at the back of the theatre.

It is likely that the below ground drainage will be required to be designed to meet the requirements of the London Plan. This will require approximately 50m³ of storage to be provided on site. At this stage, it is expected to locate this volume of attenuation under the vehicular ramp.

1.2 Site History

The early maps indicate that the site is occupied by the All Saints Church. By 1896 the church has expanded and residential properties are also present on the site.

By 1940 the site has been cleared of buildings and remains this way until the early 1950's when a large undisclosed building (thought to be associated with the University College London) has been constructed.

All buildings on the site are demolished by the early 1990's and site remains unchanged until present day.

The early maps show that the majority of the site surrounding area is comprised of inner city terraced properties with some areas of public open space. University College is located adjacent to the sites western boundary. Euston, St Pancras and Kings Cross stations are located between 400 and 700m to the north. Industry in the area comprises of timber yards, saw mills, engineering works, gas works, printing works etc.

1.0 Introduction

Over time and specifically post WW2 much of the residential properties have been demolished either due to bomb damage or through intended redevelopment. By the late 1900's much of the site surrounding area is comprised of commercial and office buildings. University College has expanded significantly and has a number of buildings located within the sites vicinity.

In 2008 a building was proposed for the site and the design progressed sufficiently to allow the installation of a section of the proposed secant pile wall forming the basement, however ultimately the project was abandoned.

2.0 Stage 1 - Screening

This section was completed using the screening tools as provided by the LBC in the Geological, Hydrogeological and Hydrological Study document, prepared by Arup, and was covered in the Planning Application BIA prepared by Curtins and dated March 2015, refer to Appendix A.

A summary of the results is as follows:

- **Surface flow:**
No potential issues identified
- **Subterranean flow:**
There is the potential for the ground water flow to be affected by the proposed basement. Check against Crossrail Report Appendix E: analysis of impacts on groundwater.
- **Land Stability:**
There is potential for ground movement from the unloading of the London clay at the base of the excavation within the perimeter of the secant pile wall and potential for damage to the neighbouring properties and public highway from the movement of the secant pile wall. Assess the ground movement as described in CIRIA guide C580 and anticipated damage to the surrounding buildings based on the Burland scale.

3.0 Stage 2 - Scoping

The scoping was discussed as part of the Planning Application BIA prepared by Curtins and dated March 2015, which is included in Appendix A of this report.

To address the items identified in the screening it is proposed that the following are carried out:

1. Calculation of the basement impact on groundwater flow, to include a reconnaissance survey of basements along Gordon Street 250m each way from the proposed development.
2. Interrogate groundwater data collected from adjacent developments.
3. Set up the conceptual model
4. Estimate the damming effect from a similar exercise carried out as part of the EIA for the Crossrail project as presented in a Crossrail report "Appendix E: Analysis of Impacts on Groundwater".
5. Detailed geotechnical and structural design of the basement and foundations addressing the ground stability issues identified in the 'slope stability' screening questions to reduce to acceptable levels the risk of impact on adjacent structures.

4.0 Stage 3 – Site Investigations

Two site investigations have been carried out at the site to cover both the geotechnical and geo-environmental aspects. The information provided by the two reports have been used together with the structural design of the secant pile wall carried out as part of the previous Panopticon building design proposals for the site to produce the ground movement and damage category assessment report. This has been included in appendix C of this document.

4.1 Desk study

Refer to the Phase 2 Intrusive Ground Condition Investigation dated July 2013 by Curtins Consulting, included in Appendix F.

4.2 Intrusive testing

Intrusive investigations are covered by both the factual report on Ground Investigations dated March 2007 by Soil Mechanics (Appendix G) and by the phase 2 intrusive ground condition investigations dated July 2013 by Curtins Consulting (Appendix F). The findings are summarised in the planning Application BIA prepared by Curtins and dated March 2015 (Appendix A).

4.3 Monitoring

The data from 2006 revealed perched groundwater at 5m below ground level. This is in line with what observed during the works on the nearby Wates House site, approximately 50m away.

4.4 Interpretation

The phase 2 intrusive ground condition investigations dated July 2013 by Curtins Consulting provide an interpretation of the ground investigations previously carried out by Soil Mechanics and confirm the original design assumptions are to be used in the design of the secant pile wall for the previous development proposed for the site.

The previous proposals are particularly relevant as the position of the basement secant wall for the current proposals are almost identical to the previous scheme, the depth of the current basement is only marginally shallower and the majority of the south elevation secant pile wall was installed as part of the previous Panopticon project and the intention is to incorporate them in the current design.

To comply with the requirements for the London Borough of Camden for a BIA Curtins have produced a Ground movement and damage category assessment included in appendix C of this report.

5.0 Stage 4 – Impact Assessment

5.1 Surface flow

The BIA screening process did not identify any potential issues for surface flow. Additionally a flood risk assessment has been carried out by Curtins in February 2015.

The site will discharge surface water to the existing drainage network/Thames Sewer via suitable flow controls and SuDS techniques in line with the London Plan.

The online EA flood map and SFRA for North London show the development site in Flood Zone 1.

In line with table 3 of the NPPF, the site is suitable for classification therefore, if the principles set out within the FRA report are followed and developed at detailed design stage the site can be considered to have a low probability of suffering from any form of flooding and will not increase the probability of flood risk to the local catchment area.

5.2 Subterranean flow

In January 2013, Curtins were instructed by University College London (UCL) to undertake a Phase 2 Intrusive Investigation on the site located off Gordon Street, London, document reference EB1029/DJS/2872 dated July 2013 (Appendix F).

Site investigation fieldwork was undertaken in two phases as follows:

- February 2013 Harrison Group undertook the advancement of three window sample boreholes. The window samples were advanced to depths of between 1.20m and 4.00m below ground level (bgl) and confirmed the anticipated geology of sandy gravelly clay made ground, underlined by a gravelly sand and clay Lynch Hill Gravel Member. Groundwater was not encountered during the advancement of all three window sample boreholes.
- September 2006, three deeper cable percussive boreholes were undertaken by Soil Mechanics. The boreholes were advanced to depths of between 35.75m and 40.50m bgl. Made ground was recorded between 2.70m and 3.00m bgl and below this the Lynch Hill Gravel Member lies, comprising gravelly sands and clays extending to depths of between 5.7m to 6.30m bgl.

As also detailed in the next section, the London Clay Formation was encountered below the Lynch Hill Gravel and was recorded to depths between 13.40m and 18.70m. Below the London Clay is the Lambeth Group, which comprises very stiff locally dark grey sandy clay to depths of around 35mbgl, which in turn is underlain by Thanet Sands and Chalk.

During advancement of these deeper holes, the Lynch Hill Gravel was recorded as damp with only 'possible seepage' noted in BH02 at 5m just above the boundary with the London Clay. The remaining natural largely cohesive material was recorded as 'dry'.

Water level monitoring was undertaken in BH2 and BH3, across October to December 2006, in pipes and/or piezometers in the Lynch Hill Gravel, London Clay and the Lambeth Group. Monitoring showed the water levels to be relatively consistent at around 5m bgl. It is considered that groundwater would flow in a southerly direction, i.e. towards and in the direction of flow of the River Thames.

5.0 Stage 4 – Impact Assessment

In addition groundwater was not encountered in the three window sample boreholes undertaken in February 2013 to depths between 1.20m and 4.00. It is proposed that further monitoring is carried out prior to construction to confirm the groundwater levels.

When considering the depth of the basement construction, the lower 4m will be excavated in London Clay a generally impermeable strata with little appreciable water flow and thus the basement excavation in this strata will not affect the groundwater regime across the site.

Consideration of the Lynch Hill Gravel shows that this stratum will be fully removed for the extent, in depth and plan, of the basement construction. Although upper gravels are typically water bearing, in this location the investigation and monitoring has shown very little water present in the Lynch Hill Gravel. Consequently the basement construction will not significantly affect the flow of water in this stratum.

The monitoring has shown a potential artesian water level in the Lambeth Group, and underlying Thanet Sands and Chalk, but this is well below the basement construction and the basement construction does not penetrate this stratum.

It is concluded therefore that the construction of the basement to its full depth will not intercept significant water flow and hence will not affect the groundwater regime across the site and result in any inundation on the site or immediate surroundings.

Furthermore, Curtins have reviewed the groundwater information available for two nearby projects, Wates House and the Wilkins Terrace and the available data is in line with the results of the investigations for the proposed site, with perched groundwater encountered at approximately 4m below ground level.

To address the hydrogeological issue identified in the screening, an assessment of the basement impact on groundwater flow has been carried out. The proposals have been assessed against the finding of the Crossrail line 1 Assessment of Water Impacts produced by Mott MacDonald and in particular appendix E: Analysis of Impacts on Groundwater, section E.6 Shallow aquifer: Impact on New structures, included in appendix H of this report.

As part of the Crossrail assessment a simple groundwater model was created to calculate the likely impacts of groundwater levels from a new structure acting as a barrier to groundwater flow in the shallow aquifer. This was based on the width of the structure and the hydraulic properties of the aquifer with the expectation that a wider structure across the direction of the flow will have a larger impact on the water table and that the amount of rise in the water levels will reduce with distance from the structure.

The conceptual model adopted is fully described in the Crossrail report with the results of the assessment of the change in water level summarised in table E.16, next page:

5.0 Stage 4 – Impact Assessment

Table E.16: Model Results

Scenario	Width of Structure	Change in Water Level from Base Case Scenario (m)			
		Upgradient		Downgradient	
		20 m	5 m	20 m	50 m
A1	40	-0.12	-0.2	0.14	0.08
A1	60	-0.2	-0.3	0.24	0.14
A1	80	-0.27	-0.39	0.35	0.21
A2	30	-0.07	-0.15	0.1	0.05
A2	40	-0.11	-0.2	0.15	0.07
A2	60	-0.18	-0.29	0.25	0.13
A2	80	-0.26	-0.37	0.35	0.2
A2	120	-0.39	-0.52	0.56	0.35
A5	40	-0.09	-0.16	0.13	0.07
A5	60	-0.15	-0.24	0.22	0.13
A5	80	-0.21	-0.32	0.32	0.19
B1	80	-0.15	-0.21	0.18	0.1

Table E.16 from Crossrail line 1 Assessment of Water Impacts produced by Mott MacDonald

The modelling shows that for a structure the size of the student centre, with a basement of less than 30m x30m, the change in water level would be minimal, less than 200mm upgradient rise in water level.

Additionally, all the adjacent basements are much shallower than the proposed building summary below:

Proposed basement	SSL: +15.750
Bloomsbury Theatre	SSL: +19.600
ACBE Laboratory	SSL: +21.150 (approx.)
No 26 Gordon Street	SSL: +22.700 (approx.)

5.3 Site geology and geotechnical properties

Section 3 of the previous BIA summarises the site geology. The stratigraphy reported of the site is as noted in Table 1.

Strata	Thickness (m)	Top of Stratum (m AOD)
Made Ground	2.7-3	+24.13 to +24.24
River Terrace Deposits (Lynch Hill Gravel)	2.7-4.3	+21.19 to +21.43
London Clay	7.7-12.4	+17.83 to +18.49
Lambeth Group	16.7-22.3	+5.43 to +10.79
Thanet Sand	4-4.3	-11.51 to -16.17

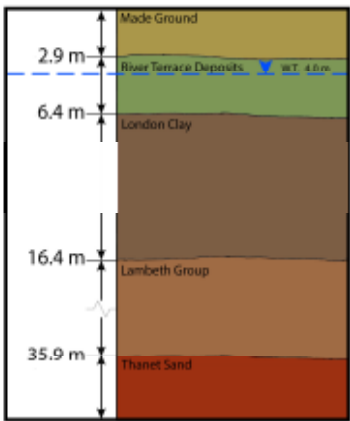


Table 1: Stratigraphy from previous investigations

5.0 Stage 4 – Impact Assessment

The formation level of the proposed development is in the London Clay with the longer load bearing piles extending into the Lambeth Group. The excavation of the basement will result in a heave of approximately 180kN/m², as determined by the Phase 2 Intrusive Ground Condition Investigation dated July 2013 by Curtins Consulting. The movement of the ground within the perimeter of the secant pile wall surrounding the basement will be mitigated by the introduction of anti-heave material that allows the soil to expand without introducing uplift to the underside of the structure.

The proposed basement will have no effect on the site geology and geotechnical properties of the soil.

5.4 Ground movement analysis

A detailed assessment of the ground movement around the perimeter of the building due to the construction of the basement has been carried out and can be found in the Ground movement and damage category assessment report included in appendix C of this document.

The ground movement has been analysed with regards to take into account the piled wall installation and wall deflection. Additionally heave and long term ground movement have also been considered.

The basement excavation will result in the unloading and instantaneous movement of the soil. The short term instantaneous heave movement will be removed as part of the excavation however long term heave needs to be considered. The maximum vertical displacement will be in the centre of the excavation gradually reducing towards the perimeter where the presence of the piled secant wall will contain the heave movement within the site perimeter as the proposed loads on the secant wall are fairly high and will mitigate the potential for uplift movement.

The proposed basement development is a very common form of construction and the structural design is such to mitigate the effects of ground movement.

5.5 Damage category assessment

The results from the ground movement analysis reported in the Ground movement and damage category assessment report included in appendix C of this document have been used, in the same report, to assess the potential damage to the surrounding buildings from the construction of the proposed development. The damage category assessment does not exceed a Category 2 at any place around the perimeter of the excavation emphasising that there could be slight damage but cracks can be easily filled and some repointing may be required externally. This is a normal category damage for a type of building nestled closely between two or three buildings.

5.6 Conclusions

The screening process of the Basement Impact Assessment identified the subterranean water flow and the land stability from the movement of the ground as the two potential issues for the development. Both have been assessed and found to be within the guidelines of acceptable values with slight damage likely to result from the movement of the ground subsequent to the excavation of the basement and only a very small potential change in water level likely from the damming effect of the secant wall on the groundwater.

The proposed basement will not result in flooding of the area and will not cause instability of the surrounding ground and structures.

6.0 Non-structural Implications

6.1 Amenity of Neighbours

Based on the ground movement assessment it is not considered that the amenity of neighbours will be harmed.

6.2 Loss of open space or trees of townscape or amenity value

The site for the proposed building is currently occupied by a 4 storey temporary building and an access road to UCL buildings to the back of Gordon Street therefore the proposals will not result in a loss of open spaces or trees of townscape or amenity value.

6.3 Appearance

The building above ground immediately over the basement has been developed in consultation with the LBC planning and a public exhibition held on the proposals. In addition the building has been sensitively designed to respect and enhance the character of the surrounding area and the adjacent listed buildings in particular.

6.4 Archaeology

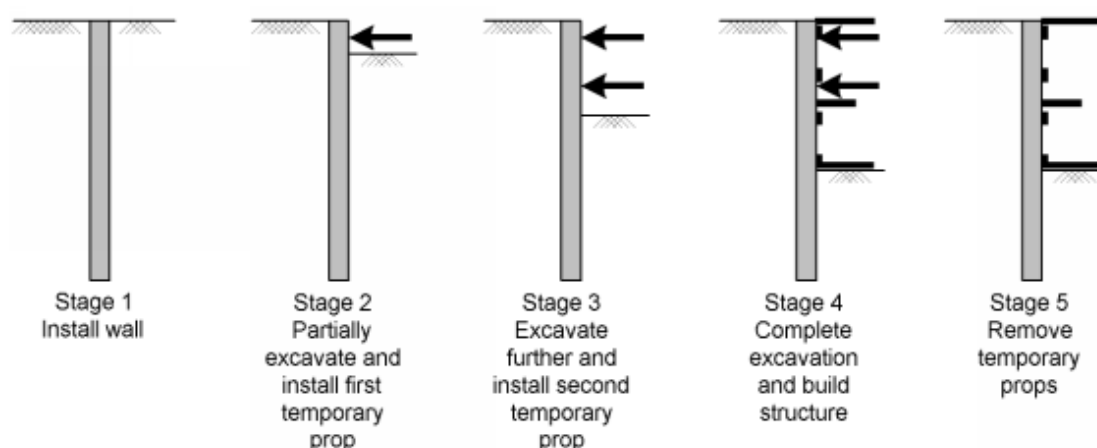
It is not anticipated that the site has potential for archaeological remains and it has been agreed with the Local Planning Authority that an archaeological assessment is not required.

Appendices

A – Planning Application BIA prepared by Curtins and dated March 2015

B – Construction method statement

The construction of the basement will follow a standard bottom up sequence of construction, as outlined in CIRIA guide C580. The following figure, from CIRIA C580, shows the typical bottom up construction.



Proposed Construction sequence

1. The piles are first installed in the required position and to the designed depth to resist the required vertical and lateral loads (Stage 1).
2. The capping beam is constructed around the perimeter of the building.
3. The basement is excavated to the base of the capping beam to allow the installation of the first level of props (Stage 2). Approximate level of the props +23.000 +24.000m AOD depending on the level of the capping beam, which is stepped. The props will be located 1m below the slab SSL.
4. With the first level of props in place the basement is excavated to +19.500 (B1 level) and the second line of props installed at this level (Stage 3), 1m above the proposed slab SSL.
5. Once the second level of props is installed the basement excavation is taken to the formation level of the basement slab.
6. The excavation is taken to the formation level of the basement slab and a third line of props installed at approximately +16.850 AOD, 1m above the proposed B2 SSL.
7. The basement piles are installed once the excavation reaches the bottom followed by anti-heave measures and the basement slab.
8. Once the basement slab is constructed the third level of props is removed.
9. The lining wall from B2 to B1 is constructed followed by the B1 slab.
10. The second level of props is removed.
11. The lining wall from B1 to the ground floor is constructed followed by the ground floor slab.
12. The first line of props is removed, completing Stage 5.

A full construction method statement for the construction of the basement will be produced by the Contractor together with detailed calculations of the basement secant pile wall once they are appointed. Both will have to follow the principles outlined in this document in order to keep within the outlined ground movement estimate.

All the necessary propping will be designed by the piling contractor.

C – Ground movement and damage category assessment

D – Monitoring

E – Flood risk assessment

***F - Phase 2 Intrusive Ground Condition Investigation dated July 2013 by
Curtins Consulting***

G – Factual report on Ground Investigations dated March 2007 by Soil Mechanics

H - Crossrail line 1 Assessment of Water Impacts produced by Mott MacDonald



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Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Analysis Options

Analysis: Boussinesq
Global Poisson's ratio: 0.20
Maximum allowable ratio between values of E: 1.5
Horizontal rigid boundary level: -21.00 [m OD]
Displacements at area centroids calculated.

Soil ProfilesSoil Profile 1

Layer	Level at top	Number of intermediate displacement levels	Youngs Modulus	Poissons ratio	Non-linear curve
	[mOD]		Top [kN/m²]	Btm [kN/m²]	
1	25.00	100	10000.	10000.	0.2000 None
2	21.50	100	50000.	50000.	0.2000 None
3	17.50	100	7500.	49600.	0.2000 None
4	7.500	100	80800.	325000.	0.2000 None
5	-11.00	100	333000.	423000.	0.2000 None

Soil Zones

Zone	Name	X coordinates min [m]	X coordinates max [m]	Y coordinates min [m]	Y coordinates max [m]	Profile
1	1	-60.00	60.00	-60.00	60.00	Soil Profile 1

Non-linear Curve Coordinates - Non-linear Curve 1

Point	Strain [%]	Factor
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Load Data

Load ref.	Name	Shape	Orientation of Plane	Centre of load (Global)		Load position	Width x or Radius	Length y	Polygon Coordinates	Rectangle tolerance	Number of rectangles	Load value			
				X	Y	Angle of local x from Y						Normal (local z)	Tangential (local x)	Tangential (local y)	
				[m]	[m]	(level)	[Degrees]	[m]	[m]			[kN/m²]	[kN/m²]	[kN/m²]	
1	1	Rectangular	Horizontal	0.0	0.0	15.00	0.0	26.00	30.00	N/A			-200.0	0.0	0.0
2	2	Rectangular	Horizontal	0.0	0.0	-1.500	0.0	34.30	38.30	N/A			65.30	0.0	0.0

Displacement Data

Ref.	Type	Name	Direction of Extrusion	First point X [m]	Line/Line for extrusion Y [m]	Second point Z[level]	No. of intrvl's across extrusion/line	Extrusion Depth [m]	No. of intrvl's along extrusion	Calculate	Show Detailed results			
1	Grid	Grid 2	Global Y	-40.00	-40.00	15.00	40.00	N/A	15.00	40	80.00	40	Yes	Yes

RESULTS FOR GRIDS

Analysis: Boussinesq
Global Poisson's ratio: 0.20
Horizontal rigid boundary level: -21.00 [m OD]

The maximum displacement difference between Boussinesq method (-2.000mm) and Mindlin method (1.166mm) occurs at point X=0.0m Y=0.0m Level -1.371mOD and is 3.246mm

Name	Location X [m]	Location Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Stresses Sum Princ [kN/m²]	Vert Strain [-]
1	0.000	0.000	15.000	-50.29	15.00	-200.0	-480.0	-0.007989
2	0.000	0.000	15.000	-1.986	-1.500	-57.26	25.51	-369.8E-6
Grid 2	-40.000	-40.000	15.000	0.03558	15.00	0.0	-56.86E-6	0.0
	-40.000	-38.000	15.000	0.03299	15.00	0.0	-61.56E-6	0.0
	-40.000	-36.000	15.000	0.02977	15.00	0.0	-66.64E-6	0.0
	-40.000	-34.000	15.000	0.02586	15.00	0.0	-72.11E-6	0.0
	-40.000	-32.000	15.000	0.02124	15.00	0.0	-77.96E-6	0.0
	-40.000	-30.000	15.000	0.01587	15.00	0.0	-84.19E-6	0.0
	-40.000	-28.000	15.000	0.009765	15.00	0.0	-90.77E-6	0.0
	-40.000	-26.000	15.000	0.002945	15.00	0.0	-97.67E-6	0.0
	-40.000	-24.000	15.000	-0.004529	15.00	0.0	-104.8E-6	0.0
	-40.000	-22.000	15.000	-0.01256	15.00	0.0	-112.1E-6	0.0
	-40.000	-20.000	15.000	-0.02101	15.00	0.0	-119.5E-6	0.0
	-40.000	-18.000	15.000	-0.02970	15.00	0.0	-126.8E-6	0.0
	-40.000	-16.000	15.000	-0.03844	15.00	0.0	-134.0E-6	0.0
	-40.000	-14.000	15.000	-0.04697	15.00	0.0	-140.7E-6	0.0
	-40.000	-12.000	15.000	-0.05504	15.00	0.0	-147.0E-6	0.0
	-40.000	-10.000	15.000	-0.06240	15.00	0.0	-152.6E-6	0.0
	-40.000	-8.000	15.000	-0.06881	15.00	0.0	-157.4E-6	0.0
	-40.000	-6.000	15.000	-0.07404	15.00	0.0	-161.2E-6	0.0
	-40.000	-4.000	15.000	-0.07791	15.00	0.0	-164.1E-6	0.0
	-40.000	-2.000	15.000	-0.08029	15.00	0.0	-165.8E-6	0.0
	-40.000	0.000	15.000	-0.08109	15.00	0.0	-166.4E-6	0.0
	-40.000	2.000	15.000	-0.08029	15.00	0.0	-165.8E-6	0.0
	-40.000	4.000	15.000	-0.07791	15.00	0.0	-164.1E-6	0.0
	-40.000	6.000	15.000	-0.07404	15.00	0.0	-161.2E-6	0.0
	-40.000	8.000	15.000	-0.06881	15.00	0.0	-157.4E-6	0.0
	-40.000	10.000	15.000	-0.06240	15.00	0.0	-152.6E-6	0.0
	-40.000	12.000	15.000	-0.05504	15.00	0.0	-147.0E-6	0.0
	-40.000	14.000	15.000	-0.04697	15.00	0.0	-140.7E-6	0.0
	-40.000	16.000	15.000	-0.03844	15.00	0.0	-134.0E-6	0.0
	-40.000	18.000	15.000	-0.02970	15.00	0.0	-126.8E-6	0.0
	-40.000	20.000	15.000	-0.02101	15.00	0.0	-119.5E-6	0.0
	-40.000	22.000	15.000	-0.01256	15.00	0.0	-112.1E-6	0.0
	-40.000	24.000	15.000	-0.004529	15.00	0.0	-104.8E-6	0.0
	-40.000	26.000	15.000	0.002945	15.00	0.0	-97.67E-6	0.0
	-40.000	28.000	15.000	0.009765	15.00	0.0	-90.77E-6	0.0
	-40.000	30.000	15.000	0.01587	15.00	0.0	-84.19E-6	0.0
	-40.000	32.000	15.000	0.02124	15.00	0.0	-77.96E-6	0.0
	-40.000	34.000	15.000	0.02586	15.00	0.0	-72.11E-6	0.0
	-40.000	36.000	15.000	0.02977	15.00	0.0	-66.64E-6	0.0
	-40.000	38.000	15.000	0.03299	15.00	0.0	-61.56E-6	0.0
	-40.000	40.000	15.000	0.03558	15.00	0.0	-56.86E-6	0.0
	-38.000	-40.000	15.000	0.03231	15.00	0.0	-61.72E-6	0.0
	-38.000	-38.000	15.000	0.02932	15.00	0.0	-67.13E-6	0.0
	-38.000	-36.000	15.000	0.02502	15.00	0.0	-73.03E-6	0.0
	-38.000	-34.000	15.000	0.01984	15.00	0.0	-79.43E-6	0.0
	-38.000	-32.000	15.000	0.01372	15.00	0.0	-86.35E-6	0.0
	-38.000	-30.000	15.000	0.006623	15.00	0.0	-93.70E-6	0.0
	-38.000	-28.000	15.000	-0.001466	15.00	0.0	-101.7E-6	0.0
	-38.000	-26.000	15.000	-0.01052	15.00	0.0	-110.1E-6	0.0
	-38.000	-24.000	15.000	-0.02047	15.00	0.0	-118.9E-6	0.0
	-38.000	-22.000	15.000	-0.03121	15.00	0.0	-127.9E-6	0.0
	-38.000	-20.000	15.000	-0.04255	15.00	0.0	-137.1E-6	0.0
	-38.000	-18.000	15.000	-0.05427	15.00	0.0	-146.3E-6	0.0
	-38.000	-16.000	15.000	-0.06609	15.00	0.0	-155.3E-6	0.0
	-38.000	-14.000	15.000	-0.07767	15.00	0.0	-163.9E-6	0.0
	-38.000	-12.000	15.000	-0.08866	15.00	0.0	-171.9E-6	0.0
	-38.000	-10.000	15.000	-0.09870	15.00	0.0	-179.1E-6	0.0
	-38.000	-8.000	15.000	-0.1074	15.00	0.0	-185.3E-6	0.0
	-38.000	-6.000	15.000	-0.1146	15.00	0.0	-190.2E-6	0.0
	-38.000	-4.000	15.000	-0.1199	15.00	0.0	-193.9E-6	0.0
	-38.000	-2.000	15.000	-0.1231	15.00	0.0	-196.1E-6	0.0
	-38.000	0.000	15.000	-0.1242	15.00	0.0	-196.8E-6	0.0
	-38.000	2.000	15.000	-0.1231	15.00	0.0	-196.1E-6	0.0
	-38.000	4.000	15.000	-0.1199	15.00	0.0	-193.9E-6	0.0
	-38.000	6.000	15.000	-0.1146	15.00	0.0	-190.2E-6	0.0
	-38.000	8.000	15.000	-0.1074	15.00	0.0	-185.3E-6	0.0
	-38.000	10.000	15.000	-0.09870	15.00	0.0	-179.1E-6	0.0
	-38.000	12.000	15.000	-0.08866	15.00	0.0	-171.9E-6	0.0
	-38.000	14.000	15.000	-0.07767	15.00	0.0	-163.9E-6	0.0



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Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	X [m]	Location Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	-38.000	16.000	15.000	-0.06609	15.00	0.0	-155.3E-6	0.0
	-38.000	18.000	15.000	-0.05427	15.00	0.0	-146.3E-6	0.0
	-38.000	20.000	15.000	-0.04255	15.00	0.0	-137.1E-6	0.0
	-38.000	22.000	15.000	-0.03121	15.00	0.0	-127.9E-6	0.0
	-38.000	24.000	15.000	-0.02047	15.00	0.0	-118.9E-6	0.0
	-38.000	26.000	15.000	-0.01052	15.00	0.0	-110.1E-6	0.0
	-38.000	28.000	15.000	-0.001466	15.00	0.0	-101.7E-6	0.0
	-38.000	30.000	15.000	0.006623	15.00	0.0	-93.78E-6	0.0
	-38.000	32.000	15.000	0.01372	15.00	0.0	-86.35E-6	0.0
	-38.000	34.000	15.000	0.01904	15.00	0.0	-79.43E-6	0.0
	-38.000	36.000	15.000	0.02502	15.00	0.0	-73.03E-6	0.0
	-38.000	38.000	15.000	0.02932	15.00	0.0	-67.13E-6	0.0
	-38.000	40.000	15.000	0.03281	15.00	0.0	-61.72E-6	0.0
	-36.000	-40.000	15.000	0.02932	15.00	0.0	-67.00E-6	0.0
	-36.000	-38.000	15.000	0.02474	15.00	0.0	-73.25E-6	0.0
	-36.000	-36.000	15.000	0.01913	15.00	0.0	-80.11E-6	0.0
	-36.000	-34.000	15.000	0.01237	15.00	0.0	-87.63E-6	0.0
	-36.000	-32.000	15.000	0.004391	15.00	0.0	-95.84E-6	0.0
	-36.000	-30.000	15.000	-0.01548	15.00	0.0	-104.7E-6	0.0
	-36.000	-28.000	15.000	-0.01548	15.00	0.0	-114.3E-6	0.0
	-36.000	-26.000	15.000	-0.02739	15.00	0.0	-124.6E-6	0.0
	-36.000	-24.000	15.000	-0.04055	15.00	0.0	-135.4E-6	0.0
	-36.000	-22.000	15.000	-0.05482	15.00	0.0	-146.7E-6	0.0
	-36.000	-20.000	15.000	-0.06997	15.00	0.0	-158.3E-6	0.0
	-36.000	-18.000	15.000	-0.08572	15.00	0.0	-170.0E-6	0.0
	-36.000	-16.000	15.000	-0.1017	15.00	0.0	-181.6E-6	0.0
	-36.000	-14.000	15.000	-0.1174	15.00	0.0	-192.7E-6	0.0
	-36.000	-12.000	15.000	-0.1323	15.00	0.0	-203.0E-6	0.0
	-36.000	-10.000	15.000	-0.1460	15.00	0.0	-212.3E-6	0.0
	-36.000	-8.000	15.000	-0.1580	15.00	0.0	-220.3E-6	0.0
	-36.000	-6.000	15.000	-0.1678	15.00	0.0	-226.7E-6	0.0
	-36.000	-4.000	15.000	-0.1750	15.00	0.0	-231.5E-6	0.0
	-36.000	-2.000	15.000	-0.1795	15.00	0.0	-234.4E-6	0.0
	-36.000	0.000	15.000	-0.1810	15.00	0.0	-235.4E-6	0.0
	-36.000	2.000	15.000	-0.1795	15.00	0.0	-234.4E-6	0.0
	-36.000	4.000	15.000	-0.1750	15.00	0.0	-231.5E-6	0.0
	-36.000	6.000	15.000	-0.1678	15.00	0.0	-226.7E-6	0.0
	-36.000	8.000	15.000	-0.1580	15.00	0.0	-220.3E-6	0.0
	-36.000	10.000	15.000	-0.1460	15.00	0.0	-212.3E-6	0.0
	-36.000	12.000	15.000	-0.1323	15.00	0.0	-203.0E-6	0.0
	-36.000	14.000	15.000	-0.1174	15.00	0.0	-192.7E-6	0.0
	-36.000	16.000	15.000	-0.1017	15.00	0.0	-181.6E-6	0.0
	-36.000	18.000	15.000	-0.08572	15.00	0.0	-170.0E-6	0.0
	-36.000	20.000	15.000	-0.06997	15.00	0.0	-158.3E-6	0.0
	-36.000	22.000	15.000	-0.05482	15.00	0.0	-146.7E-6	0.0
	-36.000	24.000	15.000	-0.04055	15.00	0.0	-135.4E-6	0.0
	-36.000	26.000	15.000	-0.02739	15.00	0.0	-124.6E-6	0.0
	-36.000	28.000	15.000	-0.01548	15.00	0.0	-114.3E-6	0.0
	-36.000	30.000	15.000	-0.004391	15.00	0.0	-104.7E-6	0.0
	-36.000	32.000	15.000	0.004391	15.00	0.0	-95.84E-6	0.0
	-36.000	34.000	15.000	0.01237	15.00	0.0	-87.63E-6	0.0
	-36.000	36.000	15.000	0.01913	15.00	0.0	-80.11E-6	0.0
	-36.000	38.000	15.000	0.02474	15.00	0.0	-73.25E-6	0.0
	-36.000	40.000	15.000	0.02932	15.00	0.0	-67.00E-6	0.0
	-34.000	-40.000	15.000	0.02504	15.00	0.0	-72.75E-6	0.0
	-34.000	-38.000	15.000	0.01915	15.00	0.0	-79.95E-6	0.0
	-34.000	-36.000	15.000	0.01194	15.00	0.0	-87.95E-6	0.0
	-34.000	-34.000	15.000	0.003258	15.00	0.0	-96.79E-6	0.0
	-34.000	-32.000	15.000	-0.007018	15.00	0.0	-106.6E-6	0.0
	-34.000	-30.000	15.000	-0.01900	15.00	0.0	-117.3E-6	0.0
	-34.000	-28.000	15.000	-0.03276	15.00	0.0	-128.9E-6	0.0
	-34.000	-26.000	15.000	-0.04831	15.00	0.0	-141.6E-6	0.0
	-34.000	-24.000	15.000	-0.06560	15.00	0.0	-155.1E-6	0.0
	-34.000	-22.000	15.000	-0.08447	15.00	0.0	-169.4E-6	0.0
	-34.000	-20.000	15.000	-0.1047	15.00	0.0	-184.2E-6	0.0
	-34.000	-18.000	15.000	-0.1258	15.00	0.0	-199.2E-6	0.0
	-34.000	-16.000	15.000	-0.1474	15.00	0.0	-214.2E-6	0.0
	-34.000	-14.000	15.000	-0.1687	15.00	0.0	-228.7E-6	0.0
	-34.000	-12.000	15.000	-0.1891	15.00	0.0	-242.2E-6	0.0
	-34.000	-10.000	15.000	-0.2078	15.00	0.0	-254.5E-6	0.0
	-34.000	-8.000	15.000	-0.2242	15.00	0.0	-265.0E-6	0.0
	-34.000	-6.000	15.000	-0.2376	15.00	0.0	-273.5E-6	0.0
	-34.000	-4.000	15.000	-0.2475	15.00	0.0	-279.8E-6	0.0
	-34.000	-2.000	15.000	-0.2536	15.00	0.0	-283.6E-6	0.0
	-34.000	0.000	15.000	-0.2557	15.00	0.0	-284.9E-6	0.0
	-34.000	2.000	15.000	-0.2536	15.00	0.0	-283.6E-6	0.0
	-34.000	4.000	15.000	-0.2475	15.00	0.0	-279.8E-6	0.0
	-34.000	6.000	15.000	-0.2376	15.00	0.0	-273.5E-6	0.0
	-34.000	8.000	15.000	-0.2242	15.00	0.0	-265.0E-6	0.0
	-34.000	10.000	15.000	-0.2078	15.00	0.0	-254.5E-6	0.0
	-34.000	12.000	15.000	-0.1891	15.00	0.0	-242.2E-6	0.0
	-34.000	14.000	15.000	-0.1687	15.00	0.0	-228.7E-6	0.0
	-34.000	16.000	15.000	-0.1474	15.00	0.0	-214.2E-6	0.0
	-34.000	18.000	15.000	-0.1258	15.00	0.0	-199.2E-6	0.0
	-34.000	20.000	15.000	-0.1047	15.00	0.0	-184.2E-6	0.0
	-34.000	22.000	15.000	-0.08447	15.00	0.0	-169.4E-6	0.0
	-34.000	24.000	15.000	-0.06560	15.00	0.0	-155.1E-6	0.0
	-34.000	26.000	15.000	-0.04831	15.00	0.0	-141.6E-6	0.0
	-34.000	28.000	15.000	-0.03276	15.00	0.0	-128.9E-6	0.0
	-34.000	30.000	15.000	-0.01900	15.00	0.0	-117.3E-6	0.0
	-34.000	32.000	15.000	-0.007018	15.00	0.0	-106.6E-6	0.0
	-34.000	34.000	15.000	0.003258	15.00	0.0	-96.79E-6	0.0
	-34.000	36.000	15.000	0.01194	15.00	0.0	-87.95E-6	0.0
	-34.000	38.000	15.000	0.01915	15.00	0.0	-79.95E-6	0.0
	-34.000	40.000	15.000	0.02504	15.00	0.0	-72.75E-6	0.0
	-32.000	-40.000	15.000	0.01990	15.00	0.0	-78.96E-6	0.0
	-32.000	-38.000	15.000	0.01245	15.00	0.0	-87.27E-6	0.0
	-32.000	-36.000	15.000	0.003322	15.00	0.0	-96.59E-6	0.0
	-32.000	-34.000	15.000	-0.007069	15.00	0.0	-107.9E-6	0.0
	-32.000	-32.000	15.000	-0.02078	15.00	0.0	-118.7E-6	0.0
	-32.000	-30.000	15.000	-0.03611	15.00	0.0	-131.6E-6	0.0
	-32.000	-28.000	15.000	-0.05383	15.00	0.0	-145.9E-6	0.0
	-32.000	-26.000	15.000	-0.07400	15.00	0.0	-161.6E-6	0.0
	-32.000	-24.000	15.000	-0.09659	15.00	0.0	-178.6E-6	0.0
	-32.000	-22.000	15.000	-0.1215	15.00	0.0	-196.8E-6	0.0
	-32.000	-20.000	15.000	-0.1484	15.00	0.0	-215.9E-6	0.0
	-32.000	-18.000	15.000	-0.1767	15.00	0.0	-235.6E-6	0.0
	-32.000	-16.000	15.000	-0.2059	15.00	0.0	-255.4E-6	0.0
	-32.000	-14.000	15.000	-0.2350	15.00	0.0	-274.6E-6	0.0
	-32.000	-12.000	15.000	-0.2630	15.00	0.0	-292.7E-6	0.0
	-32.000	-10.000	15.000	-0.2887	15.00	0.0	-309.1E-6	0.0
	-32.000	-8.000	15.000	-0.3112	15.00	0.0	-323.2E-6	0.0
	-32.000	-6.000	15.000	-0.3297	15.00	0.0	-334.6E-6	0.0
	-32.000	-4.000	15.000	-0.3433	15.00	0.0	-342.9E-6	0.0
	-32.000	-2.000	15.000	-0.3517	15.00	0.0	-348.0E-6	0.0
	-32.000	0.000	15.000	-0.3545	15.00	0.0	-349.7E-6	0.0
	-32.000	2.000	15.000	-0.3517	15.00	0.0	-348.0E-6	0.0
	-32.000	4.000	15.000	-0.3433	15.00	0.0	-342.9E-6	0.0
	-32.000	6.000	15.000	-0.3297	15.00	0.0	-334.6E-6	0.0
	-32.000	8.000	15.000	-0.3112	15.00	0.0	-323.2E-6	0.0
	-32.000	10.000	15.000	-0.2887	15.00	0.0	-309.1E-6	0.0
	-32.000	12.000	15.000	-0.2630	15.00	0.0	-292.7E-6	0.0
	-32.000	14.000	15.000	-0.2350	15.00	0.0	-274.6E-6	0.0
	-32.000	16.000	15.000	-0.2059	15.00	0.0	-255.4E-6	0.0
	-32.000	18.000	15.000	-0.1767	15.00	0.0	-235.6E-6	0.0
	-32.000	20.000	15.000	-0.1484	15.00	0.0	-215.9E-6	0.0
	-32.000	22.000	15.000	-0.1215	15.00	0.0	-196.8E-6	0.0
	-32.000	24.000	15.000	-0.09659	15.00	0.0	-178.6E-6	0.0
	-32.000	26.000	15.000	-0.07400	15.00	0.0	-161.6E-6	0.0
	-32.000	28.000	15.000	-0.05383	15.00	0.0	-145.9E-6	0.0
	-32.000	30.000	15.000	-0.03611	15.00	0.0	-131.6E-6	0.0</



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	X [m]	Location Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	-30.000	-30.000	15.000	-0.05660	15.00	0.0	-148.0E-6	0.0
	-30.000	-28.000	15.000	-0.07925	15.00	0.0	-165.6E-6	0.0
	-30.000	-26.000	15.000	-0.1052	15.00	0.0	-185.2E-6	0.0
	-30.000	-24.000	15.000	-0.1346	15.00	0.0	-206.8E-6	0.0
	-30.000	-22.000	15.000	-0.1674	15.00	0.0	-230.4E-6	0.0
	-30.000	-20.000	15.000	-0.2032	15.00	0.0	-255.5E-6	0.0
	-30.000	-18.000	15.000	-0.2414	15.00	0.0	-281.7E-6	0.0
	-30.000	-16.000	15.000	-0.2811	15.00	0.0	-308.3E-6	0.0
	-30.000	-14.000	15.000	-0.3211	15.00	0.0	-334.4E-6	0.0
	-30.000	-12.000	15.000	-0.3597	15.00	0.0	-359.1E-6	0.0
	-30.000	-10.000	15.000	-0.3953	15.00	0.0	-381.4E-6	0.0
	-30.000	-8.000	15.000	-0.4265	15.00	0.0	-400.5E-6	0.0
	-30.000	-6.000	15.000	-0.4529	15.00	0.0	-416.0E-6	0.0
	-30.000	-4.000	15.000	-0.4708	15.00	0.0	-427.2E-6	0.0
	-30.000	-2.000	15.000	-0.4824	15.00	0.0	-434.1E-6	0.0
	-30.000	0.000	15.000	-0.4862	15.00	0.0	-436.4E-6	0.0
	-30.000	2.000	15.000	-0.4824	15.00	0.0	-434.1E-6	0.0
	-30.000	4.000	15.000	-0.4708	15.00	0.0	-427.2E-6	0.0
	-30.000	6.000	15.000	-0.4529	15.00	0.0	-416.0E-6	0.0
	-30.000	8.000	15.000	-0.4265	15.00	0.0	-400.5E-6	0.0
	-30.000	10.000	15.000	-0.3953	15.00	0.0	-381.4E-6	0.0
	-30.000	12.000	15.000	-0.3597	15.00	0.0	-359.1E-6	0.0
	-30.000	14.000	15.000	-0.3211	15.00	0.0	-334.4E-6	0.0
	-30.000	16.000	15.000	-0.2811	15.00	0.0	-308.3E-6	0.0
	-30.000	18.000	15.000	-0.2414	15.00	0.0	-281.7E-6	0.0
	-30.000	20.000	15.000	-0.2032	15.00	0.0	-255.5E-6	0.0
	-30.000	22.000	15.000	-0.1674	15.00	0.0	-230.4E-6	0.0
	-30.000	24.000	15.000	-0.1346	15.00	0.0	-206.8E-6	0.0
	-30.000	26.000	15.000	-0.1052	15.00	0.0	-185.2E-6	0.0
	-30.000	28.000	15.000	-0.07925	15.00	0.0	-165.6E-6	0.0
	-30.000	30.000	15.000	-0.05660	15.00	0.0	-148.0E-6	0.0
	-30.000	32.000	15.000	-0.03715	15.00	0.0	-132.3E-6	0.0
	-30.000	34.000	15.000	-0.02065	15.00	0.0	-118.4E-6	0.0
	-30.000	36.000	15.000	-0.006834	15.00	0.0	-106.1E-6	0.0
	-30.000	38.000	15.000	0.004576	15.00	0.0	-96.23E-6	0.0
	-30.000	40.000	15.000	0.01387	15.00	0.0	-85.64E-6	0.0
	-28.000	-40.000	15.000	0.006911	15.00	0.0	-92.80E-6	0.0
	-28.000	-38.000	15.000	-0.004530	15.00	0.0	-103.8E-6	0.0
	-28.000	-36.000	15.000	-0.01862	15.00	0.0	-116.5E-6	0.0
	-28.000	-34.000	15.000	-0.03577	15.00	0.0	-131.9E-6	0.0
	-28.000	-32.000	15.000	-0.05637	15.00	0.0	-147.6E-6	0.0
	-28.000	-30.000	15.000	-0.08085	15.00	0.0	-166.7E-6	0.0
	-28.000	-28.000	15.000	-0.1096	15.00	0.0	-188.5E-6	0.0
	-28.000	-26.000	15.000	-0.1429	15.00	0.0	-213.2E-6	0.0
	-28.000	-24.000	15.000	-0.1810	15.00	0.0	-241.9E-6	0.0
	-28.000	-22.000	15.000	-0.2240	15.00	0.0	-271.9E-6	0.0
	-28.000	-20.000	15.000	-0.2716	15.00	0.0	-305.5E-6	0.0
	-28.000	-18.000	15.000	-0.3234	15.00	0.0	-341.2E-6	0.0
	-28.000	-16.000	15.000	-0.3780	15.00	0.0	-377.9E-6	0.0
	-28.000	-14.000	15.000	-0.4335	15.00	0.0	-414.2E-6	0.0
	-28.000	-12.000	15.000	-0.4875	15.00	0.0	-448.6E-6	0.0
	-28.000	-10.000	15.000	-0.5374	15.00	0.0	-479.7E-6	0.0
	-28.000	-8.000	15.000	-0.5811	15.00	0.0	-506.2E-6	0.0
	-28.000	-6.000	15.000	-0.6166	15.00	0.0	-527.5E-6	0.0
	-28.000	-4.000	15.000	-0.6427	15.00	0.0	-542.9E-6	0.0
	-28.000	-2.000	15.000	-0.6586	15.00	0.0	-552.3E-6	0.0
	-28.000	0.000	15.000	-0.6639	15.00	0.0	-555.4E-6	0.0
	-28.000	2.000	15.000	-0.6586	15.00	0.0	-552.3E-6	0.0
	-28.000	4.000	15.000	-0.6427	15.00	0.0	-542.9E-6	0.0
	-28.000	6.000	15.000	-0.6166	15.00	0.0	-527.5E-6	0.0
	-28.000	8.000	15.000	-0.5811	15.00	0.0	-506.2E-6	0.0
	-28.000	10.000	15.000	-0.5374	15.00	0.0	-479.7E-6	0.0
	-28.000	12.000	15.000	-0.4875	15.00	0.0	-448.6E-6	0.0
	-28.000	14.000	15.000	-0.4335	15.00	0.0	-414.2E-6	0.0
	-28.000	16.000	15.000	-0.3780	15.00	0.0	-377.9E-6	0.0
	-28.000	18.000	15.000	-0.3234	15.00	0.0	-341.2E-6	0.0
	-28.000	20.000	15.000	-0.2716	15.00	0.0	-305.5E-6	0.0
	-28.000	22.000	15.000	-0.2240	15.00	0.0	-271.9E-6	0.0
	-28.000	24.000	15.000	-0.1810	15.00	0.0	-241.9E-6	0.0
	-28.000	26.000	15.000	-0.1429	15.00	0.0	-213.2E-6	0.0
	-28.000	28.000	15.000	-0.1096	15.00	0.0	-188.5E-6	0.0
	-28.000	30.000	15.000	-0.08085	15.00	0.0	-166.7E-6	0.0
	-28.000	32.000	15.000	-0.05637	15.00	0.0	-147.6E-6	0.0
	-28.000	34.000	15.000	-0.03577	15.00	0.0	-131.9E-6	0.0
	-28.000	36.000	15.000	-0.01862	15.00	0.0	-116.5E-6	0.0
	-28.000	38.000	15.000	-0.004530	15.00	0.0	-103.8E-6	0.0
	-28.000	40.000	15.000	0.006911	15.00	0.0	-92.80E-6	0.0
	-26.000	-40.000	15.000	-974.7E-6	15.00	0.0	-100.4E-6	0.0
	-26.000	-38.000	15.000	-0.01488	15.00	0.0	-113.1E-6	0.0
	-26.000	-36.000	15.000	-0.03209	15.00	0.0	-127.8E-6	0.0
	-26.000	-34.000	15.000	-0.05315	15.00	0.0	-144.9E-6	0.0
	-26.000	-32.000	15.000	-0.07865	15.00	0.0	-164.8E-6	0.0
	-26.000	-30.000	15.000	-0.1092	15.00	0.0	-188.1E-6	0.0
	-26.000	-28.000	15.000	-0.1454	15.00	0.0	-215.1E-6	0.0
	-26.000	-26.000	15.000	-0.1878	15.00	0.0	-246.5E-6	0.0
	-26.000	-24.000	15.000	-0.2370	15.00	0.0	-282.7E-6	0.0
	-26.000	-22.000	15.000	-0.2933	15.00	0.0	-323.9E-6	0.0
	-26.000	-20.000	15.000	-0.3570	15.00	0.0	-369.8E-6	0.0
	-26.000	-18.000	15.000	-0.4276	15.00	0.0	-419.7E-6	0.0
	-26.000	-16.000	15.000	-0.5037	15.00	0.0	-471.9E-6	0.0
	-26.000	-14.000	15.000	-0.5822	15.00	0.0	-524.0E-6	0.0
	-26.000	-12.000	15.000	-0.6592	15.00	0.0	-573.5E-6	0.0
	-26.000	-10.000	15.000	-0.7304	15.00	0.0	-618.0E-6	0.0
	-26.000	-8.000	15.000	-0.7922	15.00	0.0	-655.6E-6	0.0
	-26.000	-6.000	15.000	-0.8421	15.00	0.0	-685.4E-6	0.0
	-26.000	-4.000	15.000	-0.8785	15.00	0.0	-706.9E-6	0.0
	-26.000	-2.000	15.000	-0.9006	15.00	0.0	-719.7E-6	0.0
	-26.000	0.000	15.000	-0.9080	15.00	0.0	-724.0E-6	0.0
	-26.000	2.000	15.000	-0.9006	15.00	0.0	-719.7E-6	0.0
	-26.000	4.000	15.000	-0.8785	15.00	0.0	-706.9E-6	0.0
	-26.000	6.000	15.000	-0.8421	15.00	0.0	-685.4E-6	0.0
	-26.000	8.000	15.000	-0.7922	15.00	0.0	-655.6E-6	0.0
	-26.000	10.000	15.000	-0.7304	15.00	0.0	-618.0E-6	0.0
	-26.000	12.000	15.000	-0.6592	15.00	0.0	-573.5E-6	0.0
	-26.000	14.000	15.000	-0.5822	15.00	0.0	-524.0E-6	0.0
	-26.000	16.000	15.000	-0.5037	15.00	0.0	-471.9E-6	0.0
	-26.000	18.000	15.000	-0.4276	15.00	0.0	-419.7E-6	0.0
	-26.000	20.000	15.000	-0.3570	15.00	0.0	-369.8E-6	0.0
	-26.000	22.000	15.000	-0.2933	15.00	0.0	-323.9E-6	0.0
	-26.000	24.000	15.000	-0.2370	15.00	0.0	-282.7E-6	0.0
	-26.000	26.000	15.000	-0.1878	15.00	0.0	-246.5E-6	0.0
	-26.000	28.000	15.000	-0.1454	15.00	0.0	-215.1E-6	0.0
	-26.000	30.000	15.000	-0.1092	15.00	0.0	-188.1E-6	0.0
	-26.000	32.000	15.000	-0.07805	15.00	0.0	-164.8E-6	0.0
	-26.000	34.000	15.000	-0.05315	15.00	0.0	-144.9E-6	0.0
	-26.000	36.000	15.000	-0.03209	15.00	0.0	-127.8E-6	0.0
	-26.000	38.000	15.000	-0.01488	15.00	0.0	-113.1E-6	0.0
	-26.000	40.000	15.000	-974.7E-6	15.00	0.0	-100.4E-6	0.0
	-24.000	-40.000	15.000	-0.00947	15.00	0.0	-106.4E-6	0.0
	-24.000	-38.000	15.000	-0.02645	15.00	0.0	-122.9E-6	0.0
	-24.000	-36.000	15.000	-0.04723	15.00	0.0	-139.9E-6	0.0
	-24.000	-34.000	15.000	-0.07284	15.00	0.0	-160.0E-6	0.0
	-24.000	-32.000	15.000	-0.1041	15.00	0.0	-183.9E-6	0.0
	-24.000	-30.000	15.000	-0.1419	15.00	0.0	-212.2E-6	0.0
	-24.000	-28.000	15.000	-0.1872	15.00	0.0	-245.9E-6	0.0
	-24.000	-26.000	15.000	-0.2409	15.00	0.0	-286.1E-6	0.0
	-24.000	-24.000	15.000	-0.3040	15.00	0.0	-333.7E-6	0.0
	-24.000	-22.000	15.000	-0.3777	15.00	0.0	-389.6E-6	0.0
	-24.000	-20.000	15.000	-0.4631	15.00	0.0	-454.1E-6	0.0
	-24.000	-18.000	15.000	-0.5606	15.00	0.0	-526.2E-6	0.0
	-24.000	-16.000	15.000	-0.6689	15.00	0.0	-603.5E-6	0.0



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Stresses					
	X	Y	Z[Level]	Z	Calc Level	Vert Stress	Sum Princ	Vert Strain
	[m]	[m]	[mod]	[mm]	[mod]	[kN/m²]	[kN/m²]	[-]
	-24.000	6.000	15.000	-1.160	15.00	0.0	-919.0E-6	0.0
	-24.000	8.000	15.000	-1.089	15.00	0.0	-876.4E-6	0.0
	-24.000	10.000	15.000	-1.000	15.00	0.0	-821.6E-6	0.0
	-24.000	12.000	15.000	-0.8961	15.00	0.0	-755.8E-6	0.0
	-24.000	14.000	15.000	-0.7832	15.00	0.0	-681.6E-6	0.0
	-24.000	16.000	15.000	-0.6689	15.00	0.0	-603.5E-6	0.0
	-24.000	18.000	15.000	-0.5606	15.00	0.0	-526.2E-6	0.0
	-24.000	20.000	15.000	-0.4631	15.00	0.0	-454.1E-6	0.0
	-24.000	22.000	15.000	-0.3777	15.00	0.0	-389.6E-6	0.0
	-24.000	24.000	15.000	-0.3040	15.00	0.0	-333.7E-6	0.0
	-24.000	26.000	15.000	-0.2409	15.00	0.0	-286.1E-6	0.0
	-24.000	28.000	15.000	-0.1872	15.00	0.0	-245.9E-6	0.0
	-24.000	30.000	15.000	-0.1419	15.00	0.0	-212.2E-6	0.0
	-24.000	32.000	15.000	-0.1041	15.00	0.0	-183.9E-6	0.0
	-24.000	34.000	15.000	-0.07284	15.00	0.0	-160.0E-6	0.0
	-24.000	36.000	15.000	-0.04723	15.00	0.0	-139.9E-6	0.0
	-24.000	38.000	15.000	-0.02645	15.00	0.0	-122.9E-6	0.0
	-24.000	40.000	15.000	-0.009747	15.00	0.0	-108.4E-6	0.0
	-22.000	-40.000	15.000	-0.01932	15.00	0.0	-116.7E-6	0.0
	-22.000	-38.000	15.000	-0.03914	15.00	0.0	-133.2E-6	0.0
	-22.000	-36.000	15.000	-0.06396	15.00	0.0	-152.9E-6	0.0
	-22.000	-34.000	15.000	-0.09478	15.00	0.0	-176.4E-6	0.0
	-22.000	-32.000	15.000	-0.1328	15.00	0.0	-204.8E-6	0.0
	-22.000	-30.000	15.000	-0.1792	15.00	0.0	-239.3E-6	0.0
	-22.000	-28.000	15.000	-0.2354	15.00	0.0	-281.3E-6	0.0
	-22.000	-26.000	15.000	-0.3031	15.00	0.0	-332.9E-6	0.0
	-22.000	-24.000	15.000	-0.3838	15.00	0.0	-396.2E-6	0.0
	-22.000	-22.000	15.000	-0.4797	15.00	0.0	-473.6E-6	0.0
	-22.000	-20.000	15.000	-0.5938	15.00	0.0	-567.0E-6	0.0
	-22.000	-18.000	15.000	-0.7303	15.00	0.0	-676.1E-6	0.0
	-22.000	-16.000	15.000	-0.8899	15.00	0.0	-797.1E-6	0.0
	-22.000	-14.000	15.000	-1.064	15.00	0.0	-921.6E-6	0.0
	-22.000	-12.000	15.000	-1.237	15.00	0.0	-0.001039	0.0
	-22.000	-10.000	15.000	-1.394	15.00	0.0	-0.001141	0.0
	-22.000	-8.000	15.000	-1.525	15.00	0.0	-0.001223	0.0
	-22.000	-6.000	15.000	-1.627	15.00	0.0	-0.001285	0.0
	-22.000	-4.000	15.000	-1.699	15.00	0.0	-0.001327	0.0
	-22.000	-2.000	15.000	-1.741	15.00	0.0	-0.001352	0.0
	-22.000	0.000	15.000	-1.755	15.00	0.0	-0.001360	0.0
	-22.000	2.000	15.000	-1.741	15.00	0.0	-0.001352	0.0
	-22.000	4.000	15.000	-1.699	15.00	0.0	-0.001327	0.0
	-22.000	6.000	15.000	-1.627	15.00	0.0	-0.001285	0.0
	-22.000	8.000	15.000	-1.525	15.00	0.0	-0.001223	0.0
	-22.000	10.000	15.000	-1.394	15.00	0.0	-0.001141	0.0
	-22.000	12.000	15.000	-1.237	15.00	0.0	-0.001039	0.0
	-22.000	14.000	15.000	-1.064	15.00	0.0	-921.6E-6	0.0
	-22.000	16.000	15.000	-0.8899	15.00	0.0	-797.1E-6	0.0
	-22.000	18.000	15.000	-0.7303	15.00	0.0	-676.1E-6	0.0
	-22.000	20.000	15.000	-0.5938	15.00	0.0	-567.0E-6	0.0
	-22.000	22.000	15.000	-0.4797	15.00	0.0	-473.6E-6	0.0
	-22.000	24.000	15.000	-0.3838	15.00	0.0	-396.2E-6	0.0
	-22.000	26.000	15.000	-0.3031	15.00	0.0	-332.9E-6	0.0
	-22.000	28.000	15.000	-0.2354	15.00	0.0	-281.3E-6	0.0
	-22.000	30.000	15.000	-0.1792	15.00	0.0	-239.3E-6	0.0
	-22.000	32.000	15.000	-0.1328	15.00	0.0	-204.8E-6	0.0
	-22.000	34.000	15.000	-0.09478	15.00	0.0	-176.4E-6	0.0
	-22.000	36.000	15.000	-0.06396	15.00	0.0	-152.9E-6	0.0
	-22.000	38.000	15.000	-0.03914	15.00	0.0	-133.2E-6	0.0
	-22.000	40.000	15.000	-0.01932	15.00	0.0	-116.7E-6	0.0
	-20.000	-40.000	15.000	-0.02957	15.00	0.0	-125.2E-6	0.0
	-20.000	-38.000	15.000	-0.05280	15.00	0.0	-143.9E-6	0.0
	-20.000	-36.000	15.000	-0.08210	15.00	0.0	-166.4E-6	0.0
	-20.000	-34.000	15.000	-0.1188	15.00	0.0	-193.9E-6	0.0
	-20.000	-32.000	15.000	-0.1645	15.00	0.0	-227.5E-6	0.0
	-20.000	-30.000	15.000	-0.2209	15.00	0.0	-269.2E-6	0.0
	-20.000	-28.000	15.000	-0.29094	15.00	0.0	-321.5E-6	0.0
	-20.000	-26.000	15.000	-0.3753	15.00	0.0	-387.7E-6	0.0
	-20.000	-24.000	15.000	-0.4782	15.00	0.0	-472.5E-6	0.0
	-20.000	-22.000	15.000	-0.6019	15.00	0.0	-581.7E-6	0.0
	-20.000	-20.000	15.000	-0.7515	15.00	0.0	-721.7E-6	0.0
	-20.000	-18.000	15.000	-0.9420	15.00	0.0	-896.9E-6	0.0
	-20.000	-16.000	15.000	-1.189	15.00	0.0	-0.001103	0.0
	-20.000	-14.000	15.000	-1.475	15.00	0.0	-0.001320	0.0
	-20.000	-12.000	15.000	-1.758	15.00	0.0	-0.001522	0.0
	-20.000	-10.000	15.000	-2.005	15.00	0.0	-0.001689	0.0
	-20.000	-8.000	15.000	-2.203	15.00	0.0	-0.001816	0.0
	-20.000	-6.000	15.000	-2.351	15.00	0.0	-0.001907	0.0
	-20.000	-4.000	15.000	-2.452	15.00	0.0	-0.001967	0.0
	-20.000	-2.000	15.000	-2.510	15.00	0.0	-0.002002	0.0
	-20.000	0.000	15.000	-2.529	15.00	0.0	-0.002013	0.0
	-20.000	2.000	15.000	-2.510	15.00	0.0	-0.002002	0.0
	-20.000	4.000	15.000	-2.452	15.00	0.0	-0.001967	0.0
	-20.000	6.000	15.000	-2.351	15.00	0.0	-0.001907	0.0
	-20.000	8.000	15.000	-2.203	15.00	0.0	-0.001816	0.0
	-20.000	10.000	15.000	-2.005	15.00	0.0	-0.001689	0.0
	-20.000	12.000	15.000	-1.758	15.00	0.0	-0.001522	0.0
	-20.000	14.000	15.000	-1.475	15.00	0.0	-0.001320	0.0
	-20.000	16.000	15.000	-1.189	15.00	0.0	-0.001103	0.0
	-20.000	18.000	15.000	-0.9420	15.00	0.0	-896.9E-6	0.0
	-20.000	20.000	15.000	-0.7515	15.00	0.0	-721.7E-6	0.0
	-20.000	22.000	15.000	-0.6019	15.00	0.0	-581.7E-6	0.0
	-20.000	24.000	15.000	-0.4782	15.00	0.0	-472.5E-6	0.0
	-20.000	26.000	15.000	-0.3753	15.00	0.0	-387.7E-6	0.0
	-20.000	28.000	15.000	-0.2904	15.00	0.0	-321.5E-6	0.0
	-20.000	30.000	15.000	-0.2209	15.00	0.0	-269.2E-6	0.0
	-20.000	32.000	15.000	-0.1645	15.00	0.0	-227.5E-6	0.0
	-20.000	34.000	15.000	-0.1188	15.00	0.0	-193.9E-6	0.0
	-20.000	36.000	15.000	-0.08210	15.00	0.0	-166.4E-6	0.0
	-20.000	38.000	15.000	-0.05280	15.00	0.0	-143.9E-6	0.0
	-20.000	40.000	15.000	-0.02957	15.00	0.0	-125.2E-6	0.0
	-18.000	-40.000	15.000	-0.04029	15.00	0.0	-133.8E-6	0.0
	-18.000	-38.000	15.000	-0.06719	15.00	0.0	-154.8E-6	0.0
	-18.000	-36.000	15.000	-0.1014	15.00	0.0	-180.4E-6	0.0
	-18.000	-34.000	15.000	-0.1445	15.00	0.0	-212.1E-6	0.0
	-18.000	-32.000	15.000	-0.1989	15.00	0.0	-251.6E-6	0.0
	-18.000	-30.000	15.000	-0.2670				

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Z[Level]	Z	Calc Level	Stresses	Sum Princ	Vert Strain
	X	Y	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[-]
	[m]	[m]						
	-16.000	-40.000	15.000	-0.05123	15.00	0.0	-142.3E-6	0.0
	-16.000	-38.000	15.000	-0.08196	15.00	0.0	-165.7E-6	0.0
	-16.000	-36.000	15.000	-0.1213	15.00	0.0	-194.5E-6	0.0
	-16.000	-34.000	15.000	-0.1714	15.00	0.0	-230.7E-6	0.0
	-16.000	-32.000	15.000	-0.2353	15.00	0.0	-276.5E-6	0.0
	-16.000	-30.000	15.000	-0.3166	15.00	0.0	-335.9E-6	0.0
	-16.000	-28.000	15.000	-0.4204	15.00	0.0	-414.4E-6	0.0
	-16.000	-26.000	15.000	-0.5532	15.00	0.0	-521.1E-6	0.0
	-16.000	-24.000	15.000	-0.7233	15.00	0.0	-671.5E-6	0.0
	-16.000	-22.000	15.000	-0.9362	15.00	0.0	-893.2E-6	0.0
	-16.000	-20.000	15.000	-1.147	15.00	0.0	-0.001240	0.0
	-16.000	-18.000	15.000	-1.122	15.00	0.0	-0.001818	0.0
	-16.000	-16.000	15.000	-1.968	15.00	0.0	-0.002792	0.0
	-16.000	-14.000	15.000	-3.149	15.00	0.0	-0.004052	0.0
	-16.000	-12.000	15.000	-4.184	15.00	0.0	-0.005020	0.0
	-16.000	-10.000	15.000	-4.903	15.00	0.0	-0.005588	0.0
	-16.000	-8.000	15.000	-5.375	15.00	0.0	-0.005918	0.0
	-16.000	-6.000	15.000	-5.681	15.00	0.0	-0.006115	0.0
	-16.000	-4.000	15.000	-5.872	15.00	0.0	-0.006233	0.0
	-16.000	-2.000	15.000	-5.977	15.00	0.0	-0.006296	0.0
	-16.000	0.000	15.000	-6.010	15.00	0.0	-0.006316	0.0
	-16.000	2.000	15.000	-5.977	15.00	0.0	-0.006296	0.0
	-16.000	4.000	15.000	-5.872	15.00	0.0	-0.006233	0.0
	-16.000	6.000	15.000	-5.681	15.00	0.0	-0.006115	0.0
	-16.000	8.000	15.000	-5.375	15.00	0.0	-0.005918	0.0
	-16.000	10.000	15.000	-4.903	15.00	0.0	-0.005588	0.0
	-16.000	12.000	15.000	-4.184	15.00	0.0	-0.005020	0.0
	-16.000	14.000	15.000	-3.149	15.00	0.0	-0.004052	0.0
	-16.000	16.000	15.000	-1.968	15.00	0.0	-0.002792	0.0
	-16.000	18.000	15.000	-1.122	15.00	0.0	-0.001818	0.0
	-16.000	20.000	15.000	-1.147	15.00	0.0	-0.001240	0.0
	-16.000	22.000	15.000	-0.9362	15.00	0.0	-893.2E-6	0.0
	-16.000	24.000	15.000	-0.7233	15.00	0.0	-671.5E-6	0.0
	-16.000	26.000	15.000	-0.5532	15.00	0.0	-521.1E-6	0.0
	-16.000	28.000	15.000	-0.4204	15.00	0.0	-414.4E-6	0.0
	-16.000	30.000	15.000	-0.3166	15.00	0.0	-335.9E-6	0.0
	-16.000	32.000	15.000	-0.2353	15.00	0.0	-276.5E-6	0.0
	-16.000	34.000	15.000	-0.1714	15.00	0.0	-230.7E-6	0.0
	-16.000	36.000	15.000	-0.1213	15.00	0.0	-194.5E-6	0.0
	-16.000	38.000	15.000	-0.08196	15.00	0.0	-165.7E-6	0.0
	-16.000	40.000	15.000	-0.05123	15.00	0.0	-142.3E-6	0.0
	-14.000	-40.000	15.000	-0.06210	15.00	0.0	-150.5E-6	0.0
	-14.000	-38.000	15.000	-0.09672	15.00	0.0	-176.2E-6	0.0
	-14.000	-36.000	15.000	-0.1413	15.00	0.0	-208.4E-6	0.0
	-14.000	-34.000	15.000	-0.1988	15.00	0.0	-249.1E-6	0.0
	-14.000	-32.000	15.000	-0.2728	15.00	0.0	-301.6E-6	0.0
	-14.000	-30.000	15.000	-0.3685	15.00	0.0	-370.8E-6	0.0
	-14.000	-28.000	15.000	-0.4932	15.00	0.0	-464.5E-6	0.0
	-14.000	-26.000	15.000	-0.6577	15.00	0.0	-596.0E-6	0.0
	-14.000	-24.000	15.000	-0.8785	15.00	0.0	-789.8E-6	0.0
	-14.000	-22.000	15.000	-1.178	15.00	0.0	-0.001096	0.0
	-14.000	-20.000	15.000	-1.556	15.00	0.0	-0.001636	0.0
	-14.000	-18.000	15.000	-1.962	15.00	0.0	-0.002788	0.0
	-14.000	-16.000	15.000	-4.155	15.00	0.0	-0.004412	0.0
	-14.000	-14.000	15.000	-7.958	15.00	0.0	-0.01625	0.0
	-14.000	-12.000	15.000	-10.39	15.00	0.0	-0.01987	0.0
	-14.000	-10.000	15.000	-11.64	15.00	0.0	-0.02101	0.0
	-14.000	-8.000	15.000	-12.35	15.00	0.0	-0.02154	0.0
	-14.000	-6.000	15.000	-12.77	15.00	0.0	-0.02182	0.0
	-14.000	-4.000	15.000	-13.02	15.00	0.0	-0.02197	0.0
	-14.000	-2.000	15.000	-13.16	15.00	0.0	-0.02205	0.0
	-14.000	0.000	15.000	-13.20	15.00	0.0	-0.02208	0.0
	-14.000	2.000	15.000	-13.16	15.00	0.0	-0.02205	0.0
	-14.000	4.000	15.000	-13.02	15.00	0.0	-0.02197	0.0
	-14.000	6.000	15.000	-12.77	15.00	0.0	-0.02182	0.0
	-14.000	8.000	15.000	-12.35	15.00	0.0	-0.02154	0.0
	-14.000	10.000	15.000	-11.64	15.00	0.0	-0.02101	0.0
	-14.000	12.000	15.000	-10.39	15.00	0.0	-0.01987	0.0
	-14.000	14.000	15.000	-7.958	15.00	0.0	-0.01625	0.0
	-14.000	16.000	15.000	-4.155	15.00	0.0	-0.004412	0.0
	-14.000	18.000	15.000	-1.962	15.00	0.0	-0.002788	0.0
	-14.000	20.000	15.000	-1.556	15.00	0.0	-0.001636	0.0
	-14.000	22.000	15.000	-1.178	15.00	0.0	-0.001096	0.0
	-14.000	24.000	15.000	-0.8785	15.00	0.0	-789.8E-6	0.0
	-14.000	26.000	15.000	-0.6577	15.00	0.0	-596.0E-6	0.0
	-14.000	28.000	15.000	-0.4932	15.00	0.0	-464.5E-6	0.0
	-14.000	30.000	15.000	-0.3685	15.00	0.0	-370.8E-6	0.0
	-14.000	32.000	15.000	-0.2728	15.00	0.0	-301.6E-6	0.0
	-14.000	34.000	15.000	-0.1988	15.00	0.0	-249.1E-6	0.0
	-14.000	36.000	15.000	-0.1413	15.00	0.0	-208.4E-6	0.0
	-14.000	38.000	15.000	-0.09672	15.00	0.0	-176.2E-6	0.0
	-14.000	40.000	15.000	-0.06210	15.00	0.0	-150.5E-6	0.0
	-12.000	-40.000	15.000	-0.07255	15.00	0.0	-158.1E-6	0.0
	-12.000	-38.000	15.000	-0.1110	15.00	0.0	-186.2E-6	0.0
	-12.000	-36.000	15.000	-0.1609	15.00	0.0	-221.5E-6	0.0
	-12.000	-34.000	15.000	-0.2256	15.00	0.0	-266.8E-6	0.0
	-12.000	-32.000	15.000	-0.3099	15.00	0.0	-325.8E-6	0.0
	-12.000	-30.000	15.000	-0.4205	15.00	0.0	-404.9E-6	0.0
	-12.000	-28.000	15.000	-0.5675	15.00	0.0	-514.0E-6	0.0
	-12.000	-26.000	15.000	-0.7670	15.00	0.0	-671.2E-6	0.0
	-12.000	-24.000	15.000	-1.047	15.00	0.0	-910.9E-6	0.0
	-12.000	-22.000	15.000	-1.457	15.00	0.0	-0.001310	0.0
	-12.000	-20.000	15.000	-2.076	15.00	0.0	-0.002077	0.0
	-12.000	-18.000	15.000	-3.135	15.00	0.0	-0.004044	0.0
	-12.000	-16.000	15.000	-7.949	15.00	0.0	-0.01625	0.0
	-12.000	-14.000	15.000	-27.69	15.00	-200.0	-480.0	-0.007989
	-12.000	-12.000	15.000	-32.77	15.00	-200.0	-480.0	-0.007989
	-12.000	-10.000	15.000	-34.70	15.00	-200.0	-480.0	-0.007989
	-12.000	-8.000	15.000	-35.68	15.00	-200.0	-480.0	-0.007989
	-12.000	-6.000	15.000	-36.23	15.00	-200.0	-480.0	-0.007989
	-12.000	-4.000	15.000	-36.54	15.00	-200.0	-480.0	-0.007989
	-12.000	-2.000	15.000	-36.71	15.00	-200.0	-480.0	-0.007989
	-12.000	0.000	15.000	-36.76	15.00	-200.0	-480.0	-0.007989
	-12.000	2.000	15.000	-36.71	15.00	-200.0	-480.0	-0.007989
	-12.000	4.000	15.000	-36.54	15.00	-200.0	-480.0	-0.007989
	-12.000	6.000	15.000	-36.23	15.00	-200.0	-480.0	-0.007989
	-12.000	8.000	15.000	-35.68	15.00	-200.0	-480.0	-0.007989
	-12.000	10.000	15.000	-34.70	15.00	-200.0	-480.0	-0.007989
	-12.000	12.000	15.000	-32.77	15.00	-200.0	-480.0	-0.007989
	-12.000	14.000	15.000	-27.69	15.00	-200.0	-480.0	-0.007989
	-12.000	16.000	15.000	-7.949	15.00	0.0	-0.01625	0.0
	-12.000	18.000	15.000	-3.135	15.00	0.0	-0.004044	0.0
	-12.000	20.000	15.000	-2.076	15.00	0.0	-0.002077	0.0
	-12.000	22.000	15.000	-1.457	15.00	0.0	-0.001310	0.0
	-12.000	24.000	15.000	-1.047	15.00	0.0	-910.9E-6	0.0
	-12.000	26.000	15.000	-0.7670	15.00	0.0	-671.2E-6	0.0
	-12.000	28.000	15.000	-0.5675	15.00	0.0	-514.0E-6	0.0
	-12.000	30.000	15.000	-0.4205	15.00	0.0	-404.9E-6	0.0
	-12.000	32						



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Stresses					
	X [m]	Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	-10.000	-4.000	15.000	-43.95	15.00	-200.0	-480.0	-0.007989
	-10.000	-2.000	15.000	-44.14	15.00	-200.0	-480.0	-0.007989
	-10.000	0.000	15.000	-44.20	15.00	-200.0	-480.0	-0.007989
	-10.000	2.000	15.000	-44.14	15.00	-200.0	-480.0	-0.007989
	-10.000	4.000	15.000	-43.95	15.00	-200.0	-480.0	-0.007989
	-10.000	6.000	15.000	-43.57	15.00	-200.0	-480.0	-0.007989
	-10.000	8.000	15.000	-42.91	15.00	-200.0	-480.0	-0.007989
	-10.000	10.000	15.000	-41.70	15.00	-200.0	-480.0	-0.007989
	-10.000	12.000	15.000	-39.23	15.00	-200.0	-480.0	-0.007989
	-10.000	14.000	15.000	-32.75	15.00	-200.0	-480.0	-0.007989
	-10.000	16.000	15.000	-10.37	15.00	0.0	-0.01986	0.0
	-10.000	18.000	15.000	-4.158	15.00	0.0	-0.005005	0.0
	-10.000	20.000	15.000	-2.574	15.00	0.0	-0.002466	0.0
	-10.000	22.000	15.000	-1.731	15.00	0.0	-0.001506	0.0
	-10.000	24.000	15.000	-1.212	15.00	0.0	-0.001024	0.0
	-10.000	26.000	15.000	-0.8734	15.00	0.0	-741.6E-6	0.0
	-10.000	28.000	15.000	-0.6391	15.00	0.0	-560.4E-6	0.0
	-10.000	30.000	15.000	-0.4702	15.00	0.0	-436.6E-6	0.0
	-10.000	32.000	15.000	-0.3450	15.00	0.0	-348.3E-6	0.0
	-10.000	34.000	15.000	-0.2508	15.00	0.0	-283.1E-6	0.0
	-10.000	36.000	15.000	-0.1791	15.00	0.0	-233.6E-6	0.0
	-10.000	38.000	15.000	-0.1242	15.00	0.0	-195.3E-6	0.0
	-10.000	40.000	15.000	-0.08222	15.00	0.0	-165.1E-6	0.0
	-8.000	-40.000	15.000	-0.09873	15.00	0.0	-171.1E-6	0.0
	-8.000	-38.000	15.000	-0.1360	15.00	0.0	-203.2E-6	0.0
	-8.000	-36.000	15.000	-0.1952	15.00	0.0	-244.1E-6	0.0
	-8.000	-34.000	15.000	-0.2732	15.00	0.0	-297.3E-6	0.0
	-8.000	-32.000	15.000	-0.3765	15.00	0.0	-368.0E-6	0.0
	-8.000	-30.000	15.000	-0.5148	15.00	0.0	-464.5E-6	0.0
	-8.000	-28.000	15.000	-0.7037	15.00	0.0	-601.0E-6	0.0
	-8.000	-26.000	15.000	-0.9691	15.00	0.0	-802.7E-6	0.0
	-8.000	-24.000	15.000	-1.359	15.00	0.0	-0.001120	0.0
	-8.000	-22.000	15.000	-1.966	15.00	0.0	-0.001667	0.0
	-8.000	-20.000	15.000	-2.971	15.00	0.0	-0.002752	0.0
	-8.000	-18.000	15.000	-4.860	15.00	0.0	-0.005564	0.0
	-8.000	-16.000	15.000	-11.60	15.00	0.0	-0.02099	0.0
	-8.000	-14.000	15.000	-34.67	15.00	-200.0	-480.0	-0.007989
	-8.000	-12.000	15.000	-41.68	15.00	-200.0	-480.0	-0.007989
	-8.000	-10.000	15.000	-44.47	15.00	-200.0	-480.0	-0.007989
	-8.000	-8.000	15.000	-45.84	15.00	-200.0	-480.0	-0.007989
	-8.000	-6.000	15.000	-46.60	15.00	-200.0	-480.0	-0.007989
	-8.000	-4.000	15.000	-47.02	15.00	-200.0	-480.0	-0.007989
	-8.000	-2.000	15.000	-47.24	15.00	-200.0	-480.0	-0.007989
	-8.000	0.000	15.000	-47.31	15.00	-200.0	-480.0	-0.007989
	-8.000	2.000	15.000	-47.24	15.00	-200.0	-480.0	-0.007989
	-8.000	4.000	15.000	-47.02	15.00	-200.0	-480.0	-0.007989
	-8.000	6.000	15.000	-46.60	15.00	-200.0	-480.0	-0.007989
	-8.000	8.000	15.000	-45.84	15.00	-200.0	-480.0	-0.007989
	-8.000	10.000	15.000	-44.47	15.00	-200.0	-480.0	-0.007989
	-8.000	12.000	15.000	-41.68	15.00	-200.0	-480.0	-0.007989
	-8.000	14.000	15.000	-34.67	15.00	-200.0	-480.0	-0.007989
	-8.000	16.000	15.000	-11.60	15.00	0.0	-0.02099	0.0
	-8.000	18.000	15.000	-4.860	15.00	0.0	-0.005564	0.0
	-8.000	20.000	15.000	-2.971	15.00	0.0	-0.002752	0.0
	-8.000	22.000	15.000	-1.966	15.00	0.0	-0.001667	0.0
	-8.000	24.000	15.000	-1.359	15.00	0.0	-0.001120	0.0
	-8.000	26.000	15.000	-0.9691	15.00	0.0	-802.7E-6	0.0
	-8.000	28.000	15.000	-0.7037	15.00	0.0	-601.0E-6	0.0
	-8.000	30.000	15.000	-0.5148	15.00	0.0	-464.5E-6	0.0
	-8.000	32.000	15.000	-0.3765	15.00	0.0	-368.0E-6	0.0
	-8.000	34.000	15.000	-0.2732	15.00	0.0	-297.3E-6	0.0
	-8.000	36.000	15.000	-0.1952	15.00	0.0	-244.1E-6	0.0
	-8.000	38.000	15.000	-0.1360	15.00	0.0	-203.2E-6	0.0
	-8.000	40.000	15.000	-0.09873	15.00	0.0	-171.1E-6	0.0
	-6.000	-40.000	15.000	-0.09776	15.00	0.0	-176.0E-6	0.0
	-6.000	-38.000	15.000	-0.1456	15.00	0.0	-209.6E-6	0.0
	-6.000	-36.000	15.000	-0.2086	15.00	0.0	-252.7E-6	0.0
	-6.000	-34.000	15.000	-0.2919	15.00	0.0	-309.0E-6	0.0
	-6.000	-32.000	15.000	-0.4027	15.00	0.0	-384.2E-6	0.0
	-6.000	-30.000	15.000	-0.5520	15.00	0.0	-487.4E-6	0.0
	-6.000	-28.000	15.000	-0.7573	15.00	0.0	-634.0E-6	0.0
	-6.000	-26.000	15.000	-1.048	15.00	0.0	-851.7E-6	0.0
	-6.000	-24.000	15.000	-1.477	15.00	0.0	-0.001195	0.0
	-6.000	-22.000	15.000	-2.148	15.00	0.0	-0.001785	0.0
	-6.000	-20.000	15.000	-3.257	15.00	0.0	-0.002945	0.0
	-6.000	-18.000	15.000	-5.309	15.00	0.0	-0.005882	0.0
	-6.000	-16.000	15.000	-12.28	15.00	0.0	-0.02150	0.0
	-6.000	-14.000	15.000	-35.62	15.00	-200.0	-480.0	-0.007989
	-6.000	-12.000	15.000	-42.86	15.00	-200.0	-480.0	-0.007989
	-6.000	-10.000	15.000	-45.81	15.00	-200.0	-480.0	-0.007989
	-6.000	-8.000	15.000	-47.29	15.00	-200.0	-480.0	-0.007989
	-6.000	-6.000	15.000	-48.11	15.00	-200.0	-480.0	-0.007989
	-6.000	-4.000	15.000	-48.57	15.00	-200.0	-480.0	-0.007989
	-6.000	-2.000	15.000	-48.81	15.00	-200.0	-480.0	-0.007989
	-6.000	0.000	15.000	-48.88	15.00	-200.0	-480.0	-0.007989
	-6.000	2.000	15.000	-48.81	15.00	-200.0	-480.0	-0.007989
	-6.000	4.000	15.000	-48.57	15.00	-200.0	-480.0	-0.007989
	-6.000	6.000	15.000	-48.11	15.00	-200.0	-480.0	-0.007989
	-6.000	8.000	15.000	-47.29	15.00	-200.0	-480.0	-0.007989
	-6.000	10.000	15.000	-45.81	15.00	-200.0	-480.0	-0.007989
	-6.000	12.000	15.000	-42.86	15.00	-200.0	-480.0	-0.007989
	-6.000	14.000	15.000	-35.62	15.00	-200.0	-480.0	-0.007989
	-6.000	16.000	15.000	-12.28	15.00	0.0	-0.02150	0.0
	-6.000	18.000	15.000	-5.309	15.00	0.0	-0.005882	0.0
	-6.000	20.000	15.000	-3.257	15.00	0.0	-0.002945	0.0
	-6.000	22.000	15.000	-2.148	15.00	0.0	-0.001785	0.0
	-6.000	24.000	15.000	-1.477	15.00	0.0	-0.001195	0.0
	-6.000	26.000	15.000	-1.048	15.00	0.0	-851.7E-6	0.0
	-6.000	28.000	15.000	-0.7573	15.00	0.0	-634.0E-6	0.0
	-6.000	30.000	15.000	-0.5520	15.00	0.0	-487.4E-6	0.0
	-6.000	32.000	15.000	-0.4027	15.00	0.0	-384.2E-6	0.0
	-6.000	34.000	15.000	-0.2919	15.00	0.0	-309.0E-6	0.0
	-6.000	36.000	15.000	-0.2086	15.00	0.0	-252.7E-6	0.0
	-6.000	38.000	15.000	-0.1456	15.00	0.0	-209.6E-6	0.0
	-6.000	40.000	15.000	-0.09776	15.00	0.0	-176.0E-6	0.0
	-4.000	-40.000	15.000	-0.1030				



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Stresses		
	X [m]	Y [m]				Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	-4.000	32.000	15.000	-0.4223	15.00	0.0	-396.1E-6	0.0
	-4.000	34.000	15.000	-0.3058	15.00	0.0	-317.7E-6	0.0
	-4.000	36.000	15.000	-0.2187	15.00	0.0	-259.1E-6	0.0
	-4.000	38.000	15.000	-0.1529	15.00	0.0	-214.4E-6	0.0
	-4.000	40.000	15.000	-0.1038	15.00	0.0	-179.6E-6	0.0
	-2.000	-40.000	15.000	-0.1062	15.00	0.0	-181.9E-6	0.0
	-2.000	-38.000	15.000	-0.1573	15.00	0.0	-217.3E-6	0.0
	-2.000	-36.000	15.000	-0.2249	15.00	0.0	-263.0E-6	0.0
	-2.000	-34.000	15.000	-0.3145	15.00	0.0	-323.0E-6	0.0
	-2.000	-32.000	15.000	-0.4344	15.00	0.0	-403.5E-6	0.0
	-2.000	-30.000	15.000	-0.5970	15.00	0.0	-514.5E-6	0.0
	-2.000	-28.000	15.000	-0.8218	15.00	0.0	-672.8E-6	0.0
	-2.000	-26.000	15.000	-1.141	15.00	0.0	-908.3E-6	0.0
	-2.000	-24.000	15.000	-1.614	15.00	0.0	-0.001279	0.0
	-2.000	-22.000	15.000	-2.349	15.00	0.0	-0.001910	0.0
	-2.000	-20.000	15.000	-3.551	15.00	0.0	-0.003132	0.0
	-2.000	-18.000	15.000	-5.733	15.00	0.0	-0.006156	0.0
	-2.000	-16.000	15.000	-12.87	15.00	0.0	-0.02189	0.0
	-2.000	-14.000	15.000	-36.37	15.00	-200.0	-480.0	-0.007989
	-2.000	-12.000	15.000	-43.78	15.00	-200.0	-480.0	-0.007989
	-2.000	-10.000	15.000	-46.86	15.00	-200.0	-480.0	-0.007989
	-2.000	-8.000	15.000	-48.43	15.00	-200.0	-480.0	-0.007989
	-2.000	-6.000	15.000	-49.31	15.00	-200.0	-480.0	-0.007989
	-2.000	-4.000	15.000	-49.81	15.00	-200.0	-480.0	-0.007989
	-2.000	-2.000	15.000	-50.07	15.00	-200.0	-480.0	-0.007989
	-2.000	0.000	15.000	-50.15	15.00	-200.0	-480.0	-0.007989
	-2.000	2.000	15.000	-50.07	15.00	-200.0	-480.0	-0.007989
	-2.000	4.000	15.000	-49.81	15.00	-200.0	-480.0	-0.007989
	-2.000	6.000	15.000	-49.31	15.00	-200.0	-480.0	-0.007989
	-2.000	8.000	15.000	-48.43	15.00	-200.0	-480.0	-0.007989
	-2.000	10.000	15.000	-46.86	15.00	-200.0	-480.0	-0.007989
	-2.000	12.000	15.000	-43.78	15.00	-200.0	-480.0	-0.007989
	-2.000	14.000	15.000	-36.37	15.00	-200.0	-480.0	-0.007989
	-2.000	16.000	15.000	-12.87	15.00	0.0	-0.02189	0.0
	-2.000	18.000	15.000	-5.733	15.00	0.0	-0.006156	0.0
	-2.000	20.000	15.000	-3.551	15.00	0.0	-0.003132	0.0
	-2.000	22.000	15.000	-2.349	15.00	0.0	-0.001910	0.0
	-2.000	24.000	15.000	-1.614	15.00	0.0	-0.001279	0.0
	-2.000	26.000	15.000	-1.141	15.00	0.0	-908.3E-6	0.0
	-2.000	28.000	15.000	-0.8218	15.00	0.0	-672.8E-6	0.0
	-2.000	30.000	15.000	-0.5970	15.00	0.0	-514.5E-6	0.0
	-2.000	32.000	15.000	-0.4344	15.00	0.0	-403.5E-6	0.0
	-2.000	34.000	15.000	-0.3145	15.00	0.0	-323.0E-6	0.0
	-2.000	36.000	15.000	-0.2249	15.00	0.0	-263.0E-6	0.0
	-2.000	38.000	15.000	-0.1573	15.00	0.0	-217.3E-6	0.0
	-2.000	40.000	15.000	-0.1062	15.00	0.0	-181.9E-6	0.0
	0.000	-40.000	15.000	-0.1073	15.00	0.0	-182.6E-6	0.0
	0.000	-38.000	15.000	-0.1589	15.00	0.0	-218.3E-6	0.0
	0.000	-36.000	15.000	-0.2270	15.00	0.0	-264.3E-6	0.0
	0.000	-34.000	15.000	-0.3174	15.00	0.0	-324.8E-6	0.0
	0.000	-32.000	15.000	-0.4386	15.00	0.0	-405.9E-6	0.0
	0.000	-30.000	15.000	-0.6029	15.00	0.0	-518.0E-6	0.0
	0.000	-28.000	15.000	-0.8301	15.00	0.0	-677.7E-6	0.0
	0.000	-26.000	15.000	-1.153	15.00	0.0	-915.3E-6	0.0
	0.000	-24.000	15.000	-1.631	15.00	0.0	-0.001289	0.0
	0.000	-22.000	15.000	-2.374	15.00	0.0	-0.001925	0.0
	0.000	-20.000	15.000	-3.586	15.00	0.0	-0.003153	0.0
	0.000	-18.000	15.000	-5.780	15.00	0.0	-0.006185	0.0
	0.000	-16.000	15.000	-12.93	15.00	0.0	-0.02193	0.0
	0.000	-14.000	15.000	-36.45	15.00	-200.0	-480.0	-0.007989
	0.000	-12.000	15.000	-43.87	15.00	-200.0	-480.0	-0.007989
	0.000	-10.000	15.000	-46.96	15.00	-200.0	-480.0	-0.007989
	0.000	-8.000	15.000	-48.55	15.00	-200.0	-480.0	-0.007989
	0.000	-6.000	15.000	-49.44	15.00	-200.0	-480.0	-0.007989
	0.000	-4.000	15.000	-49.94	15.00	-200.0	-480.0	-0.007989
	0.000	-2.000	15.000	-50.20	15.00	-200.0	-480.0	-0.007989
	0.000	0.000	15.000	-50.29	15.00	-200.0	-480.0	-0.007989
	0.000	2.000	15.000	-50.20	15.00	-200.0	-480.0	-0.007989
	0.000	4.000	15.000	-49.94	15.00	-200.0	-480.0	-0.007989
	0.000	6.000	15.000	-49.44	15.00	-200.0	-480.0	-0.007989
	0.000	8.000	15.000	-48.55	15.00	-200.0	-480.0	-0.007989
	0.000	10.000	15.000	-46.96	15.00	-200.0	-480.0	-0.007989
	0.000	12.000	15.000	-43.87	15.00	-200.0	-480.0	-0.007989
	0.000	14.000	15.000	-36.45	15.00	-200.0	-480.0	-0.007989
	0.000	16.000	15.000	-12.93	15.00	0.0	-0.02193	0.0
	0.000	18.000	15.000	-5.780	15.00	0.0	-0.006185	0.0
	0.000	20.000	15.000	-3.586	15.00	0.0	-0.003153	0.0
	0.000	22.000	15.000	-2.374	15.00	0.0	-0.001925	0.0
	0.000	24.000	15.000	-1.631	15.00	0.0	-0.001289	0.0
	0.000	26.000	15.000	-1.153	15.00	0.0	-915.3E-6	0.0
	0.000	28.000	15.000	-0.8301	15.00	0.0	-677.7E-6	0.0
	0.000	30.000	15.000	-0.6029	15.00	0.0	-518.0E-6	0.0
	0.000	32.000	15.000	-0.4386	15.00	0.0	-405.9E-6	0.0
	0.000	34.000	15.000	-0.3174	15.00	0.0	-324.8E-6	0.0
	0.000	36.000	15.000	-0.2270	15.00	0.0	-264.3E-6	0.0
	0.000	38.000	15.000	-0.1589	15.00	0.0	-218.3E-6	0.0
	0.000	40.000	15.000	-0.1073	15.00	0.0	-182.6E-6	0.0
	2.000	-40.000	15.000	-0.1062	15.00	0.0	-181.9E-6	0.0
	2.000	-38.000	15.000	-0.1573	15.00	0.0	-217.3E-6	0.0
	2.000	-36.000	15.000	-0.2249	15.00	0.0	-263.0E-6	0.0
	2.000	-34.000	15.000	-0.3145	15.00	0.0	-323.0E-6	0.0
	2.000	-32.000	15.000	-0.4344	15.00	0.0	-403.5E-6	0.0
	2.000	-30.000	15.000	-0.5970	15.00	0.0	-514.5E-6	0.0
	2.000	-28.000	15.000	-0.8218	15.00	0.0	-672.8E-6	0.0
	2.000	-26.000	15.000	-1.141	15.00	0.0	-908.3E-6	0.0
	2.000	-24.000	15.000	-1.614	15.00	0.0	-0.001279	0.0
	2.000	-22.000	15.000	-2.349	15.00	0.0	-0.001910	0.0
	2.000	-20.000	15.000	-3.551	15.00	0.0	-0.003132	0.0
	2.000	-18.000	15.000	-5.733	15.00	0.0	-0.006156	0.0
	2.000	-16.000	15.000	-12.87	15.00	0.0	-0.02189	0.0
	2.000	-14.000	15.000	-36.37	15.00	-200.0	-480.0	-0.007989
	2.000	-12.000	15.000	-43.78	15.00	-200.0	-480.0	-0.007989
	2.000	-10.000	15.000	-46.86	15.00	-200.0	-480.0	-0.007989
	2.000	-8.000	15.000	-48.43	15.00	-200.0	-480.0	-0.007989
	2.000	-6.000	15.000	-49.31	15.00	-200.0	-480.0	-0.007989
	2.000	-4.000	15.000	-49.81	15.00	-200.0	-480.0	-0.007989
	2.000	-2.000	15.000	-50.07	15.00	-200.0	-480.0	-0.007989
	2.000	0.000	15.000	-50.15	15.00	-200.0	-480.0	-0.007989
	2.000	2.000	15.000	-50.07	15.00	-200.0	-480.0	-0.007989
	2.000	4.000	15.000	-49.81	15.00	-200.0	-480.0	-0.007989
	2.000	6.000	15.000	-49.31	15.00	-200.0	-480.0	-0.007989
	2.000	8.000	15.000	-48.43	15.00	-200.0	-480.0	-0.007989
	2.000	10.000	15.000	-46.86	15.00	-200.0	-480.0	-0.007989
	2.000	12.000	15.000	-43.78	15.00	-200.0	-480.0	-0.007989
	2.000	14.000	15.000	-36.37	15.00	-200.0	-480.0	-0.007989
	2.000	16.000	15.000	-12.87	15.00	0.0	-0.02189	0.0
	2.000	18.000	15.000	-5.733	15.00	0.0	-0.006156	0.0
	2.000	20.000	15.000	-3.551	15.00	0.0	-0.003132	0.0
	2.00							



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	X	Location	Z[Level]	Z	Calc Level	Vert Stress	Sum Princ	Vert Strain
	[m]	[m]	[MOD]	[mm]	[MOD]	[kN/m²]	[kN/m²]	[-]
	4.000	-14.000	15.000	-36.12	15.00	-200.0	-480.0	-0.007989
	4.000	-12.000	15.000	-43.47	15.00	-200.0	-480.0	-0.007989
	4.000	-10.000	15.000	-46.51	15.00	-200.0	-480.0	-0.007989
	4.000	-8.000	15.000	-48.05	15.00	-200.0	-480.0	-0.007989
	4.000	-6.000	15.000	-48.91	15.00	-200.0	-480.0	-0.007989
	4.000	-4.000	15.000	-49.40	15.00	-200.0	-480.0	-0.007989
	4.000	-2.000	15.000	-49.65	15.00	-200.0	-480.0	-0.007989
	4.000	0.000	15.000	-49.73	15.00	-200.0	-480.0	-0.007989
	4.000	2.000	15.000	-49.65	15.00	-200.0	-480.0	-0.007989
	4.000	4.000	15.000	-49.40	15.00	-200.0	-480.0	-0.007989
	4.000	6.000	15.000	-48.91	15.00	-200.0	-480.0	-0.007989
	4.000	8.000	15.000	-48.05	15.00	-200.0	-480.0	-0.007989
	4.000	10.000	15.000	-46.51	15.00	-200.0	-480.0	-0.007989
	4.000	12.000	15.000	-43.47	15.00	-200.0	-480.0	-0.007989
	4.000	14.000	15.000	-36.12	15.00	-200.0	-480.0	-0.007989
	4.000	16.000	15.000	-12.67	15.00	0.0	-0.02176	0.0
	4.000	18.000	15.000	-5.584	15.00	0.0	-0.006062	0.0
	4.000	20.000	15.000	-3.445	15.00	0.0	-0.003066	0.0
	4.000	22.000	15.000	-2.275	15.00	0.0	-0.001864	0.0
	4.000	24.000	15.000	-1.562	15.00	0.0	-0.001248	0.0
	4.000	26.000	15.000	-1.106	15.00	0.0	-887.1E-6	0.0
	4.000	28.000	15.000	-0.7972	15.00	0.0	-658.1E-6	0.0
	4.000	30.000	15.000	-0.5798	15.00	0.0	-504.2E-6	0.0
	4.000	32.000	15.000	-0.4223	15.00	0.0	-396.1E-6	0.0
	4.000	34.000	15.000	-0.3058	15.00	0.0	-317.7E-6	0.0
	4.000	36.000	15.000	-0.2187	15.00	0.0	-259.1E-6	0.0
	4.000	38.000	15.000	-0.1529	15.00	0.0	-214.4E-6	0.0
	4.000	40.000	15.000	-0.1030	15.00	0.0	-179.6E-6	0.0
	6.000	-40.000	15.000	-0.09776	15.00	0.0	-176.9E-6	0.0
	6.000	-38.000	15.000	-0.1456	15.00	0.0	-209.6E-6	0.0
	6.000	-36.000	15.000	-0.2086	15.00	0.0	-252.7E-6	0.0
	6.000	-34.000	15.000	-0.2919	15.00	0.0	-309.0E-6	0.0
	6.000	-32.000	15.000	-0.4027	15.00	0.0	-384.2E-6	0.0
	6.000	-30.000	15.000	-0.5520	15.00	0.0	-487.4E-6	0.0
	6.000	-28.000	15.000	-0.7573	15.00	0.0	-634.0E-6	0.0
	6.000	-26.000	15.000	-1.048	15.00	0.0	-851.7E-6	0.0
	6.000	-24.000	15.000	-1.477	15.00	0.0	-0.001195	0.0
	6.000	-22.000	15.000	-2.148	15.00	0.0	-0.001785	0.0
	6.000	-20.000	15.000	-3.257	15.00	0.0	-0.002945	0.0
	6.000	-18.000	15.000	-5.309	15.00	0.0	-0.005882	0.0
	6.000	-16.000	15.000	-12.28	15.00	0.0	-0.02150	0.0
	6.000	-14.000	15.000	-35.62	15.00	-200.0	-480.0	-0.007989
	6.000	-12.000	15.000	-42.86	15.00	-200.0	-480.0	-0.007989
	6.000	-10.000	15.000	-45.81	15.00	-200.0	-480.0	-0.007989
	6.000	-8.000	15.000	-47.29	15.00	-200.0	-480.0	-0.007989
	6.000	-6.000	15.000	-48.11	15.00	-200.0	-480.0	-0.007989
	6.000	-4.000	15.000	-48.57	15.00	-200.0	-480.0	-0.007989
	6.000	-2.000	15.000	-48.81	15.00	-200.0	-480.0	-0.007989
	6.000	0.000	15.000	-48.88	15.00	-200.0	-480.0	-0.007989
	6.000	2.000	15.000	-48.81	15.00	-200.0	-480.0	-0.007989
	6.000	4.000	15.000	-48.57	15.00	-200.0	-480.0	-0.007989
	6.000	6.000	15.000	-48.11	15.00	-200.0	-480.0	-0.007989
	6.000	8.000	15.000	-47.29	15.00	-200.0	-480.0	-0.007989
	6.000	10.000	15.000	-45.81	15.00	-200.0	-480.0	-0.007989
	6.000	12.000	15.000	-42.86	15.00	-200.0	-480.0	-0.007989
	6.000	14.000	15.000	-35.62	15.00	-200.0	-480.0	-0.007989
	6.000	16.000	15.000	-12.28	15.00	0.0	-0.02150	0.0
	6.000	18.000	15.000	-5.309	15.00	0.0	-0.005882	0.0
	6.000	20.000	15.000	-3.257	15.00	0.0	-0.002945	0.0
	6.000	22.000	15.000	-2.148	15.00	0.0	-0.001785	0.0
	6.000	24.000	15.000	-1.477	15.00	0.0	-0.001195	0.0
	6.000	26.000	15.000	-1.048	15.00	0.0	-851.7E-6	0.0
	6.000	28.000	15.000	-0.7573	15.00	0.0	-634.0E-6	0.0
	6.000	30.000	15.000	-0.5520	15.00	0.0	-487.4E-6	0.0
	6.000	32.000	15.000	-0.4027	15.00	0.0	-384.2E-6	0.0
	6.000	34.000	15.000	-0.2919	15.00	0.0	-309.0E-6	0.0
	6.000	36.000	15.000	-0.2086	15.00	0.0	-252.7E-6	0.0
	6.000	38.000	15.000	-0.1456	15.00	0.0	-209.6E-6	0.0
	6.000	40.000	15.000	-0.09776	15.00	0.0	-176.9E-6	0.0
	8.000	-40.000	15.000	-0.09073	15.00	0.0	-171.1E-6	0.0
	8.000	-38.000	15.000	-0.1360	15.00	0.0	-203.2E-6	0.0
	8.000	-36.000	15.000	-0.1952	15.00	0.0	-244.1E-6	0.0
	8.000	-34.000	15.000	-0.2732	15.00	0.0	-297.3E-6	0.0
	8.000	-32.000	15.000	-0.3765	15.00	0.0	-368.0E-6	0.0
	8.000	-30.000	15.000	-0.5148	15.00	0.0	-464.5E-6	0.0
	8.000	-28.000	15.000	-0.7037	15.00	0.0	-601.0E-6	0.0
	8.000	-26.000	15.000	-0.9691	15.00	0.0	-802.7E-6	0.0
	8.000	-24.000	15.000	-1.359	15.00	0.0	-0.001120	0.0
	8.000	-22.000	15.000	-1.966	15.00	0.0	-0.001667	0.0
	8.000	-20.000	15.000	-2.971	15.00	0.0	-0.002752	0.0
	8.000	-18.000	15.000	-4.860	15.00	0.0	-0.005564	0.0
	8.000	-16.000	15.000	-11.60	15.00	0.0	-0.02099	0.0
	8.000	-14.000	15.000	-34.67	15.00	-200.0	-480.0	-0.007989
	8.000	-12.000	15.000	-41.68	15.00	-200.0	-480.0	-0.007989
	8.000	-10.000	15.000	-44.47	15.00	-200.0	-480.0	-0.007989
	8.000	-8.000	15.000	-45.84	15.00	-200.0	-480.0	-0.007989
	8.000	-6.000	15.000	-46.60	15.00	-200.0	-480.0	-0.007989
	8.000	-4.000	15.000	-47.02	15.00	-200.0	-480.0	-0.007989
	8.000	-2.000	15.000	-47.24	15.00	-200.0	-480.0	-0.007989
	8.000	0.000	15.000	-47.31	15.00	-200.0	-480.0	-0.007989
	8.000	2.000	15.000	-47.24	15.00	-200.0	-480.0	-0.007989
	8.000	4.000	15.000	-47.02	15.00	-200.0	-480.0	-0.007989
	8.000	6.000	15.000	-46.60	15.00	-200.0	-480.0	-0.007989
	8.000	8.000	15.000	-45.84	15.00	-200.0	-480.0	-0.007989
	8.000	10.000	15.000	-44.47	15.00	-200.0	-480.0	-0.007989
	8.000	12.000	15.000	-41.68	15.00	-200.0	-480.0	-0.007989
	8.000	14.000	15.000	-34.67	15.00	-200.0	-480.0	-0.007989
	8.000	16.000	15.000	-11.60	15.00	0.0	-0.02099	0.0
	8.000	18.000	15.000	-4.860	15.00	0.0	-0.005564	0.0
	8.000	20.000	15.000	-2.971	15.00	0.0	-0.002752	0.0
	8.000	22.000	15.000	-1.966	15.00	0.0	-0.001667	0.0
	8.000	24.000	15.000	-1.359	15.00	0.0	-0.001120	0.0
	8.000	26.000	15.000	-0.9691	15.00	0.0	-802.7E-6	0.0
	8.000	28.000	15.000	-0.7037	15.00	0.0	-601.0E-6	0.0
	8.000	30.000	15.000	-0.5148	15.00	0.0	-464.5E-6	0.0
	8.000	32.000	15.000	-0.3765	15.00	0.0		



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Stresses		
	X [m]	Y [m]				Vert Stress [kN/m ²]	Sum Princ [kN/m ²]	Vert Strain [-]
	10.000	22.000	15.000	-1.731	15.00	0.0	-0.001506	0.0
	10.000	24.000	15.000	-1.212	15.00	0.0	-0.001024	0.0
	10.000	26.000	15.000	-0.8734	15.00	0.0	-741.6E-6	0.0
	10.000	28.000	15.000	-0.6391	15.00	0.0	-560.4E-6	0.0
	10.000	30.000	15.000	-0.4702	15.00	0.0	-436.6E-6	0.0
	10.000	32.000	15.000	-0.3450	15.00	0.0	-348.3E-6	0.0
	10.000	34.000	15.000	-0.2508	15.00	0.0	-283.1E-6	0.0
	10.000	36.000	15.000	-0.1791	15.00	0.0	-233.6E-6	0.0
	10.000	38.000	15.000	-0.1242	15.00	0.0	-195.3E-6	0.0
	10.000	40.000	15.000	-0.08222	15.00	0.0	-165.1E-6	0.0
	12.000	-40.000	15.000	-0.07255	15.00	0.0	-158.1E-6	0.0
	12.000	-38.000	15.000	-0.1110	15.00	0.0	-186.2E-6	0.0
	12.000	-36.000	15.000	-0.1609	15.00	0.0	-221.5E-6	0.0
	12.000	-34.000	15.000	-0.2256	15.00	0.0	-266.8E-6	0.0
	12.000	-32.000	15.000	-0.3099	15.00	0.0	-325.8E-6	0.0
	12.000	-30.000	15.000	-0.4205	15.00	0.0	-404.9E-6	0.0
	12.000	-28.000	15.000	-0.5675	15.00	0.0	-514.0E-6	0.0
	12.000	-26.000	15.000	-0.7670	15.00	0.0	-671.2E-6	0.0
	12.000	-24.000	15.000	-1.047	15.00	0.0	-910.9E-6	0.0
	12.000	-22.000	15.000	-1.457	15.00	0.0	-0.001310	0.0
	12.000	-20.000	15.000	-2.076	15.00	0.0	-0.002077	0.0
	12.000	-18.000	15.000	-3.135	15.00	0.0	-0.004044	0.0
	12.000	-16.000	15.000	-7.949	15.00	0.0	-0.01625	0.0
	12.000	-14.000	15.000	-27.69	15.00	-200.0	-480.0	-0.007989
	12.000	-12.000	15.000	-32.77	15.00	-200.0	-480.0	-0.007989
	12.000	-10.000	15.000	-34.70	15.00	-200.0	-480.0	-0.007989
	12.000	-8.000	15.000	-35.68	15.00	-200.0	-480.0	-0.007989
	12.000	-6.000	15.000	-36.23	15.00	-200.0	-480.0	-0.007989
	12.000	-4.000	15.000	-36.54	15.00	-200.0	-480.0	-0.007989
	12.000	-2.000	15.000	-36.71	15.00	-200.0	-480.0	-0.007989
	12.000	0.000	15.000	-36.76	15.00	-200.0	-480.0	-0.007989
	12.000	2.000	15.000	-36.71	15.00	-200.0	-480.0	-0.007989
	12.000	4.000	15.000	-36.54	15.00	-200.0	-480.0	-0.007989
	12.000	6.000	15.000	-36.23	15.00	-200.0	-480.0	-0.007989
	12.000	8.000	15.000	-35.68	15.00	-200.0	-480.0	-0.007989
	12.000	10.000	15.000	-34.70	15.00	-200.0	-480.0	-0.007989
	12.000	12.000	15.000	-32.77	15.00	-200.0	-480.0	-0.007989
	12.000	14.000	15.000	-27.69	15.00	-200.0	-480.0	-0.007989
	12.000	16.000	15.000	-7.949	15.00	0.0	-0.01625	0.0
	12.000	18.000	15.000	-3.135	15.00	0.0	-0.004044	0.0
	12.000	20.000	15.000	-2.076	15.00	0.0	-0.002077	0.0
	12.000	22.000	15.000	-1.457	15.00	0.0	-0.001310	0.0
	12.000	24.000	15.000	-1.047	15.00	0.0	-910.9E-6	0.0
	12.000	26.000	15.000	-0.7670	15.00	0.0	-671.2E-6	0.0
	12.000	28.000	15.000	-0.5675	15.00	0.0	-514.0E-6	0.0
	12.000	30.000	15.000	-0.4205	15.00	0.0	-404.9E-6	0.0
	12.000	32.000	15.000	-0.3099	15.00	0.0	-325.8E-6	0.0
	12.000	34.000	15.000	-0.2256	15.00	0.0	-266.8E-6	0.0
	12.000	36.000	15.000	-0.1609	15.00	0.0	-221.5E-6	0.0
	12.000	38.000	15.000	-0.1110	15.00	0.0	-186.2E-6	0.0
	12.000	40.000	15.000	-0.07255	15.00	0.0	-158.1E-6	0.0
	14.000	-40.000	15.000	-0.06210	15.00	0.0	-150.5E-6	0.0
	14.000	-38.000	15.000	-0.09672	15.00	0.0	-176.2E-6	0.0
	14.000	-36.000	15.000	-0.1413	15.00	0.0	-208.4E-6	0.0
	14.000	-34.000	15.000	-0.1908	15.00	0.0	-249.1E-6	0.0
	14.000	-32.000	15.000	-0.2728	15.00	0.0	-301.6E-6	0.0
	14.000	-30.000	15.000	-0.3685	15.00	0.0	-370.8E-6	0.0
	14.000	-28.000	15.000	-0.4932	15.00	0.0	-464.5E-6	0.0
	14.000	-26.000	15.000	-0.6577	15.00	0.0	-596.0E-6	0.0
	14.000	-24.000	15.000	-0.8785	15.00	0.0	-789.8E-6	0.0
	14.000	-22.000	15.000	-1.178	15.00	0.0	-0.001096	0.0
	14.000	-20.000	15.000	-1.556	15.00	0.0	-0.001636	0.0
	14.000	-18.000	15.000	-1.962	15.00	0.0	-0.002788	0.0
	14.000	-16.000	15.000	-4.155	15.00	0.0	-0.006412	0.0
	14.000	-14.000	15.000	-7.958	15.00	0.0	-0.01626	0.0
	14.000	-12.000	15.000	-10.39	15.00	0.0	-0.01987	0.0
	14.000	-10.000	15.000	-11.64	15.00	0.0	-0.02101	0.0
	14.000	-8.000	15.000	-12.35	15.00	0.0	-0.02154	0.0
	14.000	-6.000	15.000	-12.77	15.00	0.0	-0.02182	0.0
	14.000	-4.000	15.000	-13.02	15.00	0.0	-0.02197	0.0
	14.000	-2.000	15.000	-13.16	15.00	0.0	-0.02205	0.0
	14.000	0.000	15.000	-13.20	15.00	0.0	-0.02208	0.0
	14.000	2.000	15.000	-13.16	15.00	0.0	-0.02205	0.0
	14.000	4.000	15.000	-13.02	15.00	0.0	-0.02197	0.0
	14.000	6.000	15.000	-12.77	15.00	0.0	-0.02182	0.0
	14.000	8.000	15.000	-12.35	15.00	0.0	-0.02154	0.0
	14.000	10.000	15.000	-11.64	15.00	0.0	-0.02101	0.0
	14.000	12.000	15.000	-10.39	15.00	0.0	-0.01987	0.0
	14.000	14.000	15.000	-7.958	15.00	0.0	-0.01626	0.0
	14.000	16.000	15.000	-4.155	15.00	0.0	-0.006412	0.0
	14.000	18.000	15.000	-1.962	15.00	0.0	-0.002788	0.0
	14.000	20.000	15.000	-1.556	15.00	0.0	-0.001636	0.0
	14.000	22.000	15.000	-1.178	15.00	0.0	-0.001096	0.0
	14.000	24.000	15.000	-0.8785	15.00	0.0	-789.8E-6	0.0
	14.000	26.000	15.000	-0.6577	15.00	0.0	-596.0E-6	0.0
	14.000	28.000	15.000	-0.4932	15.00	0.0	-464.5E-6	0.0
	14.000	30.000	15.000	-0.3685	15.00	0.0	-370.8E-6	0.0
	14.000	32.000	15.000	-0.2728	15.00	0.0	-301.6E-6	0.0
	14.000	34.000	15.000	-0.1908	15.00	0.0	-249.1E-6	0.0
	14.000	36.000	15.000	-0.1413	15.00	0.0	-208.4E-6	0.0
	14.000	38.000	15.000	-0.09672	15.00	0.0	-176.2E-6	0.0
	14.000	40.000	15.000	-0.06210	15.00	0.0	-150.5E-6	0.0
	16.000	-40.000	15.000	-0.05123	15.00	0.0	-142.3E-6	0.0
	16.000	-38.000	15.000	-0.08196	15.00	0.0	-165.7E-6	0.0
	16.000	-36.000	15.000	-0.1213	15.00	0.0	-194.5E-6	0.0
	16.000	-34.000	15.000	-0.1714	15.00	0.0	-230.7E-6	0.0
	16.000	-32.000	15.000	-0.2353	15.00	0.0	-276.5E-6	0.0
	16.000	-30.000	15.000	-0.3166	15.00	0.0	-335.9E-6	0.0
	16.000	-28.000	15.000	-0.4204	15.00	0.0	-414.4E-6	0.0
	16.000	-26.000	15.000	-0.5532	15.00	0.0	-521.1E-6	0.0
	16.000	-24.000	15.000	-0.7233	15.00	0.0	-671.5E-6	0.0
	16.000	-22.000	15.000	-0.9362	15.00	0.0	-893.2E-6	0.0
	16.000	-20.000	15.000	-1.147	15.00	0.0	-0.001240	0.0
	16.000	-18.000	15.000	-1.122	15.00	0.0	-0.001818	0.0
	16.000	-16.000	15.000	-1.968	15.00	0.0	-0.002792	0.0
	16.000	-14.000	15.000	-3.149	15.00	0.0	-0.004052	0.0
	16.000	-12.000	15.000	-4.184	15.00	0.0	-0.005020	0.0
	16.000	-10.000	15.000	-4.993	15.00	0.0	-0.005588	0.0
	16.000	-8.000	15.000	-5.375	15.00	0.0	-0.005918	0.0
	16.000	-6.000	15.000	-5.681	15.00	0.0	-0.006115	0.0
	16.000	-4.000	15.000	-5.872	15.00	0.0	-0.006233	0.0
	16.000	-2.000	15.000	-5.977	15.00	0.0	-0.006296	0.0
	16.000	0.000	15.000	-6.019	15.00	0.0	-0.006316	0.0
	16.000	2.000	15.000	-5.977	15.00	0.0	-0.006296	0.0
	16.000	4.000	15.000	-5.872	15.00	0.0	-0.006233	0.0
	16.000	6.000	15.000	-5.681	15.00	0.0	-0.006115	0.0
	16.000	8.000	15.000	-5.375	15.00	0.0	-0.005918	0.0
	16.000	10.000	15.000	-4.993	15.00	0.0	-0.005588	



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Stresses					
	X	Y	Z[Level]	Z	Calc Level	Vert Stress	Sum Princ	Vert Strain
	[m]	[m]	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[-]
	18.000	-24.000	15.000	-0.5900	15.00	0.0	-564.3E-6	0.0
	18.000	-22.000	15.000	-0.7491	15.00	0.0	-720.2E-6	0.0
	18.000	-20.000	15.000	-0.9272	15.00	0.0	-938.0E-6	0.0
	18.000	-18.000	15.000	-1.150	15.00	0.0	-0.001242	0.0
	18.000	-16.000	15.000	-1.565	15.00	0.0	-0.001641	0.0
	18.000	-14.000	15.000	-2.093	15.00	0.0	-0.002087	0.0
	18.000	-12.000	15.000	-2.601	15.00	0.0	-0.002481	0.0
	18.000	-10.000	15.000	-3.013	15.00	0.0	-0.002776	0.0
	18.000	-8.000	15.000	-3.318	15.00	0.0	-0.002979	0.0
	18.000	-6.000	15.000	-3.532	15.00	0.0	-0.003114	0.0
	18.000	-4.000	15.000	-3.672	15.00	0.0	-0.003199	0.0
	18.000	-2.000	15.000	-3.751	15.00	0.0	-0.003246	0.0
	18.000	0.000	15.000	-3.777	15.00	0.0	-0.003261	0.0
	18.000	2.000	15.000	-3.751	15.00	0.0	-0.003246	0.0
	18.000	4.000	15.000	-3.672	15.00	0.0	-0.003199	0.0
	18.000	6.000	15.000	-3.532	15.00	0.0	-0.003114	0.0
	18.000	8.000	15.000	-3.318	15.00	0.0	-0.002979	0.0
	18.000	10.000	15.000	-3.013	15.00	0.0	-0.002776	0.0
	18.000	12.000	15.000	-2.601	15.00	0.0	-0.002481	0.0
	18.000	14.000	15.000	-2.093	15.00	0.0	-0.002087	0.0
	18.000	16.000	15.000	-1.565	15.00	0.0	-0.001641	0.0
	18.000	18.000	15.000	-1.150	15.00	0.0	-0.001242	0.0
	18.000	20.000	15.000	-0.9272	15.00	0.0	-938.0E-6	0.0
	18.000	22.000	15.000	-0.7491	15.00	0.0	-720.2E-6	0.0
	18.000	24.000	15.000	-0.5900	15.00	0.0	-564.3E-6	0.0
	18.000	26.000	15.000	-0.4585	15.00	0.0	-450.8E-6	0.0
	18.000	28.000	15.000	-0.3523	15.00	0.0	-366.1E-6	0.0
	18.000	30.000	15.000	-0.2670	15.00	0.0	-301.6E-6	0.0
	18.000	32.000	15.000	-0.1989	15.00	0.0	-251.6E-6	0.0
	18.000	34.000	15.000	-0.1445	15.00	0.0	-212.1E-6	0.0
	18.000	36.000	15.000	-0.1014	15.00	0.0	-180.4E-6	0.0
	18.000	38.000	15.000	-0.06719	15.00	0.0	-154.8E-6	0.0
	18.000	40.000	15.000	-0.04029	15.00	0.0	-133.8E-6	0.0
	20.000	-40.000	15.000	-0.02957	15.00	0.0	-125.2E-6	0.0
	20.000	-38.000	15.000	-0.05280	15.00	0.0	-143.9E-6	0.0
	20.000	-36.000	15.000	-0.08210	15.00	0.0	-166.4E-6	0.0
	20.000	-34.000	15.000	-0.1188	15.00	0.0	-193.9E-6	0.0
	20.000	-32.000	15.000	-0.1645	15.00	0.0	-227.5E-6	0.0
	20.000	-30.000	15.000	-0.2209	15.00	0.0	-269.2E-6	0.0
	20.000	-28.000	15.000	-0.2904	15.00	0.0	-321.5E-6	0.0
	20.000	-26.000	15.000	-0.3753	15.00	0.0	-387.7E-6	0.0
	20.000	-24.000	15.000	-0.4782	15.00	0.0	-472.5E-6	0.0
	20.000	-22.000	15.000	-0.6019	15.00	0.0	-581.7E-6	0.0
	20.000	-20.000	15.000	-0.7515	15.00	0.0	-721.7E-6	0.0
	20.000	-18.000	15.000	-0.9420	15.00	0.0	-896.9E-6	0.0
	20.000	-16.000	15.000	-1.189	15.00	0.0	-0.001103	0.0
	20.000	-14.000	15.000	-1.475	15.00	0.0	-0.001320	0.0
	20.000	-12.000	15.000	-1.758	15.00	0.0	-0.001522	0.0
	20.000	-10.000	15.000	-2.005	15.00	0.0	-0.001689	0.0
	20.000	-8.000	15.000	-2.203	15.00	0.0	-0.001816	0.0
	20.000	-6.000	15.000	-2.351	15.00	0.0	-0.001907	0.0
	20.000	-4.000	15.000	-2.452	15.00	0.0	-0.001967	0.0
	20.000	-2.000	15.000	-2.510	15.00	0.0	-0.002002	0.0
	20.000	0.000	15.000	-2.529	15.00	0.0	-0.002013	0.0
	20.000	2.000	15.000	-2.510	15.00	0.0	-0.002002	0.0
	20.000	4.000	15.000	-2.452	15.00	0.0	-0.001967	0.0
	20.000	6.000	15.000	-2.351	15.00	0.0	-0.001907	0.0
	20.000	8.000	15.000	-2.203	15.00	0.0	-0.001816	0.0
	20.000	10.000	15.000	-2.005	15.00	0.0	-0.001689	0.0
	20.000	12.000	15.000	-1.758	15.00	0.0	-0.001522	0.0
	20.000	14.000	15.000	-1.475	15.00	0.0	-0.001320	0.0
	20.000	16.000	15.000	-1.189	15.00	0.0	-0.001103	0.0
	20.000	18.000	15.000	-0.9420	15.00	0.0	-896.9E-6	0.0
	20.000	20.000	15.000	-0.7515	15.00	0.0	-721.7E-6	0.0
	20.000	22.000	15.000	-0.6019	15.00	0.0	-581.7E-6	0.0
	20.000	24.000	15.000	-0.4782	15.00	0.0	-472.5E-6	0.0
	20.000	26.000	15.000	-0.3753	15.00	0.0	-387.7E-6	0.0
	20.000	28.000	15.000	-0.2904	15.00	0.0	-321.5E-6	0.0
	20.000	30.000	15.000	-0.2209	15.00	0.0	-269.2E-6	0.0
	20.000	32.000	15.000	-0.1645	15.00	0.0	-227.5E-6	0.0
	20.000	34.000	15.000	-0.1188	15.00	0.0	-193.9E-6	0.0
	20.000	36.000	15.000	-0.08210	15.00	0.0	-166.4E-6	0.0
	20.000	38.000	15.000	-0.05280	15.00	0.0	-143.9E-6	0.0
	20.000	40.000	15.000	-0.02957	15.00	0.0	-125.2E-6	0.0
	22.000	-40.000	15.000	-0.01932	15.00	0.0	-116.7E-6	0.0
	22.000	-38.000	15.000	-0.03914	15.00	0.0	-133.2E-6	0.0
	22.000	-36.000	15.000	-0.06396	15.00	0.0	-152.9E-6	0.0
	22.000	-34.000	15.000	-0.09478	15.00	0.0	-176.4E-6	0.0
	22.000	-32.000	15.000	-0.1328	15.00	0.0	-204.8E-6	0.0
	22.000	-30.000	15.000	-0.1792	15.00	0.0	-239.3E-6	0.0
	22.000	-28.000	15.000	-0.2354	15.00	0.0	-281.3E-6	0.0
	22.000	-26.000	15.000	-0.3031	15.00	0.0	-332.9E-6	0.0
	22.000	-24.000	15.000	-0.3838	15.00	0.0	-396.2E-6	0.0
	22.000	-22.000	15.000	-0.4797	15.00	0.0	-473.6E-6	0.0
	22.000	-20.000	15.000	-0.5938	15.00	0.0	-567.9E-6	0.0
	22.000	-18.000	15.000	-0.7303	15.00	0.0	-676.1E-6	0.0
	22.000	-16.000	15.000	-0.8899	15.00	0.0	-797.1E-6	0.0
	22.000	-14.000	15.000	-1.064	15.00	0.0	-921.6E-6	0.0
	22.000	-12.000	15.000	-1.237	15.00	0.0	-0.001039	0.0
	22.000	-10.000	15.000	-1.394	15.00	0.0	-0.001141	0.0
	22.000	-8.000	15.000	-1.525	15.00	0.0	-0.001223	0.0
	22.000	-6.000	15.000	-1.627	15.00	0.0	-0.001285	0.0
	22.000	-4.000	15.000	-1.699	15.00	0.0	-0.001327	0.0
	22.000	-2.000	15.000	-1.741	15.00	0.0	-0.001352	0.0
	22.000	0.000	15.000	-1.755	15.00	0.0	-0.001360	0.0
	22.000	2.000	15.000	-1.741	15.00	0.0	-0.001352	0.0
	22.000	4.000	15.000	-1.699	15.00	0.0	-0.001327	0.0
	22.000	6.000	15.000	-1.627	15.00	0.0	-0.001285	0.0
	22.000	8.000	15.000	-1.525	15.00	0.0	-0.001223	0.0
	22.000	10.000	15.000	-1.394	15.00	0.0	-0.001141	0.0
	22.000	12.000	15.000	-1.237	15.00	0.0	-0.001039	0.0
	22.000	14.000	15.000	-1.064	15.00	0.0	-921.6E-6	0.0
	22.000	16.000	15.000	-0.8899	15.00	0.0	-797.1E-6	0.0
	22.000	18.000	15.000	-0.7303	15.00	0.0	-676.1E-6	0.0
	22.000	20.000	15.000	-0.5938	15.00	0.0	-567.9E-6	0.0
	22.000	22.000	15.000	-0				



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Z[Level]	Z	Calc Level	Stresses		Vert Strain
	X	Y	[mOD]	[mm]	[mOD]	Vert Stress	Sum Princ	[-]
	[m]	[m]				[kN/m²]	[kN/m²]	
	24.000	12.000	15.000	-0.8961	15.00	0.0	-755.8E-6	0.0
	24.000	14.000	15.000	-0.7832	15.00	0.0	-681.6E-6	0.0
	24.000	16.000	15.000	-0.6689	15.00	0.0	-603.5E-6	0.0
	24.000	18.000	15.000	-0.5606	15.00	0.0	-526.2E-6	0.0
	24.000	20.000	15.000	-0.4631	15.00	0.0	-454.1E-6	0.0
	24.000	22.000	15.000	-0.3777	15.00	0.0	-389.6E-6	0.0
	24.000	24.000	15.000	-0.3040	15.00	0.0	-333.7E-6	0.0
	24.000	26.000	15.000	-0.2409	15.00	0.0	-286.1E-6	0.0
	24.000	28.000	15.000	-0.1872	15.00	0.0	-245.9E-6	0.0
	24.000	30.000	15.000	-0.1419	15.00	0.0	-212.2E-6	0.0
	24.000	32.000	15.000	-0.1041	15.00	0.0	-183.9E-6	0.0
	24.000	34.000	15.000	-0.07284	15.00	0.0	-160.0E-6	0.0
	24.000	36.000	15.000	-0.04723	15.00	0.0	-139.9E-6	0.0
	24.000	38.000	15.000	-0.02645	15.00	0.0	-122.9E-6	0.0
	24.000	40.000	15.000	-0.009747	15.00	0.0	-108.4E-6	0.0
	26.000	-40.000	15.000	-974.7E-6	15.00	0.0	-109.4E-6	0.0
	26.000	-38.000	15.000	-0.01488	15.00	0.0	-113.1E-6	0.0
	26.000	-36.000	15.000	-0.03209	15.00	0.0	-127.8E-6	0.0
	26.000	-34.000	15.000	-0.05315	15.00	0.0	-144.9E-6	0.0
	26.000	-32.000	15.000	-0.07865	15.00	0.0	-164.8E-6	0.0
	26.000	-30.000	15.000	-0.1092	15.00	0.0	-188.1E-6	0.0
	26.000	-28.000	15.000	-0.1454	15.00	0.0	-215.1E-6	0.0
	26.000	-26.000	15.000	-0.1878	15.00	0.0	-246.5E-6	0.0
	26.000	-24.000	15.000	-0.2370	15.00	0.0	-282.7E-6	0.0
	26.000	-22.000	15.000	-0.2933	15.00	0.0	-323.9E-6	0.0
	26.000	-20.000	15.000	-0.3570	15.00	0.0	-369.8E-6	0.0
	26.000	-18.000	15.000	-0.4276	15.00	0.0	-419.7E-6	0.0
	26.000	-16.000	15.000	-0.5037	15.00	0.0	-471.9E-6	0.0
	26.000	-14.000	15.000	-0.5822	15.00	0.0	-524.0E-6	0.0
	26.000	-12.000	15.000	-0.6592	15.00	0.0	-573.5E-6	0.0
	26.000	-10.000	15.000	-0.7304	15.00	0.0	-618.0E-6	0.0
	26.000	-8.000	15.000	-0.7922	15.00	0.0	-655.6E-6	0.0
	26.000	-6.000	15.000	-0.8421	15.00	0.0	-685.4E-6	0.0
	26.000	-4.000	15.000	-0.8785	15.00	0.0	-706.9E-6	0.0
	26.000	-2.000	15.000	-0.9006	15.00	0.0	-719.7E-6	0.0
	26.000	0.000	15.000	-0.9080	15.00	0.0	-724.0E-6	0.0
	26.000	2.000	15.000	-0.9006	15.00	0.0	-719.7E-6	0.0
	26.000	4.000	15.000	-0.8785	15.00	0.0	-706.9E-6	0.0
	26.000	6.000	15.000	-0.8421	15.00	0.0	-685.4E-6	0.0
	26.000	8.000	15.000	-0.8002	15.00	0.0	-655.6E-6	0.0
	26.000	10.000	15.000	-0.7304	15.00	0.0	-618.0E-6	0.0
	26.000	12.000	15.000	-0.6592	15.00	0.0	-573.5E-6	0.0
	26.000	14.000	15.000	-0.5822	15.00	0.0	-524.0E-6	0.0
	26.000	16.000	15.000	-0.5037	15.00	0.0	-471.9E-6	0.0
	26.000	18.000	15.000	-0.4276	15.00	0.0	-419.7E-6	0.0
	26.000	20.000	15.000	-0.3570	15.00	0.0	-369.8E-6	0.0
	26.000	22.000	15.000	-0.2933	15.00	0.0	-323.9E-6	0.0
	26.000	24.000	15.000	-0.2370	15.00	0.0	-282.7E-6	0.0
	26.000	26.000	15.000	-0.1878	15.00	0.0	-246.5E-6	0.0
	26.000	28.000	15.000	-0.1454	15.00	0.0	-215.1E-6	0.0
	26.000	30.000	15.000	-0.1092	15.00	0.0	-188.1E-6	0.0
	26.000	32.000	15.000	-0.07865	15.00	0.0	-164.8E-6	0.0
	26.000	34.000	15.000	-0.05315	15.00	0.0	-144.9E-6	0.0
	26.000	36.000	15.000	-0.03209	15.00	0.0	-127.8E-6	0.0
	26.000	38.000	15.000	-0.01488	15.00	0.0	-113.1E-6	0.0
	26.000	40.000	15.000	-974.7E-6	15.00	0.0	-108.4E-6	0.0
	28.000	-40.000	15.000	0.006911	15.00	0.0	-92.80E-6	0.0
	28.000	-38.000	15.000	-0.004530	15.00	0.0	-103.8E-6	0.0
	28.000	-36.000	15.000	-0.01862	15.00	0.0	-116.5E-6	0.0
	28.000	-34.000	15.000	-0.03577	15.00	0.0	-131.0E-6	0.0
	28.000	-32.000	15.000	-0.05637	15.00	0.0	-147.6E-6	0.0
	28.000	-30.000	15.000	-0.08085	15.00	0.0	-166.7E-6	0.0
	28.000	-28.000	15.000	-0.1096	15.00	0.0	-188.5E-6	0.0
	28.000	-26.000	15.000	-0.1429	15.00	0.0	-213.2E-6	0.0
	28.000	-24.000	15.000	-0.1810	15.00	0.0	-241.0E-6	0.0
	28.000	-22.000	15.000	-0.2240	15.00	0.0	-271.9E-6	0.0
	28.000	-20.000	15.000	-0.2716	15.00	0.0	-305.5E-6	0.0
	28.000	-18.000	15.000	-0.3234	15.00	0.0	-341.2E-6	0.0
	28.000	-16.000	15.000	-0.3780	15.00	0.0	-377.9E-6	0.0
	28.000	-14.000	15.000	-0.4335	15.00	0.0	-414.2E-6	0.0
	28.000	-12.000	15.000	-0.4875	15.00	0.0	-448.6E-6	0.0
	28.000	-10.000	15.000	-0.5374	15.00	0.0	-479.7E-6	0.0
	28.000	-8.000	15.000	-0.5811	15.00	0.0	-506.2E-6	0.0
	28.000	-6.000	15.000	-0.6166	15.00	0.0	-527.5E-6	0.0
	28.000	-4.000	15.000	-0.6427	15.00	0.0	-542.9E-6	0.0
	28.000	-2.000	15.000	-0.6586	15.00	0.0	-552.3E-6	0.0
	28.000	0.000	15.000	-0.6639	15.00	0.0	-555.4E-6	0.0
	28.000	2.000	15.000	-0.6586	15.00	0.0	-552.3E-6	0.0
	28.000	4.000	15.000	-0.6427	15.00	0.0	-542.9E-6	0.0
	28.000	6.000	15.000	-0.6166	15.00	0.0	-527.5E-6	0.0
	28.000	8.000	15.000	-0.5811	15.00	0.0	-506.2E-6	0.0
	28.000	10.000	15.000	-0.5374	15.00	0.0	-479.7E-6	0.0
	28.000	12.000	15.000	-0.4875	15.00	0.0	-448.6E-6	0.0
	28.000	14.000	15.000	-0.4335	15.00	0.0	-414.2E-6	0.0
	28.000	16.000	15.000	-0.3780	15.00	0.0	-377.9E-6	0.0
	28.000	18.000	15.000	-0.3234	15.00	0.0	-341.2E-6	0.0
	28.000	20.000	15.000	-0.2716	15.00	0.0	-305.5E-6	0.0
	28.000	22.000	15.000	-0.2240	15.00	0.0	-271.9E-6	0.0
	28.000	24.000	15.000	-0.1810	15.00	0.0	-241.0E-6	0.0
	28.000	26.000	15.000	-0.1429	15.00	0.0	-213.2E-6	0.0
	28.000	28.000	15.000	-0.1096	15.00	0.0	-188.5E-6	0.0
	28.000	30.000	15.000	-0.08085	15.00	0.0	-166.7E-6	0.0
	28.000	32.000	15.000	-0.05637	15.00	0.0	-147.6E-6	0.0
	28.000	34.000	15.000	-0.03577	15.00	0.0	-131.0E-6	0.0
	28.000	36.000	15.000	-0.01862	15.00	0.0	-116.5E-6	0.0
	28.000	38.000	15.000	-0.004530	15.00	0.0	-103.8E-6	0.0
	28.000	40.000	15.000	0.006911	15.00	0.0	-92.80E-6	0.0
	30.000	-40.000	15.000	0.01387	15.00	0.0	-85.64E-6	0.0
	30.000	-38.000	15.000	0.004576	15.00	0.0	-95.23E-6	0.0
	30.000	-36.000	15.000	-0.006834	15.00	0.0	-106.1E-6	0.0
	30.000	-34.000	15.000	-0.02065	15.00	0.0	-118.4E-6	0.0
	30.000	-32.000	15.000	-0.03715	15.00	0.0	-132.3E-6	0.0
	30.000	-30.000	15.000	-0.05660	15.00	0.0	-148.0E-6	0.0
	30.000	-28.000	15.000	-0.07925	15.00	0.0	-165.6E-6	0.0
	30.000	-26.000	15.000	-0.1052	15.00	0.0	-185.2E-6	0.0
	30.000	-24.000	15.000	-0.1346	15.00	0.0	-206.8E-6	0.0
	30.000	-22.000	15.000	-0.1674	15.00	0.0	-230.4E-6	0.0
	30.000	-20.000	15.000	-0.2032	15.00	0.0	-255.5E-6	0.0
	30.000	-18.000	15.000	-0.2414	15.00	0.0	-281.7E-6	0.0
	30.000	-16.000	15.000	-0.2811	15.00	0.0	-308.3E-6	0.0
	30.000	-14.000	15.000	-0.3211	15.00	0.0	-334.4E-6	0.0
	30.000	-12.000	15.000	-0.3597	15.00	0.0	-359.1E-6	0.0
	30.000	-10.000	15.000	-0.3953	15.00	0.0	-381.4E-6	0.0
	30.000	-8.000	15.000	-0.4205	15.00	0.0	-400.5E-6	0.0
	30.000	-6.000	15.000	-0.4520	15.00	0.0	-416.0E-6	0.0
	30.000	-4.000	15.000	-0.4708	15.00	0.0	-427.2E-6	0.0
	30.000	-2.000	15.000	-0.4824	15.00	0.0	-434.1E-6	0.0



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	Location		Stresses			Vert Strain		
	X	Y	Z[Level]	Z	Calc Level	Vert Stress	Sum Princ	Vert Strain
	[m]	[m]	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[-]
	32.000	-34.000	15.000	-0.007689	15.00	0.0	-107.0E-6	0.0
	32.000	-32.000	15.000	-0.02078	15.00	0.0	-118.7E-6	0.0
	32.000	-30.000	15.000	-0.03611	15.00	0.0	-131.6E-6	0.0
	32.000	-28.000	15.000	-0.05383	15.00	0.0	-145.9E-6	0.0
	32.000	-26.000	15.000	-0.07400	15.00	0.0	-161.6E-6	0.0
	32.000	-24.000	15.000	-0.09659	15.00	0.0	-178.6E-6	0.0
	32.000	-22.000	15.000	-0.1215	15.00	0.0	-196.8E-6	0.0
	32.000	-20.000	15.000	-0.1484	15.00	0.0	-215.9E-6	0.0
	32.000	-18.000	15.000	-0.1767	15.00	0.0	-235.6E-6	0.0
	32.000	-16.000	15.000	-0.2069	15.00	0.0	-255.4E-6	0.0
	32.000	-14.000	15.000	-0.2350	15.00	0.0	-274.6E-6	0.0
	32.000	-12.000	15.000	-0.2630	15.00	0.0	-292.7E-6	0.0
	32.000	-10.000	15.000	-0.2887	15.00	0.0	-309.1E-6	0.0
	32.000	-8.000	15.000	-0.3112	15.00	0.0	-323.2E-6	0.0
	32.000	-6.000	15.000	-0.3297	15.00	0.0	-334.6E-6	0.0
	32.000	-4.000	15.000	-0.3433	15.00	0.0	-342.9E-6	0.0
	32.000	-2.000	15.000	-0.3517	15.00	0.0	-348.0E-6	0.0
	32.000	0.000	15.000	-0.3545	15.00	0.0	-349.7E-6	0.0
	32.000	2.000	15.000	-0.3517	15.00	0.0	-348.0E-6	0.0
	32.000	4.000	15.000	-0.3433	15.00	0.0	-342.9E-6	0.0
	32.000	6.000	15.000	-0.3297	15.00	0.0	-334.6E-6	0.0
	32.000	8.000	15.000	-0.3112	15.00	0.0	-323.2E-6	0.0
	32.000	10.000	15.000	-0.2887	15.00	0.0	-309.1E-6	0.0
	32.000	12.000	15.000	-0.2630	15.00	0.0	-292.7E-6	0.0
	32.000	14.000	15.000	-0.2350	15.00	0.0	-274.6E-6	0.0
	32.000	16.000	15.000	-0.2069	15.00	0.0	-255.4E-6	0.0
	32.000	18.000	15.000	-0.1767	15.00	0.0	-235.6E-6	0.0
	32.000	20.000	15.000	-0.1484	15.00	0.0	-215.9E-6	0.0
	32.000	22.000	15.000	-0.1215	15.00	0.0	-196.8E-6	0.0
	32.000	24.000	15.000	-0.09659	15.00	0.0	-178.6E-6	0.0
	32.000	26.000	15.000	-0.07400	15.00	0.0	-161.6E-6	0.0
	32.000	28.000	15.000	-0.05383	15.00	0.0	-145.9E-6	0.0
	32.000	30.000	15.000	-0.03611	15.00	0.0	-131.6E-6	0.0
	32.000	32.000	15.000	-0.02078	15.00	0.0	-118.7E-6	0.0
	32.000	34.000	15.000	-0.007689	15.00	0.0	-107.0E-6	0.0
	32.000	36.000	15.000	0.003322	15.00	0.0	-96.59E-6	0.0
	32.000	38.000	15.000	0.01245	15.00	0.0	-87.27E-6	0.0
	32.000	40.000	15.000	0.01990	15.00	0.0	-78.96E-6	0.0
	34.000	-40.000	15.000	0.02504	15.00	0.0	-72.75E-6	0.0
	34.000	-38.000	15.000	0.01915	15.00	0.0	-79.95E-6	0.0
	34.000	-36.000	15.000	0.01194	15.00	0.0	-87.95E-6	0.0
	34.000	-34.000	15.000	0.003258	15.00	0.0	-96.79E-6	0.0
	34.000	-32.000	15.000	-0.007018	15.00	0.0	-106.6E-6	0.0
	34.000	-30.000	15.000	-0.01990	15.00	0.0	-117.3E-6	0.0
	34.000	-28.000	15.000	-0.03276	15.00	0.0	-128.9E-6	0.0
	34.000	-26.000	15.000	-0.04831	15.00	0.0	-141.6E-6	0.0
	34.000	-24.000	15.000	-0.06560	15.00	0.0	-155.1E-6	0.0
	34.000	-22.000	15.000	-0.08447	15.00	0.0	-169.4E-6	0.0
	34.000	-20.000	15.000	-0.1047	15.00	0.0	-184.2E-6	0.0
	34.000	-18.000	15.000	-0.1258	15.00	0.0	-199.2E-6	0.0
	34.000	-16.000	15.000	-0.1474	15.00	0.0	-214.2E-6	0.0
	34.000	-14.000	15.000	-0.1687	15.00	0.0	-228.7E-6	0.0
	34.000	-12.000	15.000	-0.1891	15.00	0.0	-242.2E-6	0.0
	34.000	-10.000	15.000	-0.2078	15.00	0.0	-254.5E-6	0.0
	34.000	-8.000	15.000	-0.2242	15.00	0.0	-265.0E-6	0.0
	34.000	-6.000	15.000	-0.2376	15.00	0.0	-273.5E-6	0.0
	34.000	-4.000	15.000	-0.2475	15.00	0.0	-279.8E-6	0.0
	34.000	-2.000	15.000	-0.2536	15.00	0.0	-283.6E-6	0.0
	34.000	0.000	15.000	-0.2557	15.00	0.0	-284.9E-6	0.0
	34.000	2.000	15.000	-0.2536	15.00	0.0	-283.6E-6	0.0
	34.000	4.000	15.000	-0.2475	15.00	0.0	-279.8E-6	0.0
	34.000	6.000	15.000	-0.2376	15.00	0.0	-273.5E-6	0.0
	34.000	8.000	15.000	-0.2242	15.00	0.0	-265.0E-6	0.0
	34.000	10.000	15.000	-0.2078	15.00	0.0	-254.5E-6	0.0
	34.000	12.000	15.000	-0.1891	15.00	0.0	-242.2E-6	0.0
	34.000	14.000	15.000	-0.1687	15.00	0.0	-228.7E-6	0.0
	34.000	16.000	15.000	-0.1474	15.00	0.0	-214.2E-6	0.0
	34.000	18.000	15.000	-0.1258	15.00	0.0	-199.2E-6	0.0
	34.000	20.000	15.000	-0.1047	15.00	0.0	-184.2E-6	0.0
	34.000	22.000	15.000	-0.08447	15.00	0.0	-169.4E-6	0.0
	34.000	24.000	15.000	-0.06560	15.00	0.0	-155.1E-6	0.0
	34.000	26.000	15.000	-0.04831	15.00	0.0	-141.6E-6	0.0
	34.000	28.000	15.000	-0.03276	15.00	0.0	-128.9E-6	0.0
	34.000	30.000	15.000	-0.01990	15.00	0.0	-117.3E-6	0.0
	34.000	32.000	15.000	-0.007018	15.00	0.0	-106.6E-6	0.0
	34.000	34.000	15.000	0.003258	15.00	0.0	-96.79E-6	0.0
	34.000	36.000	15.000	0.01194	15.00	0.0	-87.95E-6	0.0
	34.000	38.000	15.000	0.01915	15.00	0.0	-79.95E-6	0.0
	34.000	40.000	15.000	0.02504	15.00	0.0	-72.75E-6	0.0
	36.000	-40.000	15.000	0.02932	15.00	0.0	-67.00E-6	0.0
	36.000	-38.000	15.000	0.02474	15.00	0.0	-73.25E-6	0.0
	36.000	-36.000	15.000	0.01913	15.00	0.0	-80.11E-6	0.0
	36.000	-34.000	15.000	0.01237	15.00	0.0	-87.63E-6	0.0
	36.000	-32.000	15.000	0.004391	15.00	0.0	-95.84E-6	0.0
	36.000	-30.000	15.000	-0.004882	15.00	0.0	-104.7E-6	0.0
	36.000	-28.000	15.000	-0.01548	15.00	0.0	-114.3E-6	0.0
	36.000	-26.000	15.000	-0.02739	15.00	0.0	-124.6E-6	0.0
	36.000	-24.000	15.000	-0.04055	15.00	0.0	-135.4E-6	0.0
	36.000	-22.000	15.000	-0.05482	15.00	0.0	-146.7E-6	0.0
	36.000	-20.000	15.000	-0.06997	15.00	0.0	-158.3E-6	0.0
	36.000	-18.000	15.000	-0.08572	15.00	0.0	-170.0E-6	0.0
	36.000	-16.000	15.000	-0.1017	15.00	0.0	-181.6E-6	0.0
	36.000	-14.000	15.000	-0.1174	15.00	0.0	-192.7E-6	0.0
	36.000	-12.000	15.000	-0.1323	15.00	0.0	-203.0E-6	0.0
	36.000	-10.000	15.000	-0.1460	15.00	0.0	-212.3E-6	0.0
	36.000	-8.000	15.000	-0.1580	15.00	0.0	-220.3E-6	0.0
	36.000	-6.000	15.000	-0.1678	15.00	0.0	-226.7E-6	0.0
	36.000	-4.000	15.000	-0.1750	15.00	0.0	-231.5E-6	0.0
	36.000	-2.000	15.000	-0.1795	15.00	0.0	-234.4E-6	0.0
	36.000	0.000	15.000	-0.1810	15.00	0.0	-235.4E-6	0.0
	36.000	2.000	15.000	-0.1795	15.00	0.0	-234.4E-6	0.0
	36.000	4.000	15.000	-0.1750	15.00	0.0	-231.5E-6	0.0
	36.000	6.000	15.000	-0.1678	15.00	0.0	-226.7E-6	0.0
	36.000	8.000	15.000	-0.1580	15.00	0.0	-220.3E-6	0.0
	36.000	10.000	15.000	-0.1460	15.00	0.0</		



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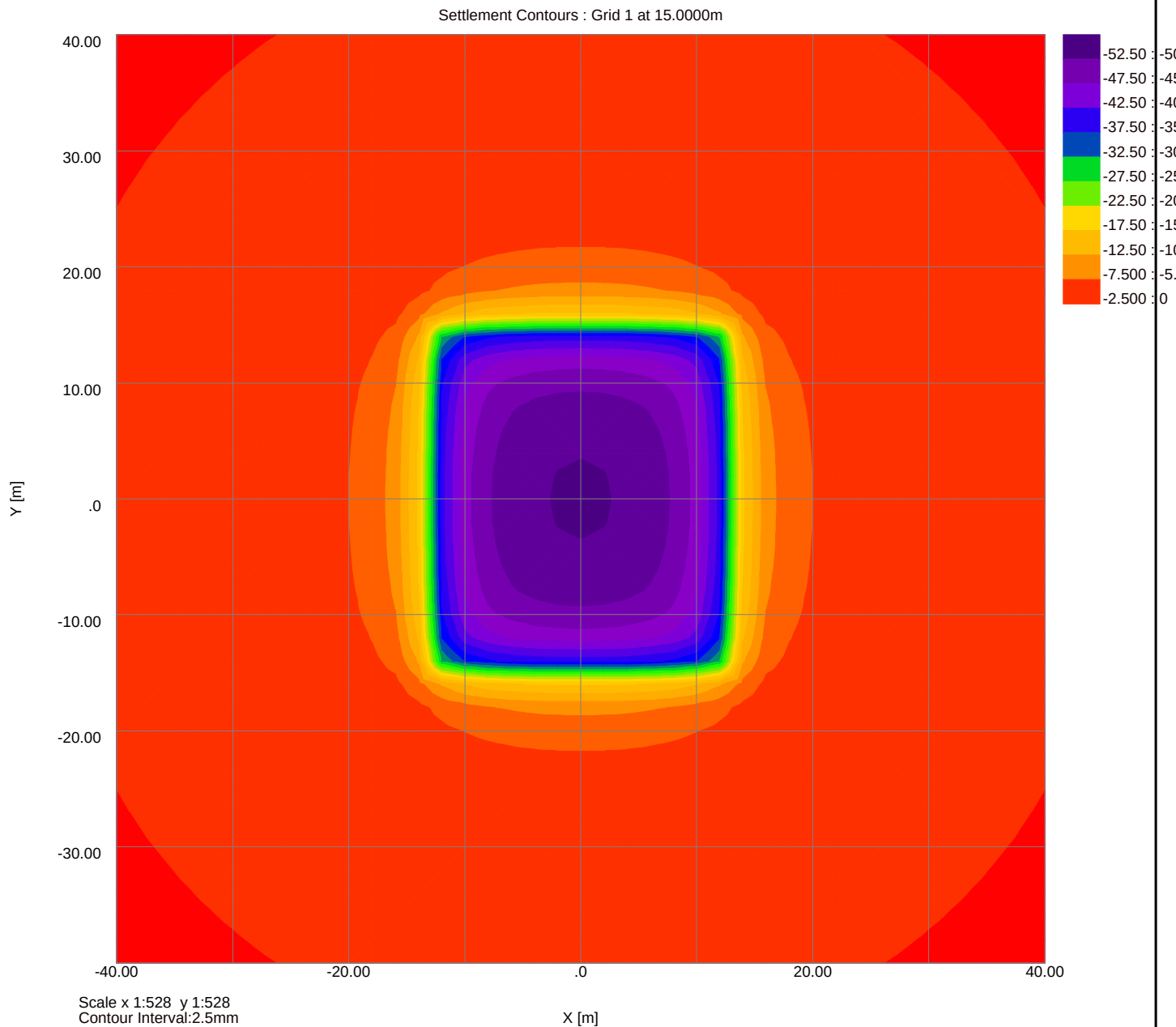
GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by BO	Date	Checked

Name	X [m]	Location Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Stresses Sum Princ [kN/m²]	Vert Strain [-]
	38.000	2.000	15.000	-0.1231	15.00	0.0	-196.1E-6	0.0
	38.000	4.000	15.000	-0.1199	15.00	0.0	-193.9E-6	0.0
	38.000	6.000	15.000	-0.1146	15.00	0.0	-190.2E-6	0.0
	38.000	8.000	15.000	-0.1074	15.00	0.0	-185.3E-6	0.0
	38.000	10.000	15.000	-0.99070	15.00	0.0	-179.1E-6	0.0
	38.000	12.000	15.000	-0.98866	15.00	0.0	-171.9E-6	0.0
	38.000	14.000	15.000	-0.97767	15.00	0.0	-163.9E-6	0.0
	38.000	16.000	15.000	-0.96609	15.00	0.0	-155.3E-6	0.0
	38.000	18.000	15.000	-0.95427	15.00	0.0	-146.3E-6	0.0
	38.000	20.000	15.000	-0.94255	15.00	0.0	-137.1E-6	0.0
	38.000	22.000	15.000	-0.93121	15.00	0.0	-127.9E-6	0.0
	38.000	24.000	15.000	-0.92047	15.00	0.0	-118.9E-6	0.0
	38.000	26.000	15.000	-0.91052	15.00	0.0	-110.1E-6	0.0
	38.000	28.000	15.000	-0.901466	15.00	0.0	-101.7E-6	0.0
	38.000	30.000	15.000	0.906623	15.00	0.0	-93.78E-6	0.0
	38.000	32.000	15.000	0.91372	15.00	0.0	-86.35E-6	0.0
	38.000	34.000	15.000	0.91984	15.00	0.0	-79.43E-6	0.0
	38.000	36.000	15.000	0.92502	15.00	0.0	-73.03E-6	0.0
	38.000	38.000	15.000	0.92932	15.00	0.0	-67.13E-6	0.0
	40.000	40.000	15.000	0.93281	15.00	0.0	-61.72E-6	0.0
	40.000	-40.000	15.000	0.93558	15.00	0.0	-56.86E-6	0.0
	40.000	-38.000	15.000	0.93299	15.00	0.0	-61.56E-6	0.0
	40.000	-36.000	15.000	0.92977	15.00	0.0	-66.64E-6	0.0
	40.000	-34.000	15.000	0.92586	15.00	0.0	-72.11E-6	0.0
	40.000	-32.000	15.000	0.92124	15.00	0.0	-77.96E-6	0.0
	40.000	-30.000	15.000	0.91587	15.00	0.0	-84.19E-6	0.0
	40.000	-28.000	15.000	0.909765	15.00	0.0	-90.77E-6	0.0
	40.000	-26.000	15.000	0.902945	15.00	0.0	-97.67E-6	0.0
	40.000	-24.000	15.000	-0.904529	15.00	0.0	-104.8E-6	0.0
	40.000	-22.000	15.000	-0.91256	15.00	0.0	-112.1E-6	0.0
	40.000	-20.000	15.000	-0.92101	15.00	0.0	-119.5E-6	0.0
	40.000	-18.000	15.000	-0.92970	15.00	0.0	-126.8E-6	0.0
	40.000	-16.000	15.000	-0.93844	15.00	0.0	-134.0E-6	0.0
	40.000	-14.000	15.000	-0.94697	15.00	0.0	-140.7E-6	0.0
	40.000	-12.000	15.000	-0.95504	15.00	0.0	-147.0E-6	0.0
	40.000	-10.000	15.000	-0.96240	15.00	0.0	-152.6E-6	0.0
	40.000	-8.000	15.000	-0.96881	15.00	0.0	-157.4E-6	0.0
	40.000	-6.000	15.000	-0.97404	15.00	0.0	-161.2E-6	0.0
	40.000	-4.000	15.000	-0.97791	15.00	0.0	-164.1E-6	0.0
	40.000	-2.000	15.000	-0.98029	15.00	0.0	-165.8E-6	0.0
	40.000	0.000	15.000	-0.98109	15.00	0.0	-166.4E-6	0.0
	40.000	2.000	15.000	-0.98029	15.00	0.0	-165.8E-6	0.0
	40.000	4.000	15.000	-0.97791	15.00	0.0	-164.1E-6	0.0
	40.000	6.000	15.000	-0.97404	15.00	0.0	-161.2E-6	0.0
	40.000	8.000	15.000	-0.96881	15.00	0.0	-157.4E-6	0.0
	40.000	10.000	15.000	-0.96240	15.00	0.0	-152.6E-6	0.0
	40.000	12.000	15.000	-0.95504	15.00	0.0	-147.0E-6	0.0
	40.000	14.000	15.000	-0.94697	15.00	0.0	-140.7E-6	0.0
	40.000	16.000	15.000	-0.93844	15.00	0.0	-134.0E-6	0.0
	40.000	18.000	15.000	-0.92970	15.00	0.0	-126.8E-6	0.0
	40.000	20.000	15.000	-0.92101	15.00	0.0	-119.5E-6	0.0
	40.000	22.000	15.000	-0.91256	15.00	0.0	-112.1E-6	0.0
	40.000	24.000	15.000	-0.904529	15.00	0.0	-104.8E-6	0.0
	40.000	26.000	15.000	0.902945	15.00	0.0	-97.67E-6	0.0
	40.000	28.000	15.000	0.909765	15.00	0.0	-90.77E-6	0.0
	40.000	30.000	15.000	0.91587	15.00	0.0	-84.19E-6	0.0
	40.000	32.000	15.000	0.92124	15.00	0.0	-77.96E-6	0.0
	40.000	34.000	15.000	0.92586	15.00	0.0	-72.11E-6	0.0
	40.000	36.000	15.000	0.92977	15.00	0.0	-66.64E-6	0.0
	40.000	38.000	15.000	0.93299	15.00	0.0	-61.56E-6	0.0
	40.000	40.000	15.000	0.93558	15.00	0.0	-56.86E-6	0.0

Job No.	Sheet No.	Rev.
Drg. Ref.		
Made by	Date	Checked
BO		





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GEOTECHNICAL CONSULTING GROUP

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Heave Calculation

Analysis Options

Analysis: Boussinesq
Global Poisson's ratio: 0.50
Maximum allowable ratio between values of E: 1.5
Horizontal rigid boundary level: -21.00 [m OD]
Displacements at area centroids calculated.

Soil ProfilesSoil Profile 1

Layer	Level at top	Number of intermediate displacement levels	Youngs Modulus	Poissons ratio	Non-linear curve
	[mOD]		Top [kN/m ²]	Btm [kN/m ²]	
1	25.00	100	10000.	10000.	0.2000 None
2	21.50	100	50000.	50000.	0.2000 None
3	17.50	100	10000.	62000.	0.5000 None
4	7.500	100	101000.	407000.	0.5000 None
5	-11.00	100	333000.	423000.	0.2000 None

Soil Zones

Zone	Name	X coordinates min [m]	X coordinates max [m]	Y coordinates min [m]	Y coordinates max [m]	Profile
1	1	-60.00	60.00	-60.00	60.00	Soil Profile 1

Non-linear Curve Coordinates - Non-linear Curve 1

Point	Strain [%]	Factor
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Load Data

Load ref.	Name	Shape	Orientation of Plane	Centre of load (Global)	Load position Angle of local x from Y	Width x or Radius	Length y	Polygon Coordinates	Rectangle tolerance	Number of rectangles	Normal (local z)	Tangential (local x)	Load value (local y)
				X [m]	Z [level]		[m]	[m]			[kN/m ²]	[kN/m ²]	[kN/m ²]
1	1	Rectangular	Horizontal	0.0	0.0	15.00	0.0	26.00	30.00	N/A			

Displacement Data

Ref.	Type	Name	Direction of Extrusion	Line/Line For extrusion				No. of intrvl across extrusion/line	Extrusion Depth	No. of intrvl along extrusion	Calculate	Show Detailed results		
				First point X [m]	Y [m]	Z(level) [m]	Second point X [m]						Y [m]	Z(level) [m]
1	Grid	Grid 2	Global Y	-40.00	-40.00	15.00	40.00	N/A	15.00	40	80.00	40	Yes	Yes

RESULTS FOR GRIDS

Analysis: Boussinesq
Global Poisson's ratio: 0.50
Horizontal rigid boundary level: -21.00 [m OD]

The maximum displacement difference between Boussinesq method (-3.322mm) and Mindlin method (-3.393mm) occurs at point X=0.0m Y=0.0m Level -3.490mOD and is 0.07070mm

Name	X [m]	Location Y [m]	Z[level] [mOD]	Z [mm]	Calc Level [mOD]	Stresses Vert Stress [kN/m ²]	Sum Princ [kN/m ²]	Vert Strain [-]
1	0.000	0.000	15.000	-20.19	15.00	-200.0	600.0	0.0
Grid 2	-40.000	-40.000	15.000	0.2815	15.00	0.0	-77.87E-6	0.0
	-40.000	-38.000	15.000	0.2970	15.00	0.0	-84.31E-6	0.0
	-40.000	-36.000	15.000	0.3131	15.00	0.0	-91.26E-6	0.0
	-40.000	-34.000	15.000	0.3297	15.00	0.0	-98.74E-6	0.0
	-40.000	-32.000	15.000	0.3466	15.00	0.0	-106.8E-6	0.0
	-40.000	-30.000	15.000	0.3639	15.00	0.0	-115.3E-6	0.0
	-40.000	-28.000	15.000	0.3813	15.00	0.0	-124.3E-6	0.0
	-40.000	-26.000	15.000	0.3988	15.00	0.0	-133.8E-6	0.0
	-40.000	-24.000	15.000	0.4162	15.00	0.0	-143.5E-6	0.0
	-40.000	-22.000	15.000	0.4332	15.00	0.0	-153.6E-6	0.0
	-40.000	-20.000	15.000	0.4498	15.00	0.0	-163.7E-6	0.0
	-40.000	-18.000	15.000	0.4657	15.00	0.0	-173.7E-6	0.0
	-40.000	-16.000	15.000	0.4807	15.00	0.0	-183.5E-6	0.0
	-40.000	-14.000	15.000	0.4946	15.00	0.0	-192.7E-6	0.0
	-40.000	-12.000	15.000	0.5072	15.00	0.0	-201.3E-6	0.0
	-40.000	-10.000	15.000	0.5181	15.00	0.0	-209.0E-6	0.0
	-40.000	-8.000	15.000	0.5274	15.00	0.0	-215.5E-6	0.0
	-40.000	-6.000	15.000	0.5348	15.00	0.0	-220.8E-6	0.0
	-40.000	-4.000	15.000	0.5402	15.00	0.0	-224.7E-6	0.0
	-40.000	-2.000	15.000	0.5435	15.00	0.0	-227.1E-6	0.0
	-40.000	0.000	15.000	0.5446	15.00	0.0	-227.9E-6	0.0
	-40.000	2.000	15.000	0.5435	15.00	0.0	-227.1E-6	0.0
	-40.000	4.000	15.000	0.5402	15.00	0.0	-224.7E-6	0.0
	-40.000	6.000	15.000	0.5348	15.00	0.0	-220.8E-6	0.0
	-40.000	8.000	15.000	0.5274	15.00	0.0	-215.5E-6	0.0
	-40.000	10.000	15.000	0.5181	15.00	0.0	-209.0E-6	0.0
	-40.000	12.000	15.000	0.5072	15.00	0.0	-201.3E-6	0.0
	-40.000	14.000	15.000	0.4946	15.00	0.0	-192.7E-6	0.0
	-40.000	16.000	15.000	0.4807	15.00	0.0	-183.5E-6	0.0
	-40.000	18.000	15.000	0.4657	15.00	0.0	-173.7E-6	0.0
	-40.000	20.000	15.000	0.4498	15.00	0.0	-163.7E-6	0.0
	-40.000	22.000	15.000	0.4332	15.00	0.0	-153.6E-6	0.0
	-40.000	24.000	15.000	0.4162	15.00	0.0	-143.5E-6	0.0
	-40.000	26.000	15.000	0.3988	15.00	0.0	-133.8E-6	0.0
	-40.000	28.000	15.000	0.3813	15.00	0.0	-124.3E-6	0.0
	-40.000	30.000	15.000	0.3639	15.00	0.0	-115.3E-6	0.0
	-40.000	32.000	15.000	0.3466	15.00	0.0	-106.8E-6	0.0
	-40.000	34.000	15.000	0.3297	15.00	0.0	-98.74E-6	0.0
	-40.000	36.000	15.000	0.3131	15.00	0.0	-91.26E-6	0.0
	-40.000	38.000	15.000	0.2970	15.00	0.0	-84.31E-6	0.0
	-40.000	40.000	15.000	0.2815	15.00	0.0	-77.87E-6	0.0
	-38.000	-40.000	15.000	0.2974	15.00	0.0	-84.52E-6	0.0
	-38.000	-38.000	15.000	0.3144	15.00	0.0	-91.94E-6	0.0
	-38.000	-36.000	15.000	0.3321	15.00	0.0	-100.0E-6	0.0
	-38.000	-34.000	15.000	0.3504	15.00	0.0	-108.8E-6	0.0
	-38.000	-32.000	15.000	0.3692	15.00	0.0	-118.3E-6	0.0
	-38.000	-30.000	15.000	0.3884	15.00	0.0	-128.4E-6	0.0
	-38.000	-28.000	15.000	0.4079	15.00	0.0	-139.3E-6	0.0
	-38.000	-26.000	15.000	0.4275	15.00	0.0	-150.8E-6	0.0
	-38.000	-24.000	15.000	0.4470	15.00	0.0	-162.8E-6	0.0
	-38.000	-22.000	15.000	0.4663	15.00	0.0	-175.2E-6	0.0
	-38.000	-20.000	15.000	0.4851	15.00	0.0	-187.8E-6	0.0
	-38.000	-18.000	15.000	0.5031	15.00	0.0	-200.4E-6	0.0
	-38.000	-16.000	15.000	0.5202	15.00	0.0	-212.7E-6	0.0
	-38.000	-14.000	15.000	0.5360	15.00	0.0	-224.5E-6	0.0
	-38.000	-12.000	15.000	0.5503	15.00	0.0	-235.5E-6	0.0
	-38.000	-10.000	15.000	0.5629	15.00	0.0	-245.3E-6	0.0
	-38.000	-8.000	15.000	0.5735	15.00	0.0	-253.7E-6	0.0
	-38.000	-6.000	15.000	0.5820	15.00	0.0	-260.5E-6	0.0
	-38.000	-4.000	15.000	0.5882	15.00	0.0	-265.5E-6	0.0
	-38.000	-2.000	15.000	0.5919	15.00	0.0	-268.5E-6	0.0
	-38.000	0.000	15.000	0.5932	15.00	0.0	-269.6E-6	0.0
	-38.000	2.000	15.000	0.5919	15.00	0.0	-268.5E-6	0.0
	-38.000	4.000	15.000	0.5882	15.00	0.0	-265.5E-6	0.0
	-38.000	6.000	15.000	0.5820	15.00	0.0	-260.5E-6	0.0
	-38.000	8.000	15.000	0.5735	15.00	0.0	-253.7E-6	0.0
	-38.000	10.000	15.000	0.5629	15.00	0.0	-245.3E-6	0.0
	-38.000	12.000	15.000	0.5503	15.00	0.0	-235.5E-6	0.0
	-38.000	14.000	15.000	0.5360	15.00	0.0	-224.5E-6	0.0
	-38.000	16.000	15.000	0.5202	15.00	0.0	-212.7E-6	0.0
	-38.000	18.000	15.000	0.5031	15.00	0.0	-200.4E-6	0.0



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Stresses					
	X [m]	Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [.]
	-38.000	20.000	15.000	0.4851	15.00	0.0	-187.8E-6	0.0
	-38.000	22.000	15.000	0.4663	15.00	0.0	-175.2E-6	0.0
	-38.000	24.000	15.000	0.4470	15.00	0.0	-162.8E-6	0.0
	-38.000	26.000	15.000	0.4275	15.00	0.0	-150.8E-6	0.0
	-38.000	28.000	15.000	0.4079	15.00	0.0	-139.3E-6	0.0
	-38.000	30.000	15.000	0.3884	15.00	0.0	-128.4E-6	0.0
	-38.000	32.000	15.000	0.3692	15.00	0.0	-118.3E-6	0.0
	-38.000	34.000	15.000	0.3504	15.00	0.0	-108.8E-6	0.0
	-38.000	36.000	15.000	0.3321	15.00	0.0	-100.0E-6	0.0
	-38.000	38.000	15.000	0.3144	15.00	0.0	-91.94E-6	0.0
	-38.000	40.000	15.000	0.2974	15.00	0.0	-84.52E-6	0.0
	-36.000	-40.000	15.000	0.3139	15.00	0.0	-91.76E-6	0.0
	-36.000	-38.000	15.000	0.3326	15.00	0.0	-100.3E-6	0.0
	-36.000	-36.000	15.000	0.3520	15.00	0.0	-109.7E-6	0.0
	-36.000	-34.000	15.000	0.3722	15.00	0.0	-120.0E-6	0.0
	-36.000	-32.000	15.000	0.3930	15.00	0.0	-131.2E-6	0.0
	-36.000	-30.000	15.000	0.4144	15.00	0.0	-143.4E-6	0.0
	-36.000	-28.000	15.000	0.4361	15.00	0.0	-156.6E-6	0.0
	-36.000	-26.000	15.000	0.4581	15.00	0.0	-170.6E-6	0.0
	-36.000	-24.000	15.000	0.4800	15.00	0.0	-185.5E-6	0.0
	-36.000	-22.000	15.000	0.5018	15.00	0.0	-200.9E-6	0.0
	-36.000	-20.000	15.000	0.5230	15.00	0.0	-216.8E-6	0.0
	-36.000	-18.000	15.000	0.5435	15.00	0.0	-232.9E-6	0.0
	-36.000	-16.000	15.000	0.5629	15.00	0.0	-248.7E-6	0.0
	-36.000	-15.000	15.000	0.5800	15.00	0.0	-263.8E-6	0.0
	-36.000	-12.000	15.000	0.5973	15.00	0.0	-278.0E-6	0.0
	-36.000	-10.000	15.000	0.6117	15.00	0.0	-290.7E-6	0.0
	-36.000	-8.000	15.000	0.6239	15.00	0.0	-301.7E-6	0.0
	-36.000	-6.000	15.000	0.6336	15.00	0.0	-310.5E-6	0.0
	-36.000	-4.000	15.000	0.6407	15.00	0.0	-317.0E-6	0.0
	-36.000	-2.000	15.000	0.6450	15.00	0.0	-321.0E-6	0.0
	-36.000	0.000	15.000	0.6465	15.00	0.0	-322.3E-6	0.0
	-36.000	2.000	15.000	0.6450	15.00	0.0	-321.0E-6	0.0
	-36.000	4.000	15.000	0.6407	15.00	0.0	-317.0E-6	0.0
	-36.000	6.000	15.000	0.6336	15.00	0.0	-310.5E-6	0.0
	-36.000	8.000	15.000	0.6239	15.00	0.0	-301.7E-6	0.0
	-36.000	10.000	15.000	0.6117	15.00	0.0	-290.7E-6	0.0
	-36.000	12.000	15.000	0.5973	15.00	0.0	-278.0E-6	0.0
	-36.000	14.000	15.000	0.5800	15.00	0.0	-263.8E-6	0.0
	-36.000	16.000	15.000	0.5629	15.00	0.0	-248.7E-6	0.0
	-36.000	18.000	15.000	0.5435	15.00	0.0	-232.9E-6	0.0
	-36.000	20.000	15.000	0.5230	15.00	0.0	-216.8E-6	0.0
	-36.000	22.000	15.000	0.5018	15.00	0.0	-200.9E-6	0.0
	-36.000	24.000	15.000	0.4800	15.00	0.0	-185.5E-6	0.0
	-36.000	26.000	15.000	0.4581	15.00	0.0	-170.6E-6	0.0
	-36.000	28.000	15.000	0.4361	15.00	0.0	-156.6E-6	0.0
	-36.000	30.000	15.000	0.4144	15.00	0.0	-143.4E-6	0.0
	-36.000	32.000	15.000	0.3930	15.00	0.0	-131.2E-6	0.0
	-36.000	34.000	15.000	0.3722	15.00	0.0	-120.0E-6	0.0
	-36.000	36.000	15.000	0.3520	15.00	0.0	-109.7E-6	0.0
	-36.000	38.000	15.000	0.3326	15.00	0.0	-100.3E-6	0.0
	-36.000	40.000	15.000	0.3139	15.00	0.0	-91.76E-6	0.0
	-34.000	-40.000	15.000	0.3310	15.00	0.0	-99.62E-6	0.0
	-34.000	-38.000	15.000	0.3514	15.00	0.0	-109.5E-6	0.0
	-34.000	-36.000	15.000	0.3728	15.00	0.0	-120.4E-6	0.0
	-34.000	-34.000	15.000	0.3950	15.00	0.0	-132.6E-6	0.0
	-34.000	-32.000	15.000	0.4181	15.00	0.0	-145.9E-6	0.0
	-34.000	-30.000	15.000	0.4418	15.00	0.0	-160.6E-6	0.0
	-34.000	-28.000	15.000	0.4660	15.00	0.0	-176.6E-6	0.0
	-34.000	-26.000	15.000	0.4906	15.00	0.0	-193.9E-6	0.0
	-34.000	-24.000	15.000	0.5152	15.00	0.0	-212.4E-6	0.0
	-34.000	-22.000	15.000	0.5397	15.00	0.0	-231.9E-6	0.0
	-34.000	-20.000	15.000	0.5638	15.00	0.0	-252.2E-6	0.0
	-34.000	-18.000	15.000	0.5870	15.00	0.0	-272.8E-6	0.0
	-34.000	-16.000	15.000	0.6090	15.00	0.0	-293.3E-6	0.0
	-34.000	-14.000	15.000	0.6296	15.00	0.0	-313.2E-6	0.0
	-34.000	-12.000	15.000	0.6483	15.00	0.0	-331.7E-6	0.0
	-34.000	-10.000	15.000	0.6648	15.00	0.0	-348.5E-6	0.0
	-34.000	-8.000	15.000	0.6788	15.00	0.0	-362.9E-6	0.0
	-34.000	-6.000	15.000	0.6899	15.00	0.0	-374.6E-6	0.0
	-34.000	-4.000	15.000	0.6981	15.00	0.0	-383.1E-6	0.0
	-34.000	-2.000	15.000	0.7030	15.00	0.0	-388.4E-6	0.0
	-34.000	0.000	15.000	0.7047	15.00	0.0	-390.1E-6	0.0
	-34.000	2.000	15.000	0.7030	15.00	0.0	-388.4E-6	0.0
	-34.000	4.000	15.000	0.6981	15.00	0.0	-383.1E-6	0.0
	-34.000	6.000	15.000	0.6899	15.00	0.0	-374.6E-6	0.0
	-34.000	8.000	15.000	0.6788	15.00	0.0	-362.9E-6	0.0
	-34.000	10.000	15.000	0.6648	15.00	0.0	-348.5E-6	0.0
	-34.000	12.000	15.000	0.6483	15.00	0.0	-331.7E-6	0.0
	-34.000	14.000	15.000	0.6296	15.00	0.0	-313.2E-6	0.0
	-34.000	16.000	15.000	0.6090	15.00	0.0	-293.3E-6	0.0
	-34.000	18.000	15.000	0.5870	15.00	0.0	-272.8E-6	0.0
	-34.000	20.000	15.000	0.5638	15.00	0.0	-252.2E-6	0.0
	-34.000	22.000	15.000	0.5397	15.00	0.0	-231.9E-6	0.0
	-34.000	24.000	15.000	0.5152	15.00	0.0	-212.4E-6	0.0
	-34.000	26.000	15.000	0.4906	15.00	0.0	-193.9E-6	0.0
	-34.000	28.000	15.000	0.4660	15.00	0.0	-176.6E-6	0.0
	-34.000	30.000	15.000	0.4418	15.00	0.0	-160.6E-6	0.0
	-34.000	32.000	15.000	0.4181	15.00	0.0	-145.9E-6	0.0
	-34.000	34.000	15.000	0.3950	15.00	0.0	-132.6E-6	0.0
	-34.000	36.000	15.000	0.3728	15.00	0.0	-120.4E-6	0.0
	-34.000	38.000	15.000	0.3514	15.00	0.0	-109.5E-6	0.0
	-34.000	40.000	15.000	0.3310	15.00	0.0	-99.62E-6	0.0
	-32.000	-40.000	15.000	0.3485	15.00	0.0	-108.1E-6	0.0
	-32.000	-38.000	15.000	0.3708	15.00	0.0	-119.5E-6	0.0
	-32.000	-36.000	15.000	0.3943	15.00	0.0	-132.3E-6	0.0
	-32.000	-34.000	15.000	0.4187	15.00	0.0	-146.6E-6	0.0
	-32.000	-32.000	15.000	0.4442	15.00	0.0	-162.5E-6	0.0
	-32.000	-30.000	15.000	0.4705	15.00	0.0	-180.2E-6	0.0
	-32.000	-28.000	15.000	0.4975	15.00	0.0	-199.8E-6	0.0
	-32.000	-26.000	15.000	0.5249	15.00	0.0	-221.3E-6	0.0
	-32.000	-24.000	15.000	0.5526	15.00	0.0	-244.6E-6	0.0
	-32.000	-22.000	15.000	0.5802	15.00	0.0	-269.5E-6	0.0
	-32.000	-20.000	15.000	0.6073	15.00	0.0	-295.7E-6	0.0
	-32.000	-18.000	15.000	0.6336	15.00	0.0	-322.7E-6	0.0
	-32.000	-16.000	15.000	0.6586	15.00	0.0	-349.7E-6	0.0
	-32.000	-14.000	15.000	0.6829	15.00	0.0	-376.1E-6	0.0
	-32.000	-12.000	15.000	0.7033	15.00	0.0	-400.9E-6	0.0
	-32.000	-10.000	15.000	0.7222	15.00	0.0	-423.3E-6	0.0
	-32.000	-8.000	15.000	0.7382	15.00	0.0	-442.6E-6	0.0
	-32.000	-6.000	15.000	0.7510	15.00	0.0	-458.2E-6	0.0
	-32.000	-4.000	15.000	0.7603	15.00	0.0	-469.6E-6	0.0
	-32.000	-2.000	15.000	0.7660	15.00	0.0	-476.5E-6	0.0
	-32.000	0.000	15.000	0.7679	15.00	0.0	-478.9E-6	0.0
	-32.000	2.000	15.000	0.7660	15.00	0.0	-476.5E-6	0.0
	-32.000	4.000	15.000	0.7603	15.00	0.0	-469.6E-6	0.0
	-32.000	6.000	15.000	0.7510	15.00	0.0	-458.2E-6	0.0
	-32.000	8.000	15.000	0.7382	15.00	0.		



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Stresses					
	X	Y	Z[Level]	Z	Calc Level	Vert Stress	Sum Princ	Vert Strain
	[m]	[m]	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[-]
	-30.000	-26.000	15.000	0.5611	15.00	0.0	-253.6E-6	0.0
	-30.000	-24.000	15.000	0.5920	15.00	0.0	-283.3E-6	0.0
	-30.000	-22.000	15.000	0.6230	15.00	0.0	-315.5E-6	0.0
	-30.000	-20.000	15.000	0.6535	15.00	0.0	-349.9E-6	0.0
	-30.000	-18.000	15.000	0.6832	15.00	0.0	-385.8E-6	0.0
	-30.000	-16.000	15.000	0.7115	15.00	0.0	-422.2E-6	0.0
	-30.000	-14.000	15.000	0.7380	15.00	0.0	-458.0E-6	0.0
	-30.000	-12.000	15.000	0.7622	15.00	0.0	-491.7E-6	0.0
	-30.000	-10.000	15.000	0.7836	15.00	0.0	-522.3E-6	0.0
	-30.000	-8.000	15.000	0.8018	15.00	0.0	-548.5E-6	0.0
	-30.000	-6.000	15.000	0.8165	15.00	0.0	-569.6E-6	0.0
	-30.000	-4.000	15.000	0.8272	15.00	0.0	-585.1E-6	0.0
	-30.000	-2.000	15.000	0.8337	15.00	0.0	-594.5E-6	0.0
	-30.000	0.000	15.000	0.8359	15.00	0.0	-597.6E-6	0.0
	-30.000	2.000	15.000	0.8337	15.00	0.0	-594.5E-6	0.0
	-30.000	4.000	15.000	0.8272	15.00	0.0	-585.1E-6	0.0
	-30.000	6.000	15.000	0.8165	15.00	0.0	-569.6E-6	0.0
	-30.000	8.000	15.000	0.8018	15.00	0.0	-548.5E-6	0.0
	-30.000	10.000	15.000	0.7836	15.00	0.0	-522.3E-6	0.0
	-30.000	12.000	15.000	0.7622	15.00	0.0	-491.7E-6	0.0
	-30.000	14.000	15.000	0.7380	15.00	0.0	-458.0E-6	0.0
	-30.000	16.000	15.000	0.7115	15.00	0.0	-422.2E-6	0.0
	-30.000	18.000	15.000	0.6832	15.00	0.0	-385.8E-6	0.0
	-30.000	20.000	15.000	0.6535	15.00	0.0	-349.9E-6	0.0
	-30.000	22.000	15.000	0.6230	15.00	0.0	-315.5E-6	0.0
	-30.000	24.000	15.000	0.5920	15.00	0.0	-283.3E-6	0.0
	-30.000	26.000	15.000	0.5611	15.00	0.0	-253.6E-6	0.0
	-30.000	28.000	15.000	0.5305	15.00	0.0	-226.8E-6	0.0
	-30.000	30.000	15.000	0.5095	15.00	0.0	-202.7E-6	0.0
	-30.000	32.000	15.000	0.4714	15.00	0.0	-181.2E-6	0.0
	-30.000	34.000	15.000	0.4433	15.00	0.0	-162.1E-6	0.0
	-30.000	36.000	15.000	0.4164	15.00	0.0	-145.3E-6	0.0
	-30.000	38.000	15.000	0.3908	15.00	0.0	-130.4E-6	0.0
	-30.000	40.000	15.000	0.3665	15.00	0.0	-117.3E-6	0.0
	-28.000	-40.000	15.000	0.3847	15.00	0.0	-127.1E-6	0.0
	-28.000	-38.000	15.000	0.4111	15.00	0.0	-142.2E-6	0.0
	-28.000	-36.000	15.000	0.4391	15.00	0.0	-159.5E-6	0.0
	-28.000	-34.000	15.000	0.4685	15.00	0.0	-179.4E-6	0.0
	-28.000	-32.000	15.000	0.4994	15.00	0.0	-202.2E-6	0.0
	-28.000	-30.000	15.000	0.5315	15.00	0.0	-228.3E-6	0.0
	-28.000	-28.000	15.000	0.5648	15.00	0.0	-258.1E-6	0.0
	-28.000	-26.000	15.000	0.5988	15.00	0.0	-292.0E-6	0.0
	-28.000	-24.000	15.000	0.6333	15.00	0.0	-330.1E-6	0.0
	-28.000	-22.000	15.000	0.6679	15.00	0.0	-372.4E-6	0.0
	-28.000	-20.000	15.000	0.7021	15.00	0.0	-418.4E-6	0.0
	-28.000	-18.000	15.000	0.7353	15.00	0.0	-467.3E-6	0.0
	-28.000	-16.000	15.000	0.7670	15.00	0.0	-517.5E-6	0.0
	-28.000	-14.000	15.000	0.7967	15.00	0.0	-567.2E-6	0.0
	-28.000	-12.000	15.000	0.8238	15.00	0.0	-614.3E-6	0.0
	-28.000	-10.000	15.000	0.8480	15.00	0.0	-656.9E-6	0.0
	-28.000	-8.000	15.000	0.8686	15.00	0.0	-693.3E-6	0.0
	-28.000	-6.000	15.000	0.8852	15.00	0.0	-722.4E-6	0.0
	-28.000	-4.000	15.000	0.8974	15.00	0.0	-743.5E-6	0.0
	-28.000	-2.000	15.000	0.9048	15.00	0.0	-756.3E-6	0.0
	-28.000	0.000	15.000	0.9073	15.00	0.0	-760.6E-6	0.0
	-28.000	2.000	15.000	0.9048	15.00	0.0	-756.3E-6	0.0
	-28.000	4.000	15.000	0.8974	15.00	0.0	-743.5E-6	0.0
	-28.000	6.000	15.000	0.8852	15.00	0.0	-722.4E-6	0.0
	-28.000	8.000	15.000	0.8686	15.00	0.0	-693.3E-6	0.0
	-28.000	10.000	15.000	0.8480	15.00	0.0	-656.9E-6	0.0
	-28.000	12.000	15.000	0.8238	15.00	0.0	-614.3E-6	0.0
	-28.000	14.000	15.000	0.7967	15.00	0.0	-567.2E-6	0.0
	-28.000	16.000	15.000	0.7670	15.00	0.0	-517.5E-6	0.0
	-28.000	18.000	15.000	0.7353	15.00	0.0	-467.3E-6	0.0
	-28.000	20.000	15.000	0.7021	15.00	0.0	-418.4E-6	0.0
	-28.000	22.000	15.000	0.6679	15.00	0.0	-372.4E-6	0.0
	-28.000	24.000	15.000	0.6333	15.00	0.0	-330.1E-6	0.0
	-28.000	26.000	15.000	0.5988	15.00	0.0	-292.0E-6	0.0
	-28.000	28.000	15.000	0.5648	15.00	0.0	-258.1E-6	0.0
	-28.000	30.000	15.000	0.5315	15.00	0.0	-228.3E-6	0.0
	-28.000	32.000	15.000	0.4994	15.00	0.0	-202.2E-6	0.0
	-28.000	34.000	15.000	0.4685	15.00	0.0	-179.4E-6	0.0
	-28.000	36.000	15.000	0.4391	15.00	0.0	-159.5E-6	0.0
	-28.000	38.000	15.000	0.4111	15.00	0.0	-142.2E-6	0.0
	-28.000	40.000	15.000	0.3847	15.00	0.0	-127.1E-6	0.0
	-26.000	-40.000	15.000	0.4031	15.00	0.0	-137.5E-6	0.0
	-26.000	-38.000	15.000	0.4317	15.00	0.0	-154.8E-6	0.0
	-26.000	-36.000	15.000	0.4621	15.00	0.0	-175.0E-6	0.0
	-26.000	-34.000	15.000	0.4943	15.00	0.0	-198.4E-6	0.0
	-26.000	-32.000	15.000	0.5281	15.00	0.0	-225.7E-6	0.0
	-26.000	-30.000	15.000	0.5634	15.00	0.0	-257.5E-6	0.0
	-26.000	-28.000	15.000	0.6001	15.00	0.0	-294.6E-6	0.0
	-26.000	-26.000	15.000	0.6378	15.00	0.0	-337.6E-6	0.0
	-26.000	-24.000	15.000	0.6761	15.00	0.0	-387.2E-6	0.0
	-26.000	-22.000	15.000	0.7144	15.00	0.0	-443.5E-6	0.0
	-26.000	-20.000	15.000	0.7522	15.00	0.0	-506.5E-6	0.0
	-26.000	-18.000	15.000	0.7887	15.00	0.0	-574.8E-6	0.0
	-26.000	-16.000	15.000	0.8235	15.00	0.0	-646.2E-6	0.0
	-26.000	-14.000	15.000	0.8560	15.00	0.0	-717.6E-6	0.0
	-26.000	-12.000	15.000	0.8858	15.00	0.0	-785.4E-6	0.0
	-26.000	-10.000	15.000	0.9124	15.00	0.0	-846.3E-6	0.0
	-26.000	-8.000	15.000	0.9353	15.00	0.0	-897.9E-6	0.0
	-26.000	-6.000	15.000	0.9539	15.00	0.0	-938.7E-6	0.0
	-26.000	-4.000	15.000	0.9676	15.00	0.0	-968.0E-6	0.0
	-26.000	-2.000	15.000	0.9760	15.00	0.0	-985.6E-6	0.0
	-26.000	0.000	15.000	0.9788	15.00	0.0	-991.5E-6	0.0
	-26.000	2.000	15.000	0.9760	15.00	0.0	-985.6E-6	0.0
	-26.000	4.000	15.000	0.9676	15.00	0.0	-968.0E-6	0.0
	-26.000	6.000	15.000	0.9539	15.00	0.0	-938.7E-6	0.0
	-26.000	8.000	15.000	0.9353	15.00	0.0	-897.9E-6	0.0
	-26.000	10.000	15.000	0.9124	15.00	0.0	-846.3E-6	0.0
	-26.000	12.000	15.000	0.8858	15.00	0.0	-785.4E-6	0.0
	-26.000	14.000	15.000	0.8560	15.00	0.0	-717.6E-6	0.0
	-26.000	16.000	15.000	0.8235	15.00	0.0	-646.2E-6	0.0
	-26.000	18.000	15.000	0.7887	15.00	0.0	-574.8E-6	0.0
	-26.							



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	X [m]	Location Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	-24.000	10.000	15.000	0.9697	15.00	0.0	-0.001125	0.0
	-24.000	12.000	15.000	0.9418	15.00	0.0	-0.001035	0.0
	-24.000	14.000	15.000	0.9109	15.00	0.0	-933.5E-6	0.0
	-24.000	16.000	15.000	0.8773	15.00	0.0	-826.5E-6	0.0
	-24.000	18.000	15.000	0.8418	15.00	0.0	-720.7E-6	0.0
	-24.000	20.000	15.000	0.8022	15.00	0.0	-621.9E-6	0.0
	-24.000	22.000	15.000	0.7615	15.00	0.0	-533.6E-6	0.0
	-24.000	24.000	15.000	0.7197	15.00	0.0	-457.0E-6	0.0
	-24.000	26.000	15.000	0.6777	15.00	0.0	-391.8E-6	0.0
	-24.000	28.000	15.000	0.6362	15.00	0.0	-336.8E-6	0.0
	-24.000	30.000	15.000	0.5959	15.00	0.0	-290.8E-6	0.0
	-24.000	32.000	15.000	0.5572	15.00	0.0	-251.8E-6	0.0
	-24.000	34.000	15.000	0.5203	15.00	0.0	-219.2E-6	0.0
	-24.000	36.000	15.000	0.4853	15.00	0.0	-191.6E-6	0.0
	-24.000	38.000	15.000	0.4524	15.00	0.0	-168.3E-6	0.0
	-24.000	40.000	15.000	0.4215	15.00	0.0	-148.4E-6	0.0
	-22.000	-40.000	15.000	0.4396	15.00	0.0	-159.8E-6	0.0
	-22.000	-38.000	15.000	0.4728	15.00	0.0	-182.4E-6	0.0
	-22.000	-36.000	15.000	0.5084	15.00	0.0	-209.4E-6	0.0
	-22.000	-34.000	15.000	0.5462	15.00	0.0	-241.6E-6	0.0
	-22.000	-32.000	15.000	0.5864	15.00	0.0	-280.5E-6	0.0
	-22.000	-30.000	15.000	0.6286	15.00	0.0	-327.7E-6	0.0
	-22.000	-28.000	15.000	0.6726	15.00	0.0	-385.3E-6	0.0
	-22.000	-26.000	15.000	0.7178	15.00	0.0	-455.9E-6	0.0
	-22.000	-24.000	15.000	0.7632	15.00	0.0	-542.6E-6	0.0
	-22.000	-22.000	15.000	0.8075	15.00	0.0	-648.6E-6	0.0
	-22.000	-20.000	15.000	0.8492	15.00	0.0	-776.5E-6	0.0
	-22.000	-18.000	15.000	0.8867	15.00	0.0	-925.9E-6	0.0
	-22.000	-16.000	15.000	0.9196	15.00	0.0	-0.001092	0.0
	-22.000	-14.000	15.000	0.9488	15.00	0.0	-0.001201	0.0
	-22.000	-12.000	15.000	0.9758	15.00	0.0	-0.001423	0.0
	-22.000	-10.000	15.000	1.002	15.00	0.0	-0.001562	0.0
	-22.000	-8.000	15.000	1.026	15.00	0.0	-0.001675	0.0
	-22.000	-6.000	15.000	1.046	15.00	0.0	-0.001759	0.0
	-22.000	-4.000	15.000	1.062	15.00	0.0	-0.001831	0.0
	-22.000	-2.000	15.000	1.072	15.00	0.0	-0.001852	0.0
	-22.000	0.000	15.000	1.076	15.00	0.0	-0.001863	0.0
	-22.000	2.000	15.000	1.072	15.00	0.0	-0.001852	0.0
	-22.000	4.000	15.000	1.062	15.00	0.0	-0.001818	0.0
	-22.000	6.000	15.000	1.046	15.00	0.0	-0.001759	0.0
	-22.000	8.000	15.000	1.026	15.00	0.0	-0.001675	0.0
	-22.000	10.000	15.000	1.002	15.00	0.0	-0.001562	0.0
	-22.000	12.000	15.000	0.9758	15.00	0.0	-0.001423	0.0
	-22.000	14.000	15.000	0.9488	15.00	0.0	-0.001262	0.0
	-22.000	16.000	15.000	0.9196	15.00	0.0	-0.001092	0.0
	-22.000	18.000	15.000	0.8867	15.00	0.0	-925.9E-6	0.0
	-22.000	20.000	15.000	0.8492	15.00	0.0	-776.5E-6	0.0
	-22.000	22.000	15.000	0.8075	15.00	0.0	-648.6E-6	0.0
	-22.000	24.000	15.000	0.7632	15.00	0.0	-542.6E-6	0.0
	-22.000	26.000	15.000	0.7178	15.00	0.0	-455.9E-6	0.0
	-22.000	28.000	15.000	0.6726	15.00	0.0	-385.3E-6	0.0
	-22.000	30.000	15.000	0.6286	15.00	0.0	-327.7E-6	0.0
	-22.000	32.000	15.000	0.5864	15.00	0.0	-280.5E-6	0.0
	-22.000	34.000	15.000	0.5462	15.00	0.0	-241.6E-6	0.0
	-22.000	36.000	15.000	0.5084	15.00	0.0	-209.4E-6	0.0
	-22.000	38.000	15.000	0.4728	15.00	0.0	-182.4E-6	0.0
	-22.000	40.000	15.000	0.4396	15.00	0.0	-159.8E-6	0.0
	-20.000	-40.000	15.000	0.4573	15.00	0.0	-171.4E-6	0.0
	-20.000	-38.000	15.000	0.4929	15.00	0.0	-197.1E-6	0.0
	-20.000	-36.000	15.000	0.5311	15.00	0.0	-227.9E-6	0.0
	-20.000	-34.000	15.000	0.5719	15.00	0.0	-265.5E-6	0.0
	-20.000	-32.000	15.000	0.6153	15.00	0.0	-311.5E-6	0.0
	-20.000	-30.000	15.000	0.6611	15.00	0.0	-368.7E-6	0.0
	-20.000	-28.000	15.000	0.7087	15.00	0.0	-440.2E-6	0.0
	-20.000	-26.000	15.000	0.7573	15.00	0.0	-531.0E-6	0.0
	-20.000	-24.000	15.000	0.8052	15.00	0.0	-647.1E-6	0.0
	-20.000	-22.000	15.000	0.8498	15.00	0.0	-796.6E-6	0.0
	-20.000	-20.000	15.000	0.8874	15.00	0.0	-988.4E-6	0.0
	-20.000	-18.000	15.000	0.9143	15.00	0.0	-0.001228	0.0
	-20.000	-16.000	15.000	0.9294	15.00	0.0	-0.001511	0.0
	-20.000	-14.000	15.000	0.9374	15.00	0.0	-0.001808	0.0
	-20.000	-12.000	15.000	0.9462	15.00	0.0	-0.002084	0.0
	-20.000	-10.000	15.000	0.9603	15.00	0.0	-0.002313	0.0
	-20.000	-8.000	15.000	0.9787	15.00	0.0	-0.002487	0.0
	-20.000	-6.000	15.000	0.9978	15.00	0.0	-0.002611	0.0
	-20.000	-4.000	15.000	1.014	15.00	0.0	-0.002694	0.0
	-20.000	-2.000	15.000	1.024	15.00	0.0	-0.002741	0.0
	-20.000	0.000	15.000	1.028	15.00	0.0	-0.002756	0.0
	-20.000	2.000	15.000	1.024	15.00	0.0	-0.002741	0.0
	-20.000	4.000	15.000	1.014	15.00	0.0	-0.002694	0.0
	-20.000	6.000	15.000	0.9978	15.00	0.0	-0.002611	0.0
	-20.000	8.000	15.000	0.9787	15.00	0.0	-0.002487	0.0
	-20.000	10.000	15.000	0.9603	15.00	0.0	-0.002313	0.0
	-20.000	12.000	15.000	0.9462	15.00	0.0	-0.002084	0.0
	-20.000	14.000	15.000	0.9374	15.00	0.0	-0.001908	0.0
	-20.000	16.000	15.000	0.9294	15.00	0.0	-0.001510	0.0
	-20.000	18.000	15.000	0.9143	15.00	0.0	-0.001228	0.0
	-20.000	20.000	15.000	0.8874	15.00	0.0	-988.4E-6	0.0
	-20.000	22.000	15.000	0.8498	15.00	0.0	-796.6E-6	0.0
	-20.000	24.000	15.000	0.8052	15.00	0.0	-647.1E-6	0.0
	-20.000	26.000	15.000	0.7573	15.00	0.0	-531.0E-6	0.0
	-20.000	28.000	15.000	0.7087	15.00	0.0	-440.2E-6	0.0
	-20.000	30.000	15.000	0.6611	15.00	0.0	-368.7E-6	0.0
	-20.000	32.000	15.000	0.6153	15.00	0.0	-311.5E-6	0.0
	-20.000	34.000	15.000	0.5719	15.00	0.0	-265.5E-6	0.0
	-20.000	36.000	15.000	0.5311	15.00	0.0	-227.9E-6	0.0
	-20.000	38.000	15.000	0.4929	15.00	0.0	-197.1E-6	0.0
	-20.000	40.000	15.000	0.4573	15.00	0.0	-171.4E-6	0.0
	-18.000	-40.000	15.000	0.4744	15.00	0.0	-183.2E-6	0.0
	-18.000	-38.000	15.000	0.510	15.00	0.0	-212.0E-6	0.0
	-18.000	-36.000	15.000	0.5531	15.00	0.0	-247.1E-6	0.0
	-18.000	-34.000	15.000	0.5969	15.00	0.0	-290.4E-6	0.0
	-18.000	-32.000	15.000	0.6435	15.00	0.0	-344.5E-6	0.0
	-18.000	-30.000	15.000	0.6928	15.00	0.0	-413.1E-6	0.0
	-18.000	-28.000	15.000	0.7439	15.00	0.0	-501.4E-6	0.0
	-18.000	-26.000	15.000	0.7953	15.00	0.0	-617.3E-6	0.0
	-18.000	-24.000	15.000	0.8441	15.00	0.0	-772.8E-6	0.0
	-18.000	-22.000	15.000	0.8846	15.00	0.0	-986.2E-6	0.0
	-18.000	-20.000	15.000	0.9072	15.00	0.0	-0.001285	0.0
	-18.000	-18.000	15.000	0.8904	15.00	0.0	-0.001701	0.0
	-18.000	-16.000	15.000	0.8541	15.00	0.0	-0.002248	0.0
	-18.000	-14.000	15.000	0.7882	15.00	0.0	-0.002857	0.0
	-18.000	-12.000	15.000	0.7369	15.00	0.0	-0.003398	0.0
	-18.000	-10.000	15.000	0.7144	15.00	0.0	-0.003861	0.0
	-18.000	-8.000	15.000	0.7165	15.00	0.0	-0.004079	0.0
	-18.000	-6.000	15.000	0.7294	15.00	0.0	-0.004264	0.0
	-18.000	-4.000	15.000	0.7439	15.00	0.0	-0.004381	0.0
	-18.000	-2.000	15.000	0.7543	15.00	0.0	-0.004445	0.0
	-18.000	0.000	15.000	0.7508	15.00	0.0	-0.004468	0.0
	-18.000	2.000	15.000	0.7543	15.00	0.0	-0.004445	0.0
	-18.000	4.000	15.000	0.7439	15.00	0.0	-0.004381	0.0
	-18.000	6.000	15.000	0.7294	15.00	0.0	-0.004264	0.0
	-18.000	8.000	15.000	0.7165	15.00	0.0	-0.004079	0.0
	-18.000	10.000	15.000	0.7144	15.00	0.0	-0.003861	0.0
	-18.000	12.000	15.000	0.7369	15.00	0.0	-0.003398	0.0
	-18.000	14.000	15.000	0.7882	15.00	0.0	-0.002857	0.0
	-18.000	16.000	15.000	0.8541	15.00	0.0	-0.002248	0.0
	-18.000	18.000	15.000	0.8994	15.00	0.0	-0.001701	0.0
	-18.000	20.000	15.000	0.9072	15.00	0.0	-0.001285	0.0
	-18.000	22.000	15.000	0.8846	15.00	0.0	-986.2E-6	0.0
	-18.000	24.000	15.000	0.8441	15.00	0.0	-772.8E-6	0.0
	-18.000	26.000	15.000	0.7953	15.00	0.0	-617.3E-6	0.0



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Stresses					
	X	Y	Z[Level]	Z	Calc Level	Vert Stress	Sum Princ	Vert Strain
	[m]	[m]	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[-]
	-16.000	-36.000	15.000	0.5741	15.00	0.0	-266.4E-6	0.0
	-16.000	-34.000	15.000	0.6208	15.00	0.0	-315.9E-6	0.0
	-16.000	-32.000	15.000	0.6706	15.00	0.0	-378.7E-6	0.0
	-16.000	-30.000	15.000	0.7232	15.00	0.0	-460.0E-6	0.0
	-16.000	-28.000	15.000	0.7775	15.00	0.0	-567.4E-6	0.0
	-16.000	-26.000	15.000	0.8310	15.00	0.0	-713.6E-6	0.0
	-16.000	-24.000	15.000	0.8783	15.00	0.0	-919.5E-6	0.0
	-16.000	-22.000	15.000	0.9081	15.00	0.0	-0.001223	0.0
	-16.000	-20.000	15.000	0.8959	15.00	0.0	-0.001698	0.0
	-16.000	-18.000	15.000	0.7967	15.00	0.0	-0.002490	0.0
	-16.000	-16.000	15.000	0.5572	15.00	0.0	-0.003823	0.0
	-16.000	-14.000	15.000	0.2254	15.00	0.0	-0.005548	0.0
	-16.000	-12.000	15.000	-0.02140	15.00	0.0	-0.006875	0.0
	-16.000	-10.000	15.000	-0.1354	15.00	0.0	-0.007652	0.0
	-16.000	-8.000	15.000	-0.1696	15.00	0.0	-0.008104	0.0
	-16.000	-6.000	15.000	-0.1693	15.00	0.0	-0.008375	0.0
	-16.000	-4.000	15.000	-0.1587	15.00	0.0	-0.008536	0.0
	-16.000	-2.000	15.000	-0.1491	15.00	0.0	-0.008622	0.0
	-16.000	0.000	15.000	-0.1455	15.00	0.0	-0.008649	0.0
	-16.000	2.000	15.000	-0.1491	15.00	0.0	-0.008622	0.0
	-16.000	4.000	15.000	-0.1587	15.00	0.0	-0.008536	0.0
	-16.000	6.000	15.000	-0.1693	15.00	0.0	-0.008375	0.0
	-16.000	8.000	15.000	-0.1696	15.00	0.0	-0.008104	0.0
	-16.000	10.000	15.000	-0.1354	15.00	0.0	-0.007652	0.0
	-16.000	12.000	15.000	-0.02140	15.00	0.0	-0.006875	0.0
	-16.000	14.000	15.000	0.2254	15.00	0.0	-0.005548	0.0
	-16.000	16.000	15.000	0.5572	15.00	0.0	-0.003823	0.0
	-16.000	18.000	15.000	0.7967	15.00	0.0	-0.002490	0.0
	-16.000	20.000	15.000	0.8959	15.00	0.0	-0.001698	0.0
	-16.000	22.000	15.000	0.9081	15.00	0.0	-0.001223	0.0
	-16.000	24.000	15.000	0.8783	15.00	0.0	-919.5E-6	0.0
	-16.000	26.000	15.000	0.8310	15.00	0.0	-713.6E-6	0.0
	-16.000	28.000	15.000	0.7775	15.00	0.0	-567.4E-6	0.0
	-16.000	30.000	15.000	0.7232	15.00	0.0	-460.0E-6	0.0
	-16.000	32.000	15.000	0.6706	15.00	0.0	-378.7E-6	0.0
	-16.000	34.000	15.000	0.6208	15.00	0.0	-315.9E-6	0.0
	-16.000	36.000	15.000	0.5741	15.00	0.0	-266.4E-6	0.0
	-16.000	38.000	15.000	0.5308	15.00	0.0	-226.9E-6	0.0
	-16.000	40.000	15.000	0.4906	15.00	0.0	-194.8E-6	0.0
	-14.000	-40.000	15.000	0.5057	15.00	0.0	-206.0E-6	0.0
	-14.000	-38.000	15.000	0.5480	15.00	0.0	-241.3E-6	0.0
	-14.000	-36.000	15.000	0.5938	15.00	0.0	-285.4E-6	0.0
	-14.000	-34.000	15.000	0.6432	15.00	0.0	-341.1E-6	0.0
	-14.000	-32.000	15.000	0.6960	15.00	0.0	-413.0E-6	0.0
	-14.000	-30.000	15.000	0.7518	15.00	0.0	-507.7E-6	0.0
	-14.000	-28.000	15.000	0.8089	15.00	0.0	-636.1E-6	0.0
	-14.000	-26.000	15.000	0.8636	15.00	0.0	-816.2E-6	0.0
	-14.000	-24.000	15.000	0.9074	15.00	0.0	-0.001082	0.0
	-14.000	-22.000	15.000	0.9192	15.00	0.0	-0.001501	0.0
	-14.000	-20.000	15.000	0.8465	15.00	0.0	-0.002240	0.0
	-14.000	-18.000	15.000	0.5529	15.00	0.0	-0.003819	0.0
	-14.000	-16.000	15.000	-0.3234	15.00	0.0	-0.008782	0.0
	-14.000	-14.000	15.000	-1.968	15.00	0.0	-0.02226	0.0
	-14.000	-12.000	15.000	-2.852	15.00	0.0	-0.02722	0.0
	-14.000	-10.000	15.000	-3.161	15.00	0.0	-0.02878	0.0
	-14.000	-8.000	15.000	-3.258	15.00	0.0	-0.02949	0.0
	-14.000	-6.000	15.000	-3.277	15.00	0.0	-0.02987	0.0
	-14.000	-4.000	15.000	-3.272	15.00	0.0	-0.03009	0.0
	-14.000	-2.000	15.000	-3.264	15.00	0.0	-0.03020	0.0
	-14.000	0.000	15.000	-3.261	15.00	0.0	-0.03024	0.0
	-14.000	2.000	15.000	-3.264	15.00	0.0	-0.03020	0.0
	-14.000	4.000	15.000	-3.272	15.00	0.0	-0.03009	0.0
	-14.000	6.000	15.000	-3.277	15.00	0.0	-0.02987	0.0
	-14.000	8.000	15.000	-3.258	15.00	0.0	-0.02949	0.0
	-14.000	10.000	15.000	-3.161	15.00	0.0	-0.02878	0.0
	-14.000	12.000	15.000	-2.852	15.00	0.0	-0.02722	0.0
	-14.000	14.000	15.000	-1.968	15.00	0.0	-0.02226	0.0
	-14.000	16.000	15.000	-0.3234	15.00	0.0	-0.008782	0.0
	-14.000	18.000	15.000	0.5529	15.00	0.0	-0.003819	0.0
	-14.000	20.000	15.000	0.8465	15.00	0.0	-0.002240	0.0
	-14.000	22.000	15.000	0.9192	15.00	0.0	-0.001501	0.0
	-14.000	24.000	15.000	0.9074	15.00	0.0	-0.001082	0.0
	-14.000	26.000	15.000	0.8636	15.00	0.0	-816.2E-6	0.0
	-14.000	28.000	15.000	0.8089	15.00	0.0	-636.1E-6	0.0
	-14.000	30.000	15.000	0.7518	15.00	0.0	-507.7E-6	0.0
	-14.000	32.000	15.000	0.6960	15.00	0.0	-413.0E-6	0.0
	-14.000	34.000	15.000	0.6432	15.00	0.0	-341.1E-6	0.0
	-14.000	36.000	15.000	0.5938	15.00	0.0	-285.4E-6	0.0
	-14.000	38.000	15.000	0.5480	15.00	0.0	-241.3E-6	0.0
	-14.000	40.000	15.000	0.5057	15.00	0.0	-206.0E-6	0.0
	-12.000	-40.000	15.000	0.5194	15.00	0.0	-216.6E-6	0.0
	-12.000	-38.000	15.000	0.5636	15.00	0.0	-255.0E-6	0.0
	-12.000	-36.000	15.000	0.6117	15.00	0.0	-303.4E-6	0.0
	-12.000	-34.000	15.000	0.6637	15.00	0.0	-365.3E-6	0.0
	-12.000	-32.000	15.000	0.7193	15.00	0.0	-446.2E-6	0.0
	-12.000	-30.000	15.000	0.7780	15.00	0.0	-554.5E-6	0.0
	-12.000	-28.000	15.000	0.8376	15.00	0.0	-703.9E-6	0.0
	-12.000	-26.000	15.000	0.8931	15.00	0.0	-919.1E-6	0.0
	-12.000	-24.000	15.000	0.9322	15.00	0.0	-0.001247	0.0
	-12.000	-22.000	15.000	0.9225	15.00	0.0	-0.001794	0.0
	-12.000	-20.000	15.000	0.7757	15.00	0.0	-0.002844	0.0
	-12.000	-18.000	15.000	0.2161	15.00	0.0	-0.005538	0.0
	-12.000	-16.000	15.000	-1.973	15.00	0.0	-0.02225	0.0
	-12.000	-14.000	15.000	-12.72	15.00	-200.0	-599.9	-1.231E-6
	-12.000	-12.000	15.000	-14.91	15.00	-200.0	-600.0	0.0
	-12.000	-10.000	15.000	-15.49	15.00	-200.0	-600.0	0.0
	-12.000	-8.000	15.000	-15.66	15.00	-200.0	-600.0	0.0
	-12.000	-6.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	-12.000	-4.000	15.000	-15.71	15.00	-200.0	-600.0	0.0
	-12.000	-2.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	-12.000	0.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	-12.000	2.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	-12.000	4.000	15.000	-15.71	15.00	-200.0	-600.0	0.0
	-12.000	6.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	-12.000	8.000	15.000	-15.66	15.00	-200.0	-600.0	0.0
	-12.000	10.000	15.000	-15.49	15.00			



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Stresses		
	X [m]	Y [m]				Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	-10.000	0.000	15.000	-18.83	15.00	-200.0	-600.0	0.0
	-10.000	2.000	15.000	-18.83	15.00	-200.0	-600.0	0.0
	-10.000	4.000	15.000	-18.83	15.00	-200.0	-600.0	0.0
	-10.000	6.000	15.000	-18.82	15.00	-200.0	-600.0	0.0
	-10.000	8.000	15.000	-18.76	15.00	-200.0	-600.0	0.0
	-10.000	10.000	15.000	-18.53	15.00	-200.0	-600.0	0.0
	-10.000	12.000	15.000	-17.76	15.00	-200.0	-600.0	0.0
	-10.000	14.000	15.000	-14.92	15.00	-200.0	-600.0	0.0
	-10.000	16.000	15.000	-2.864	15.00	0.0	-0.02720	0.0
	-10.000	18.000	15.000	-0.03664	15.00	0.0	-0.000855	0.0
	-10.000	20.000	15.000	0.7178	15.00	0.0	-0.003377	0.0
	-10.000	22.000	15.000	0.9259	15.00	0.0	-0.002063	0.0
	-10.000	24.000	15.000	0.9542	15.00	0.0	-0.001402	0.0
	-10.000	26.000	15.000	0.9194	15.00	0.0	-0.001016	0.0
	-10.000	28.000	15.000	0.8632	15.00	0.0	-767.4E-6	0.0
	-10.000	30.000	15.000	0.8013	15.00	0.0	-598.0E-6	0.0
	-10.000	32.000	15.000	0.7401	15.00	0.0	-477.0E-6	0.0
	-10.000	34.000	15.000	0.6818	15.00	0.0	-387.6E-6	0.0
	-10.000	36.000	15.000	0.6276	15.00	0.0	-319.9E-6	0.0
	-10.000	38.000	15.000	0.5775	15.00	0.0	-267.5E-6	0.0
	-10.000	40.000	15.000	0.5314	15.00	0.0	-226.1E-6	0.0
	-8.000	-40.000	15.000	0.5416	15.00	0.0	-234.3E-6	0.0
	-8.000	-38.000	15.000	0.5892	15.00	0.0	-278.3E-6	0.0
	-8.000	-36.000	15.000	0.6411	15.00	0.0	-334.3E-6	0.0
	-8.000	-34.000	15.000	0.6973	15.00	0.0	-407.2E-6	0.0
	-8.000	-32.000	15.000	0.7577	15.00	0.0	-504.0E-6	0.0
	-8.000	-30.000	15.000	0.8213	15.00	0.0	-636.2E-6	0.0
	-8.000	-28.000	15.000	0.8852	15.00	0.0	-823.0E-6	0.0
	-8.000	-26.000	15.000	0.9423	15.00	0.0	-0.001099	0.0
	-8.000	-24.000	15.000	0.9744	15.00	0.0	-0.001534	0.0
	-8.000	-22.000	15.000	0.9340	15.00	0.0	-0.002282	0.0
	-8.000	-20.000	15.000	0.6898	15.00	0.0	-0.003769	0.0
	-8.000	-18.000	15.000	-0.1575	15.00	0.0	-0.007620	0.0
	-8.000	-16.000	15.000	-3.180	15.00	0.0	-0.02875	0.0
	-8.000	-14.000	15.000	-15.50	15.00	-200.0	-600.0	0.0
	-8.000	-12.000	15.000	-18.53	15.00	-200.0	-600.0	0.0
	-8.000	-10.000	15.000	-19.40	15.00	-200.0	-600.0	0.0
	-8.000	-8.000	15.000	-19.67	15.00	-200.0	-600.0	0.0
	-8.000	-6.000	15.000	-19.75	15.00	-200.0	-600.0	0.0
	-8.000	-4.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	-8.000	-2.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	-8.000	0.000	15.000	-19.75	15.00	-200.0	-600.0	0.0
	-8.000	2.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	-8.000	4.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	-8.000	6.000	15.000	-19.75	15.00	-200.0	-600.0	0.0
	-8.000	8.000	15.000	-19.67	15.00	-200.0	-600.0	0.0
	-8.000	10.000	15.000	-19.40	15.00	-200.0	-600.0	0.0
	-8.000	12.000	15.000	-18.53	15.00	-200.0	-600.0	0.0
	-8.000	14.000	15.000	-15.50	15.00	-200.0	-600.0	0.0
	-8.000	16.000	15.000	-3.180	15.00	0.0	-0.02875	0.0
	-8.000	18.000	15.000	-0.1575	15.00	0.0	-0.007620	0.0
	-8.000	20.000	15.000	0.6898	15.00	0.0	-0.003769	0.0
	-8.000	22.000	15.000	0.9340	15.00	0.0	-0.002282	0.0
	-8.000	24.000	15.000	0.9744	15.00	0.0	-0.001534	0.0
	-8.000	26.000	15.000	0.9423	15.00	0.0	-0.001099	0.0
	-8.000	28.000	15.000	0.8852	15.00	0.0	-823.0E-6	0.0
	-8.000	30.000	15.000	0.8213	15.00	0.0	-636.2E-6	0.0
	-8.000	32.000	15.000	0.7577	15.00	0.0	-504.0E-6	0.0
	-8.000	34.000	15.000	0.6973	15.00	0.0	-407.2E-6	0.0
	-8.000	36.000	15.000	0.6411	15.00	0.0	-334.3E-6	0.0
	-8.000	38.000	15.000	0.5892	15.00	0.0	-278.3E-6	0.0
	-8.000	40.000	15.000	0.5416	15.00	0.0	-234.3E-6	0.0
	-6.000	-40.000	15.000	0.5498	15.00	0.0	-241.1E-6	0.0
	-6.000	-38.000	15.000	0.5986	15.00	0.0	-287.1E-6	0.0
	-6.000	-36.000	15.000	0.6519	15.00	0.0	-346.1E-6	0.0
	-6.000	-34.000	15.000	0.7098	15.00	0.0	-423.2E-6	0.0
	-6.000	-32.000	15.000	0.7720	15.00	0.0	-526.1E-6	0.0
	-6.000	-30.000	15.000	0.8374	15.00	0.0	-667.4E-6	0.0
	-6.000	-28.000	15.000	0.9031	15.00	0.0	-868.2E-6	0.0
	-6.000	-26.000	15.000	0.9612	15.00	0.0	-0.001166	0.0
	-6.000	-24.000	15.000	0.9922	15.00	0.0	-0.001637	0.0
	-6.000	-22.000	15.000	0.9458	15.00	0.0	-0.002444	0.0
	-6.000	-20.000	15.000	0.6846	15.00	0.0	-0.004033	0.0
	-6.000	-18.000	15.000	-0.1994	15.00	0.0	-0.008055	0.0
	-6.000	-16.000	15.000	-3.284	15.00	0.0	-0.02944	0.0
	-6.000	-14.000	15.000	-15.68	15.00	-200.0	-600.0	0.0
	-6.000	-12.000	15.000	-18.78	15.00	-200.0	-600.0	0.0
	-6.000	-10.000	15.000	-19.68	15.00	-200.0	-600.0	0.0
	-6.000	-8.000	15.000	-19.97	15.00	-200.0	-600.0	0.0
	-6.000	-6.000	15.000	-20.05	15.00	-200.0	-600.0	0.0
	-6.000	-4.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	-6.000	-2.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	-6.000	0.000	15.000	-20.06	15.00	-200.0	-600.0	0.0
	-6.000	2.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	-6.000	4.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	-6.000	6.000	15.000	-20.05	15.00	-200.0	-600.0	0.0
	-6.000	8.000	15.000	-19.97	15.00	-200.0	-600.0	0.0
	-6.000	10.000	15.000	-19.68	15.00	-200.0	-600.0	0.0
	-6.000	12.000	15.000	-18.78	15.00	-200.0	-600.0	0.0
	-6.000	14.000	15.000	-15.68	15.00	-200.0	-600.0	0.0
	-6.000	16.000	15.000	-3.284	15.00	0.0	-0.02944	0.0
	-6.000	18.000	15.000	-0.1994	15.00	0.0	-0.008055	0.0
	-6.000	20.000	15.000	0.6846	15.00	0.0	-0.004033	0.0
	-6.000	22.000	15.000	0.9458	15.00	0.0	-0.002444	0.0
	-6.000	24.000	15.000	0.9922	15.00	0.0	-0.001637	0.0
	-6.000	26.000	15.000	0.9612	15.00	0.0	-0.001166	0.0
	-6.000	28.000	15.000	0.9031	15.00	0.0	-868.2E-6	0.0
	-6.000	30.000	15.000	0.8374	15.00	0.0	-667.4E-6	0.0
	-6.000	32.000	15.000	0.7720	15.00	0.0	-526.1E-6	0.0
	-6.000	34.000	15.000	0.7098	15.00	0.0	-423.2E-6	0.0
	-6.000	36.000	15.000	0.6519	15.00	0.0	-346.1E-6	0.0
	-6.000	38.000	15.000	0.5986	15.00	0.0	-287.1E-6	0.0
	-6.000	40.000	15.000	0.5498	15.00	0.0	-241.1E-6	0.0
	-4.000	-40.000	15.000	0.5558	15.00	0.0	-246.0E-6	0.0
	-4.000	-38.000	15.000	0.6055	15.00	0.0	-293.6E-6	0.0
	-4.000	-36.000	15.000	0.6598	15.00	0.0	-354.8E-6	0.0
	-4.000	-34.000	15.000	0.7189	15.00	0.0	-435.0E-6	0.0
	-4.000	-32.000	15.000	0.7824	15.00	0.0	-542.5E-6	0.0
	-4.000	-30.000	15.000	0.8493	15.00	0.0	-690.5E-6	0.0
	-4.000	-28.000	15.000	0.9163	15.00	0.0	-901.3E-6	0.0
	-4.000	-26.000	15.000	0.9754	15.00	0.0	-0.001215	0.0
	-4.000	-24.000	15.000	1.006	15.00	0.0	-0.001709	0.0
	-4.000	-22.000	15.000	0.9577	15.00	0.0	-0.002553	0.0
	-4.000	-20.000	15.000	0.6898	15.00	0.0	-0.004198	0.0
	-4.000	-18.000	15.000	-0.2075	15.00	0.0	-0.008302	0.0
	-4.000	-16.000	15.000	-3.313	15.00	0.0	-0.02980	0.0
	-4.000	-14.000	15.000	-15.74	15.00	-200.0	-600.0	0.0
	-4.000	-12.000	15.000	-18.85	15.00	-200.0	-600.0	0.0
	-4.000	-10.000	15.000	-19.77	15.00	-200.0	-600.0	0.0
	-4.000	-8.000	15.000	-20.06	15.00	-		



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Z [Level] [mOD]	Z [mm]	Stresses			
	X [m]	Y [m]			Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	-4.000	36.000	15.000	0.6598	15.00	0.0	-354.8E-6	0.0
	-4.000	38.000	15.000	0.6055	15.00	0.0	-293.6E-6	0.0
	-4.000	40.000	15.000	0.5558	15.00	0.0	-246.0E-6	0.0
	-2.000	-38.000	15.000	0.5594	15.00	0.0	-249.1E-6	0.0
	-2.000	-36.000	15.000	0.6096	15.00	0.0	-297.6E-6	0.0
	-2.000	-34.000	15.000	0.6646	15.00	0.0	-360.2E-6	0.0
	-2.000	-32.000	15.000	0.7244	15.00	0.0	-442.3E-6	0.0
	-2.000	-30.000	15.000	0.7888	15.00	0.0	-552.5E-6	0.0
	-2.000	-28.000	15.000	0.8565	15.00	0.0	-704.6E-6	0.0
	-2.000	-26.000	15.000	0.9245	15.00	0.0	-921.4E-6	0.0
	-2.000	-24.000	15.000	0.9843	15.00	0.0	-0.001244	0.0
	-2.000	-22.000	15.000	1.016	15.00	0.0	-0.001751	0.0
	-2.000	-20.000	15.000	0.9662	15.00	0.0	-0.002615	0.0
	-2.000	-18.000	15.000	-0.2055	15.00	0.0	-0.008431	0.0
	-2.000	-16.000	15.000	-3.317	15.00	0.0	-0.02997	0.0
	-2.000	-14.000	15.000	-15.75	15.00	-200.0	-600.0	0.0
	-2.000	-12.000	15.000	-18.87	15.00	-200.0	-600.0	0.0
	-2.000	-10.000	15.000	-19.79	15.00	-200.0	-600.0	0.0
	-2.000	-8.000	15.000	-20.09	15.00	-200.0	-600.0	0.0
	-2.000	-6.000	15.000	-20.18	15.00	-200.0	-600.0	0.0
	-2.000	-4.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	-2.000	-2.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	-2.000	0.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	-2.000	2.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	-2.000	4.000	15.000	-20.18	15.00	-200.0	-600.0	0.0
	-2.000	6.000	15.000	-20.09	15.00	-200.0	-600.0	0.0
	-2.000	8.000	15.000	-19.79	15.00	-200.0	-600.0	0.0
	-2.000	10.000	15.000	-18.87	15.00	-200.0	-600.0	0.0
	-2.000	12.000	15.000	-15.75	15.00	-200.0	-600.0	0.0
	-2.000	14.000	15.000	-3.317	15.00	0.0	-0.02997	0.0
	-2.000	16.000	15.000	-0.2055	15.00	0.0	-0.008431	0.0
	-2.000	18.000	15.000	0.6096	15.00	0.0	-0.004289	0.0
	-2.000	20.000	15.000	0.9662	15.00	0.0	-0.002615	0.0
	-2.000	22.000	15.000	1.016	15.00	0.0	-0.001751	0.0
	-2.000	24.000	15.000	0.9843	15.00	0.0	-0.001244	0.0
	-2.000	26.000	15.000	0.9245	15.00	0.0	-921.4E-6	0.0
	-2.000	28.000	15.000	0.8565	15.00	0.0	-704.6E-6	0.0
	-2.000	30.000	15.000	0.7888	15.00	0.0	-552.5E-6	0.0
	-2.000	32.000	15.000	0.7244	15.00	0.0	-442.3E-6	0.0
	-2.000	34.000	15.000	0.6646	15.00	0.0	-360.2E-6	0.0
	-2.000	36.000	15.000	0.6096	15.00	0.0	-297.6E-6	0.0
	-2.000	38.000	15.000	0.5594	15.00	0.0	-249.1E-6	0.0
	0.000	-40.000	15.000	0.5606	15.00	0.0	-250.1E-6	0.0
	0.000	-38.000	15.000	0.6110	15.00	0.0	-299.0E-6	0.0
	0.000	-36.000	15.000	0.6662	15.00	0.0	-362.0E-6	0.0
	0.000	-34.000	15.000	0.7263	15.00	0.0	-444.8E-6	0.0
	0.000	-32.000	15.000	0.7909	15.00	0.0	-555.9E-6	0.0
	0.000	-30.000	15.000	0.8590	15.00	0.0	-709.3E-6	0.0
	0.000	-28.000	15.000	0.9272	15.00	0.0	-928.1E-6	0.0
	0.000	-26.000	15.000	0.9873	15.00	0.0	-0.001254	0.0
	0.000	-24.000	15.000	1.019	15.00	0.0	-0.001765	0.0
	0.000	-22.000	15.000	0.9693	15.00	0.0	-0.002636	0.0
	0.000	-20.000	15.000	0.6987	15.00	0.0	-0.004311	0.0
	0.000	-18.000	15.000	-0.2039	15.00	0.0	-0.008471	0.0
	0.000	-16.000	15.000	-3.317	15.00	0.0	-0.03003	0.0
	0.000	-14.000	15.000	-15.75	15.00	-200.0	-600.0	0.0
	0.000	-12.000	15.000	-18.87	15.00	-200.0	-600.0	0.0
	0.000	-10.000	15.000	-19.79	15.00	-200.0	-600.0	0.0
	0.000	-8.000	15.000	-20.09	15.00	-200.0	-600.0	0.0
	0.000	-6.000	15.000	-20.18	15.00	-200.0	-600.0	0.0
	0.000	-4.000	15.000	-20.20	15.00	-200.0	-600.0	0.0
	0.000	-2.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	0.000	0.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	0.000	2.000	15.000	-20.20	15.00	-200.0	-600.0	0.0
	0.000	4.000	15.000	-20.18	15.00	-200.0	-600.0	0.0
	0.000	6.000	15.000	-20.09	15.00	-200.0	-600.0	0.0
	0.000	8.000	15.000	-19.79	15.00	-200.0	-600.0	0.0
	0.000	10.000	15.000	-18.87	15.00	-200.0	-600.0	0.0
	0.000	12.000	15.000	-15.75	15.00	-200.0	-600.0	0.0
	0.000	14.000	15.000	-3.317	15.00	0.0	-0.03003	0.0
	0.000	16.000	15.000	-0.2039	15.00	0.0	-0.008471	0.0
	0.000	18.000	15.000	0.6987	15.00	0.0	-0.004311	0.0
	0.000	20.000	15.000	0.9693	15.00	0.0	-0.002636	0.0
	0.000	22.000	15.000	1.019	15.00	0.0	-0.001765	0.0
	0.000	24.000	15.000	0.9873	15.00	0.0	-0.001254	0.0
	0.000	26.000	15.000	0.9272	15.00	0.0	-928.1E-6	0.0
	0.000	28.000	15.000	0.8590	15.00	0.0	-709.3E-6	0.0
	0.000	30.000	15.000	0.7909	15.00	0.0	-555.9E-6	0.0
	0.000	32.000	15.000	0.7263	15.00	0.0	-444.8E-6	0.0
	0.000	34.000	15.000	0.6662	15.00	0.0	-362.0E-6	0.0
	0.000	36.000	15.000	0.6110	15.00	0.0	-299.0E-6	0.0
	0.000	38.000	15.000	0.5606	15.00	0.0	-250.1E-6	0.0
	2.000	-40.000	15.000	0.5594	15.00	0.0	-249.1E-6	0.0
	2.000	-38.000	15.000	0.6096	15.00	0.0	-297.6E-6	0.0
	2.000	-36.000	15.000	0.6646	15.00	0.0	-360.2E-6	0.0
	2.000	-34.000	15.000	0.7244	15.00	0.0	-442.3E-6	0.0
	2.000	-32.000	15.000	0.7888	15.00	0.0	-552.5E-6	0.0
	2.000	-30.000	15.000	0.8565	15.00	0.0	-704.6E-6	0.0
	2.000	-28.000	15.000	0.9245	15.00	0.0	-921.4E-6	0.0
	2.000	-26.000	15.000	0.9843	15.00	0.0	-0.001244	0.0
	2.000	-24.000	15.000	1.016	15.00	0.0	-0.001751	0.0
	2.000	-22.000	15.000	0.9662	15.00	0.0	-0.002615	0.0
	2.000	-20.000	15.000	0.6961	15.00	0.0	-0.004289	0.0
	2.000	-18.000	15.000	-0.2055	15.00	0.0	-0.008431	0.0
	2.000	-16.000	15.000	-3.317	15.00	0.0	-0.02997	0.0
	2.000	-14.000	15.000	-15.75	15.00	-200.0	-600.0	0.0
	2.000	-12.000	15.000	-18.87	15.00	-200.0	-600.0	0.0
	2.000	-10.000	15.000	-19.79	15.00	-200.0	-600.0	0.0
	2.000	-8.000	15.000	-20.09	15.00	-200.0	-600.0	0.0
	2.000	-6.000	15.000	-20.18	15.00	-200.0	-600.0	0.0
	2.000	-4.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	2.000	-2.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	2.000	0.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	2.000	2.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	2.000	4.000	15.000	-20.19	15.00	-200.0	-600.0	0.0
	2.000	6.000	15.000	-20.18	15.00	-200.0	-600.0	0.0
	2.000	8.000	15.000	-20.09	15.00	-200.0	-600.0	0.0
	2.000	10.000	15.000	-19.79				



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Z[Level]	Z	Calc Level	Stresses		Vert Strain
	X	Y	[mOD]	[mm]	[mOD]	Vert Stress	Sum Princ	[-]
	[m]	[m]				[kN/m²]	[kN/m²]	
	4.000	-10.000	15.000	-19.77	15.00	-200.0	-600.0	0.0
	4.000	-8.000	15.000	-20.06	15.00	-200.0	-600.0	0.0
	4.000	-6.000	15.000	-20.15	15.00	-200.0	-600.0	0.0
	4.000	-4.000	15.000	-20.17	15.00	-200.0	-600.0	0.0
	4.000	-2.000	15.000	-20.16	15.00	-200.0	-600.0	0.0
	4.000	0.000	15.000	-20.16	15.00	-200.0	-600.0	0.0
	4.000	2.000	15.000	-20.16	15.00	-200.0	-600.0	0.0
	4.000	4.000	15.000	-20.17	15.00	-200.0	-600.0	0.0
	4.000	6.000	15.000	-20.15	15.00	-200.0	-600.0	0.0
	4.000	8.000	15.000	-20.06	15.00	-200.0	-600.0	0.0
	4.000	10.000	15.000	-19.77	15.00	-200.0	-600.0	0.0
	4.000	12.000	15.000	-18.85	15.00	-200.0	-600.0	0.0
	4.000	14.000	15.000	-15.74	15.00	-200.0	-600.0	0.0
	4.000	16.000	15.000	-3.313	15.00	0.0	-0.02980	0.0
	4.000	18.000	15.000	-0.2075	15.00	0.0	-0.000302	0.0
	4.000	20.000	15.000	0.6898	15.00	0.0	-0.004198	0.0
	4.000	22.000	15.000	0.9577	15.00	0.0	-0.002553	0.0
	4.000	24.000	15.000	1.006	15.00	0.0	-0.001709	0.0
	4.000	26.000	15.000	0.9754	15.00	0.0	-0.001215	0.0
	4.000	28.000	15.000	0.9163	15.00	0.0	-0.0013E-6	0.0
	4.000	30.000	15.000	0.8493	15.00	0.0	-690.5E-6	0.0
	4.000	32.000	15.000	0.7824	15.00	0.0	-542.5E-6	0.0
	4.000	34.000	15.000	0.7189	15.00	0.0	-435.0E-6	0.0
	4.000	36.000	15.000	0.6598	15.00	0.0	-354.8E-6	0.0
	4.000	38.000	15.000	0.6055	15.00	0.0	-293.5E-6	0.0
	4.000	40.000	15.000	0.5558	15.00	0.0	-246.0E-6	0.0
	6.000	-40.000	15.000	0.5498	15.00	0.0	-241.1E-6	0.0
	6.000	-38.000	15.000	0.5986	15.00	0.0	-287.1E-6	0.0
	6.000	-36.000	15.000	0.6519	15.00	0.0	-346.1E-6	0.0
	6.000	-34.000	15.000	0.7098	15.00	0.0	-423.2E-6	0.0
	6.000	-32.000	15.000	0.7720	15.00	0.0	-526.1E-6	0.0
	6.000	-30.000	15.000	0.8374	15.00	0.0	-667.4E-6	0.0
	6.000	-28.000	15.000	0.9031	15.00	0.0	-868.2E-6	0.0
	6.000	-26.000	15.000	0.9612	15.00	0.0	-0.001166	0.0
	6.000	-24.000	15.000	0.9922	15.00	0.0	-0.001637	0.0
	6.000	-22.000	15.000	0.9458	15.00	0.0	-0.002444	0.0
	6.000	-20.000	15.000	0.6846	15.00	0.0	-0.004033	0.0
	6.000	-18.000	15.000	-0.1994	15.00	0.0	-0.008055	0.0
	6.000	-16.000	15.000	-3.284	15.00	0.0	-0.02944	0.0
	6.000	-14.000	15.000	-15.68	15.00	-200.0	-600.0	0.0
	6.000	-12.000	15.000	-18.78	15.00	-200.0	-600.0	0.0
	6.000	-10.000	15.000	-19.68	15.00	-200.0	-600.0	0.0
	6.000	-8.000	15.000	-19.97	15.00	-200.0	-600.0	0.0
	6.000	-6.000	15.000	-20.05	15.00	-200.0	-600.0	0.0
	6.000	-4.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	6.000	-2.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	6.000	0.000	15.000	-20.06	15.00	-200.0	-600.0	0.0
	6.000	2.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	6.000	4.000	15.000	-20.07	15.00	-200.0	-600.0	0.0
	6.000	6.000	15.000	-20.05	15.00	-200.0	-600.0	0.0
	6.000	8.000	15.000	-19.97	15.00	-200.0	-600.0	0.0
	6.000	10.000	15.000	-19.68	15.00	-200.0	-600.0	0.0
	6.000	12.000	15.000	-18.78	15.00	-200.0	-600.0	0.0
	6.000	14.000	15.000	-15.68	15.00	-200.0	-600.0	0.0
	6.000	16.000	15.000	-3.284	15.00	0.0	-0.02944	0.0
	6.000	18.000	15.000	-0.1994	15.00	0.0	-0.008055	0.0
	6.000	20.000	15.000	0.6846	15.00	0.0	-0.004033	0.0
	6.000	22.000	15.000	0.9458	15.00	0.0	-0.002444	0.0
	6.000	24.000	15.000	0.9922	15.00	0.0	-0.001637	0.0
	6.000	26.000	15.000	0.9612	15.00	0.0	-0.001166	0.0
	6.000	28.000	15.000	0.9031	15.00	0.0	-868.2E-6	0.0
	6.000	30.000	15.000	0.8374	15.00	0.0	-667.4E-6	0.0
	6.000	32.000	15.000	0.7720	15.00	0.0	-526.1E-6	0.0
	6.000	34.000	15.000	0.7098	15.00	0.0	-423.2E-6	0.0
	6.000	36.000	15.000	0.6519	15.00	0.0	-346.1E-6	0.0
	6.000	38.000	15.000	0.5986	15.00	0.0	-287.1E-6	0.0
	6.000	40.000	15.000	0.5498	15.00	0.0	-241.1E-6	0.0
	8.000	-40.000	15.000	0.5416	15.00	0.0	-234.3E-6	0.0
	8.000	-38.000	15.000	0.5892	15.00	0.0	-278.3E-6	0.0
	8.000	-36.000	15.000	0.6411	15.00	0.0	-334.3E-6	0.0
	8.000	-34.000	15.000	0.6973	15.00	0.0	-407.2E-6	0.0
	8.000	-32.000	15.000	0.7577	15.00	0.0	-504.0E-6	0.0
	8.000	-30.000	15.000	0.8213	15.00	0.0	-636.2E-6	0.0
	8.000	-28.000	15.000	0.8852	15.00	0.0	-823.0E-6	0.0
	8.000	-26.000	15.000	0.9423	15.00	0.0	-0.001099	0.0
	8.000	-24.000	15.000	0.9744	15.00	0.0	-0.001534	0.0
	8.000	-22.000	15.000	0.9340	15.00	0.0	-0.002282	0.0
	8.000	-20.000	15.000	0.6898	15.00	0.0	-0.003769	0.0
	8.000	-18.000	15.000	-0.1575	15.00	0.0	-0.007620	0.0
	8.000	-16.000	15.000	-3.1180	15.00	0.0	-0.02275	0.0
	8.000	-14.000	15.000	-15.50	15.00	-200.0	-600.0	0.0
	8.000	-12.000	15.000	-18.53	15.00	-200.0	-600.0	0.0
	8.000	-10.000	15.000	-19.40	15.00	-200.0	-600.0	0.0
	8.000	-8.000	15.000	-19.67	15.00	-200.0	-600.0	0.0
	8.000	-6.000	15.000	-19.75	15.00	-200.0	-600.0	0.0
	8.000	-4.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	8.000	-2.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	8.000	0.000	15.000	-19.75	15.00	-200.0	-600.0	0.0
	8.000	2.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	8.000	4.000	15.000	-19.76	15.00	-200.0	-600.0	0.0
	8.000	6.000	15.000	-19.75	15.00	-200.0	-600.0	0.0
	8.000	8.000	15.000	-19.67	15.00	-200.0	-600.0	0.0
	8.000	10.000	15.000	-19.40	15.00	-200.0	-600.0	0.0
	8.000	12.000	15.000	-18.53	15.00	-200.0	-600.0	0.0
	8.000	14.000	15.000	-15.50	15.00	-200.0	-600.0	0.0
	8.000	16.000	15.000	-3.1180	15.00	0.0	-0.02275	0.0
	8.000	18.000	15.000	-0.1575	15.00	0.0	-0.007620	0.0
	8.000	20.000	15.000	0.6898	15.00	0.0	-0.003769	0.0
	8.000	22.000	15.000	0.9340	15.00	0.0	-0.002282	0.0
	8.000	24.000	15.000	0.9744	15.00	0.0	-0.001534	0.0
	8.000	26.000	15.000	0.9423	15.00	0.0	-0.001099	0.0
	8.000	28.000	15.000	0.8852	15.00	0.0	-823.0E-6	0.0
	8.000	30.000	15.000	0.8213	15.00	0.0	-636.2E-6	0.0
	8.000	32.000	15.000	0.7577	15.00	0.0	-504.0E-6	0.0
	8.000	34.000	15.000	0.6973	15.00	0.0	-407.2E-6	0.0
	8.000	36.000	15.000	0.6411	15.00	0.0	-334.3E-6	0.0
	8.000	38.000	15.000	0.5892	15.00	0.0	-278.3E-6	0.0
	8.000	40.000	15.000	0.5416	15.00	0.0	-234.3E-6	0.0
	10.000	-40.000	15.000	0.5314	15.00	0.0	-226.1E-6	0.0
	10.000	-38.000	15.000	0.5775	15.00	0.0	-267.5E-6	0.0
	10.000	-36.000	15.000	0.6276	15.00	0.0	-319.9E-6	0.0
	10.000	-34.000	15.000	0.6818	15.00	0.0	-387.6E-6	0.0
	10.000	-32.000	15.000	0.7401	15.00	0.0	-477.0E-6	0.0
	10.000	-30.000	15.000	0.8013	15.00	0.0	-580.0E-6	0.0
	10.000	-28.000	15.000	0.8632	15.00	0.0	-767.4E-6	0.0
	10.000	-26.000	15.000	0.9194	15.00	0.0	-0.001016	0.0
	10.000	-24.000	15.000	0.9542	15.00	0.0	-0.001402	0.0
	10.000	-22.000	15.000	0.9259	15.00	0.0	-0.002063	0.0
	10.000	-20.000	15.000	0.7178	15.00	0.0	-0.003377	0.0
	10.000	-18.000	15.000	-0.				



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Z[Level]	Z	Calc Level	Stresses		Vert Strain
	X	Y	[mOD]	[mm]	[mOD]	Vert Stress	Sum Princ	[-]
	[m]	[m]				[kN/m²]	[kN/m²]	
	10.000	26.000	15.000	0.9194	15.00	0.0	-0.001016	0.0
	10.000	28.000	15.000	0.8632	15.00	0.0	-767.4E-6	0.0
	10.000	30.000	15.000	0.8013	15.00	0.0	-598.0E-6	0.0
	10.000	32.000	15.000	0.7401	15.00	0.0	-477.0E-6	0.0
	10.000	34.000	15.000	0.6818	15.00	0.0	-387.6E-6	0.0
	10.000	36.000	15.000	0.6276	15.00	0.0	-319.9E-6	0.0
	10.000	38.000	15.000	0.5775	15.00	0.0	-267.5E-6	0.0
	10.000	40.000	15.000	0.5314	15.00	0.0	-226.1E-6	0.0
	12.000	-40.000	15.000	0.5194	15.00	0.0	-216.6E-6	0.0
	12.000	-38.000	15.000	0.5636	15.00	0.0	-255.0E-6	0.0
	12.000	-36.000	15.000	0.6117	15.00	0.0	-303.4E-6	0.0
	12.000	-34.000	15.000	0.6637	15.00	0.0	-365.3E-6	0.0
	12.000	-32.000	15.000	0.7193	15.00	0.0	-446.2E-6	0.0
	12.000	-30.000	15.000	0.7789	15.00	0.0	-554.5E-6	0.0
	12.000	-28.000	15.000	0.8376	15.00	0.0	-703.9E-6	0.0
	12.000	-26.000	15.000	0.8931	15.00	0.0	-919.1E-6	0.0
	12.000	-24.000	15.000	0.9322	15.00	0.0	-0.001247	0.0
	12.000	-22.000	15.000	0.9225	15.00	0.0	-0.001794	0.0
	12.000	-20.000	15.000	0.7757	15.00	0.0	-0.002844	0.0
	12.000	-18.000	15.000	0.2161	15.00	0.0	-0.005538	0.0
	12.000	-16.000	15.000	-1.973	15.00	0.0	-0.02225	0.0
	12.000	-14.000	15.000	-12.72	15.00	-200.0	-599.9	-1.231E-6
	12.000	-12.000	15.000	-14.91	15.00	-200.0	-600.0	0.0
	12.000	-10.000	15.000	-15.49	15.00	-200.0	-600.0	0.0
	12.000	-8.000	15.000	-15.66	15.00	-200.0	-600.0	0.0
	12.000	-6.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	12.000	-4.000	15.000	-15.71	15.00	-200.0	-600.0	0.0
	12.000	-2.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	12.000	0.000	15.000	-15.78	15.00	-200.0	-600.0	0.0
	12.000	2.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	12.000	4.000	15.000	-15.71	15.00	-200.0	-600.0	0.0
	12.000	6.000	15.000	-15.70	15.00	-200.0	-600.0	0.0
	12.000	8.000	15.000	-15.66	15.00	-200.0	-600.0	0.0
	12.000	10.000	15.000	-15.49	15.00	-200.0	-600.0	0.0
	12.000	12.000	15.000	-14.91	15.00	-200.0	-600.0	0.0
	12.000	14.000	15.000	-12.72	15.00	-200.0	-599.9	-1.231E-6
	12.000	16.000	15.000	-1.973	15.00	0.0	-0.02225	0.0
	12.000	18.000	15.000	0.2161	15.00	0.0	-0.005538	0.0
	12.000	20.000	15.000	0.7757	15.00	0.0	-0.002844	0.0
	12.000	22.000	15.000	0.9225	15.00	0.0	-0.001794	0.0
	12.000	24.000	15.000	0.9322	15.00	0.0	-0.001247	0.0
	12.000	26.000	15.000	0.8931	15.00	0.0	-919.1E-6	0.0
	12.000	28.000	15.000	0.8376	15.00	0.0	-703.9E-6	0.0
	12.000	30.000	15.000	0.7789	15.00	0.0	-554.5E-6	0.0
	12.000	32.000	15.000	0.7193	15.00	0.0	-446.2E-6	0.0
	12.000	34.000	15.000	0.6637	15.00	0.0	-365.3E-6	0.0
	12.000	36.000	15.000	0.6117	15.00	0.0	-303.4E-6	0.0
	12.000	38.000	15.000	0.5636	15.00	0.0	-255.0E-6	0.0
	12.000	40.000	15.000	0.5194	15.00	0.0	-216.6E-6	0.0
	14.000	-40.000	15.000	0.5057	15.00	0.0	-206.0E-6	0.0
	14.000	-38.000	15.000	0.5480	15.00	0.0	-241.3E-6	0.0
	14.000	-36.000	15.000	0.5938	15.00	0.0	-285.4E-6	0.0
	14.000	-34.000	15.000	0.6432	15.00	0.0	-341.1E-6	0.0
	14.000	-32.000	15.000	0.6960	15.00	0.0	-413.9E-6	0.0
	14.000	-30.000	15.000	0.7518	15.00	0.0	-507.7E-6	0.0
	14.000	-28.000	15.000	0.8089	15.00	0.0	-636.1E-6	0.0
	14.000	-26.000	15.000	0.8636	15.00	0.0	-816.2E-6	0.0
	14.000	-24.000	15.000	0.9074	15.00	0.0	-0.001082	0.0
	14.000	-22.000	15.000	0.9192	15.00	0.0	-0.001501	0.0
	14.000	-20.000	15.000	0.8465	15.00	0.0	-0.002240	0.0
	14.000	-18.000	15.000	0.5529	15.00	0.0	-0.003819	0.0
	14.000	-16.000	15.000	-0.3234	15.00	0.0	-0.008782	0.0
	14.000	-14.000	15.000	-1.968	15.00	0.0	-0.02226	0.0
	14.000	-12.000	15.000	-2.852	15.00	0.0	-0.02722	0.0
	14.000	-10.000	15.000	-3.161	15.00	0.0	-0.02878	0.0
	14.000	-8.000	15.000	-3.258	15.00	0.0	-0.02949	0.0
	14.000	-6.000	15.000	-3.277	15.00	0.0	-0.02987	0.0
	14.000	-4.000	15.000	-3.272	15.00	0.0	-0.03009	0.0
	14.000	-2.000	15.000	-3.264	15.00	0.0	-0.03020	0.0
	14.000	0.000	15.000	-3.261	15.00	0.0	-0.03024	0.0
	14.000	2.000	15.000	-3.264	15.00	0.0	-0.03020	0.0
	14.000	4.000	15.000	-3.272	15.00	0.0	-0.03009	0.0
	14.000	6.000	15.000	-3.277	15.00	0.0	-0.02987	0.0
	14.000	8.000	15.000	-3.258	15.00	0.0	-0.02949	0.0
	14.000	10.000	15.000	-3.161	15.00	0.0	-0.02878	0.0
	14.000	12.000	15.000	-2.852	15.00	0.0	-0.02722	0.0
	14.000	14.000	15.000	-1.968	15.00	0.0	-0.02226	0.0
	14.000	16.000	15.000	-0.3234	15.00	0.0	-0.008782	0.0
	14.000	18.000	15.000	0.5529	15.00	0.0	-0.003819	0.0
	14.000	20.000	15.000	0.8465	15.00	0.0	-0.002240	0.0
	14.000	22.000	15.000	0.9192	15.00	0.0	-0.001501	0.0
	14.000	24.000	15.000	0.9074	15.00	0.0	-0.001082	0.0
	14.000	26.000	15.000	0.8636	15.00	0.0	-816.2E-6	0.0
	14.000	28.000	15.000	0.8089	15.00	0.0	-636.1E-6	0.0
	14.000	30.000	15.000	0.7518	15.00	0.0	-507.7E-6	0.0
	14.000	32.000	15.000	0.6960	15.00	0.0	-413.9E-6	0.0
	14.000	34.000	15.000	0.6432	15.00	0.0	-341.1E-6	0.0
	14.000	36.000	15.000	0.5938	15.00	0.0	-285.4E-6	0.0
	14.000	38.000	15.000	0.5480	15.00	0.0	-241.3E-6	0.0
	14.000	40.000	15.000	0.5057	15.00	0.0	-206.0E-6	0.0
	16.000	-40.000	15.000	0.4906	15.00	0.0	-194.8E-6	0.0
	16.000	-38.000	15.000	0.5308	15.00	0.0	-226.9E-6	0.0
	16.000	-36.000	15.000	0.5741	15.00	0.0	-266.4E-6	0.0
	16.000	-34.000	15.000	0.6208	15.00	0.0	-315.9E-6	0.0
	16.000	-32.000	15.000	0.6706	15.00	0.0	-378.7E-6	0.0
	16.000	-30.000	15.000	0.7232	15.00	0.0	-460.0E-6	0.0
	16.000	-28.000	15.000	0.7775	15.00	0.0	-567.4E-6	0.0
	16.000	-26.000	15.000	0.8310	15.00	0.0	-713.6E-6	0.0
	16.000	-24.000	15.000	0.8783	15.00	0.0	-919.5E-6	0.0
	16.000	-22.000	15.000	0.9081	15.00	0.0	-0.001223	0.0
	16.000	-20.000	15.000	0.8959	15.00	0.0	-0.001698	0.0
	16.000	-18.000	15.000	0.7967	15.00	0.0	-0.002490	0.0
	16.000	-16.000	15.000	0.5572	15.00	0.0	-0.003823	0.0
	16.000	-14.000	15.000	0.2254	15.00	0.0	-0.005548	0.0
	16.000	-12.000	15.000	-0.02140	15.00	0.0	-0.008875	0.0
	16.000	-10.000	15.000	-0.1354	15.00	0.0	-0.007652	0.0
	16.000	-8.000	15.000	-0.1696	15.00	0.0	-0.008104	0.0
	16.000	-6.000	15.000	-0.1693	15.00	0.0	-0.008375	0.0
	16.000	-4.000	15.000	-0.1587	15.00	0.0	-0.008536	0.0
	16.000	-2.000	15.000	-0.1491	15.00	0.0	-0.008622	0.0
	16.000	0.000	15.000	-0.1455	15.00	0.0	-0.008649	0.0
	16.000	2.000	15.000	-0.1491	15.00	0.0	-0.008622	0.0
	16.000	4.000	15.000	-0.1587	15.00	0.0	-0.008536	0.0
	16.000	6.000	15.000	-0.1693	15.00	0.0	-0.008375	0.0
	16.000	8.000	15.000	-0.1696	15.00	0.0	-0.008104	0.0
	16.000	10.000	15.000	-0.1354	15.00	0.0	-0.007652	0.0
	16.000	12.000	15.000	-0.02140	15.00	0.0	-0.008875	0.0
	16.000	14.000	15.000	0.2254	15.00	0.0	-0.00.	



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Heave Calculation

Name	X [m]	Location Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	18.000	-20.000	15.000	0.9072	15.00	0.0	-0.001285	0.0
	18.000	-18.000	15.000	0.8994	15.00	0.0	-0.001701	0.0
	18.000	-16.000	15.000	0.8541	15.00	0.0	-0.002248	0.0
	18.000	-14.000	15.000	0.7882	15.00	0.0	-0.002857	0.0
	18.000	-12.000	15.000	0.7360	15.00	0.0	-0.003398	0.0
	18.000	-10.000	15.000	0.7144	15.00	0.0	-0.003801	0.0
	18.000	-8.000	15.000	0.7165	15.00	0.0	-0.004079	0.0
	18.000	-6.000	15.000	0.7294	15.00	0.0	-0.004264	0.0
	18.000	-4.000	15.000	0.7439	15.00	0.0	-0.004381	0.0
	18.000	-2.000	15.000	0.7543	15.00	0.0	-0.004445	0.0
	18.000	0.000	15.000	0.7580	15.00	0.0	-0.004466	0.0
	18.000	2.000	15.000	0.7543	15.00	0.0	-0.004445	0.0
	18.000	4.000	15.000	0.7439	15.00	0.0	-0.004381	0.0
	18.000	6.000	15.000	0.7294	15.00	0.0	-0.004264	0.0
	18.000	8.000	15.000	0.7165	15.00	0.0	-0.004079	0.0
	18.000	10.000	15.000	0.7144	15.00	0.0	-0.003801	0.0
	18.000	12.000	15.000	0.7360	15.00	0.0	-0.003398	0.0
	18.000	14.000	15.000	0.7882	15.00	0.0	-0.002857	0.0
	18.000	16.000	15.000	0.8541	15.00	0.0	-0.002248	0.0
	18.000	18.000	15.000	0.8994	15.00	0.0	-0.001701	0.0
	18.000	20.000	15.000	0.9072	15.00	0.0	-0.001285	0.0
	18.000	22.000	15.000	0.8846	15.00	0.0	-986.2E-6	0.0
	18.000	24.000	15.000	0.8441	15.00	0.0	-772.8E-6	0.0
	18.000	26.000	15.000	0.7953	15.00	0.0	-617.3E-6	0.0
	18.000	28.000	15.000	0.7439	15.00	0.0	-501.4E-6	0.0
	18.000	30.000	15.000	0.6928	15.00	0.0	-413.1E-6	0.0
	18.000	32.000	15.000	0.6435	15.00	0.0	-344.5E-6	0.0
	18.000	34.000	15.000	0.5969	15.00	0.0	-290.4E-6	0.0
	18.000	36.000	15.000	0.5531	15.00	0.0	-247.1E-6	0.0
	18.000	38.000	15.000	0.5123	15.00	0.0	-212.0E-6	0.0
	18.000	40.000	15.000	0.4744	15.00	0.0	-183.2E-6	0.0
	20.000	-40.000	15.000	0.4573	15.00	0.0	-171.4E-6	0.0
	20.000	-38.000	15.000	0.4929	15.00	0.0	-197.1E-6	0.0
	20.000	-36.000	15.000	0.5311	15.00	0.0	-227.9E-6	0.0
	20.000	-34.000	15.000	0.5719	15.00	0.0	-265.5E-6	0.0
	20.000	-32.000	15.000	0.6153	15.00	0.0	-311.5E-6	0.0
	20.000	-30.000	15.000	0.6611	15.00	0.0	-368.7E-6	0.0
	20.000	-28.000	15.000	0.7087	15.00	0.0	-440.2E-6	0.0
	20.000	-26.000	15.000	0.7573	15.00	0.0	-531.9E-6	0.0
	20.000	-24.000	15.000	0.8052	15.00	0.0	-647.1E-6	0.0
	20.000	-22.000	15.000	0.8498	15.00	0.0	-796.6E-6	0.0
	20.000	-20.000	15.000	0.8874	15.00	0.0	-988.4E-6	0.0
	20.000	-18.000	15.000	0.9143	15.00	0.0	-0.001228	0.0
	20.000	-16.000	15.000	0.9294	15.00	0.0	-0.001510	0.0
	20.000	-14.000	15.000	0.9374	15.00	0.0	-0.001808	0.0
	20.000	-12.000	15.000	0.9462	15.00	0.0	-0.002084	0.0
	20.000	-10.000	15.000	0.9603	15.00	0.0	-0.002313	0.0
	20.000	-8.000	15.000	0.9787	15.00	0.0	-0.002487	0.0
	20.000	-6.000	15.000	0.9978	15.00	0.0	-0.002611	0.0
	20.000	-4.000	15.000	1.0114	15.00	0.0	-0.002694	0.0
	20.000	-2.000	15.000	1.024	15.00	0.0	-0.002741	0.0
	20.000	0.000	15.000	1.028	15.00	0.0	-0.002756	0.0
	20.000	2.000	15.000	1.024	15.00	0.0	-0.002741	0.0
	20.000	4.000	15.000	1.0114	15.00	0.0	-0.002694	0.0
	20.000	6.000	15.000	0.9978	15.00	0.0	-0.002611	0.0
	20.000	8.000	15.000	0.9787	15.00	0.0	-0.002487	0.0
	20.000	10.000	15.000	0.9603	15.00	0.0	-0.002313	0.0
	20.000	12.000	15.000	0.9462	15.00	0.0	-0.002084	0.0
	20.000	14.000	15.000	0.9374	15.00	0.0	-0.001808	0.0
	20.000	16.000	15.000	0.9294	15.00	0.0	-0.001510	0.0
	20.000	18.000	15.000	0.9143	15.00	0.0	-0.001228	0.0
	20.000	20.000	15.000	0.8874	15.00	0.0	-988.4E-6	0.0
	20.000	22.000	15.000	0.8498	15.00	0.0	-796.6E-6	0.0
	20.000	24.000	15.000	0.8052	15.00	0.0	-647.1E-6	0.0
	20.000	26.000	15.000	0.7573	15.00	0.0	-531.9E-6	0.0
	20.000	28.000	15.000	0.7087	15.00	0.0	-440.2E-6	0.0
	20.000	30.000	15.000	0.6611	15.00	0.0	-368.7E-6	0.0
	20.000	32.000	15.000	0.6153	15.00	0.0	-311.5E-6	0.0
	20.000	34.000	15.000	0.5719	15.00	0.0	-265.5E-6	0.0
	20.000	36.000	15.000	0.5311	15.00	0.0	-227.9E-6	0.0
	20.000	38.000	15.000	0.4929	15.00	0.0	-197.1E-6	0.0
	20.000	40.000	15.000	0.4573	15.00	0.0	-171.4E-6	0.0
	22.000	-40.000	15.000	0.4396	15.00	0.0	-159.8E-6	0.0
	22.000	-38.000	15.000	0.4728	15.00	0.0	-182.4E-6	0.0
	22.000	-36.000	15.000	0.5084	15.00	0.0	-209.4E-6	0.0
	22.000	-34.000	15.000	0.5462	15.00	0.0	-241.6E-6	0.0
	22.000	-32.000	15.000	0.5864	15.00	0.0	-280.5E-6	0.0
	22.000	-30.000	15.000	0.6286	15.00	0.0	-327.7E-6	0.0
	22.000	-28.000	15.000	0.6726	15.00	0.0	-385.3E-6	0.0
	22.000	-26.000	15.000	0.7178	15.00	0.0	-455.9E-6	0.0
	22.000	-24.000	15.000	0.7632	15.00	0.0	-542.6E-6	0.0
	22.000	-22.000	15.000	0.8075	15.00	0.0	-648.6E-6	0.0
	22.000	-20.000	15.000	0.8492	15.00	0.0	-776.5E-6	0.0
	22.000	-18.000	15.000	0.8867	15.00	0.0	-925.9E-6	0.0
	22.000	-16.000	15.000	0.9196	15.00	0.0	-0.001092	0.0
	22.000	-14.000	15.000	0.9488	15.00	0.0	-0.001262	0.0
	22.000	-12.000	15.000	0.9758	15.00	0.0	-0.001423	0.0
	22.000	-10.000	15.000	1.002	15.00	0.0	-0.001562	0.0
	22.000	-8.000	15.000	1.026	15.00	0.0	-0.001675	0.0
	22.000	-6.000	15.000	1.046	15.00	0.0	-0.001759	0.0
	22.000	-4.000	15.000	1.062	15.00	0.0	-0.001818	0.0
	22.000	-2.000	15.000	1.072	15.00	0.0	-0.001852	0.0
	22.000	0.000	15.000	1.076	15.00	0.0	-0.001863	0.0
	22.000	2.000	15.000	1.072	15.00	0.0	-0.001852	0.0
	22.000	4.000	15.000	1.062	15.00	0.0	-0.001818	0.0
	22.000	6.000	15.000	1.046	15.00	0.0	-0.001759	0.0
	22.000	8.000	15.000	1.026	15.00	0.0	-0.001675	0.0
	22.000	10.000	15.000	1.002	15.00	0.0	-0.001562	0.0
	22.000	12.000	15.000	0.9758	15.00	0.0	-0.001423	0.0
	22.000	14.000	15.000	0.9488	15.00	0.0	-0.001262	0.0
	22.000	16.000	15.000	0.9196	15.00	0.0	-0.001092	0.0
	22.000	18.000	15.000	0.8867	15.00	0.0	-925.9E-6	0.0
	22.000	20.000	15.000	0.8492	15.00	0.0	-776.5E-6	0.0
	22.000	22.000	15.000	0.8075	15.00	0.0	-648.6E-6	0.0
	22.000	24.000	15.000	0.7632	15.00	0.0	-542.6E-6	0.0
	22.000	26.000	15.000	0.7178	15.00	0.0	-455.9E-6	0.0
	22.000	28.000	15.000	0.6726	15.00	0.0	-385.3E-6	0.0
	22.000	30.000	15.000	0.6286	15.00	0.0	-327.7E-6	0.0
	22.000	32.000	15.000	0.5864	15.00	0.0	-280.5E-6	0.0
	22.000	34.000	15.000	0.5462	15.00	0.0	-241.6E-6	0.0
	22.000	36.000	15.000	0.5084	15.00	0.0	-209.4E-6	0.0
	22.000	38.000	15.000	0.4728	15.00	0.0	-182.4E-6	0.0
	22.000	40.000	15.000	0.4396	15.00	0.0	-159.8E-6	0.0
	24.000	-40.000	15.000	0.4215	15.00	0.0	-148.4E-6	0.0
	24.000	-38.000	15.000	0.4524	15.00	0.0	-168.3E-6	0.0
	24.000	-36.000	15.000	0.4853	15.00	0.0	-191.6E-6	0.0
	24.000	-34.000	15.000	0.5203	15.00	0.0	-219.2E-6	0.0
	24.000	-32.000	15.000	0.5572	15.00	0.0	-251.8E-6	0.0
	24.000	-30.000	15.000	0.5959	15.00	0.0	-290.6E-6	0.0
	24.000	-28.000	15.000	0.6362	15.00	0.0	-336.8E-6	0.0
	24.000	-26.000	15.000	0.6777	15.00	0.0	-391.8E-6	0.0
	24.000	-24.000	15.000	0.7197	15.00	0.0	-457.0E-6	0.0
	24.000	-22.000	15.000	0.7615	15.00	0.0	-533.6E-6	0.0
	24.000	-20.000	15.000	0.8022	15.00	0.0	-621.9E-6	0.0
	24.000	-18.000	15.000	0.8410	15.00	0.0	-720.7E-6	0.0
	24.000	-16.000	15.000	0.8773	15.00	0.0	-826.5E-6	0.0
	24.000	-14.000	15.000	0.9109	15.00	0.0	-933.5E-6	0.0
	24.000	-12.000	15.000	0.9418	15.00	0.0	-0.001035	0.0
	24.000	-10.000	15.000	0.9697	15.00	0.0	-0.001125	0.0
	24.000	-8.000	15.000	0.9942	15.00	0.0	-0.001200	0.0
	24.000	-6.000	15.000	1.0114	15.00	0.0	-0.001258	0.0
	24.000	-4.000	15.000	1.029	15.00	0.0	-0.001300	0.0</



UCL Student Centre

GEOTECHNICAL CONSULTING GROUP

Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Stresses					
	X [m]	Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Sum Princ [kN/m²]	Vert Strain [-]
	24.000	16.000	15.000	0.8773	15.00	0.0	-826.5E-6	0.0
	24.000	18.000	15.000	0.8410	15.00	0.0	-720.7E-6	0.0
	24.000	20.000	15.000	0.8022	15.00	0.0	-621.9E-6	0.0
	24.000	22.000	15.000	0.7615	15.00	0.0	-533.6E-6	0.0
	24.000	24.000	15.000	0.7197	15.00	0.0	-457.0E-6	0.0
	24.000	26.000	15.000	0.6777	15.00	0.0	-391.8E-6	0.0
	24.000	28.000	15.000	0.6362	15.00	0.0	-336.8E-6	0.0
	24.000	30.000	15.000	0.5959	15.00	0.0	-290.6E-6	0.0
	24.000	32.000	15.000	0.5572	15.00	0.0	-251.8E-6	0.0
	24.000	34.000	15.000	0.5203	15.00	0.0	-219.2E-6	0.0
	24.000	36.000	15.000	0.4853	15.00	0.0	-191.6E-6	0.0
	24.000	38.000	15.000	0.4524	15.00	0.0	-168.3E-6	0.0
	24.000	40.000	15.000	0.4215	15.00	0.0	-148.4E-6	0.0
	26.000	-40.000	15.000	0.4831	15.00	0.0	-137.5E-6	0.0
	26.000	-38.000	15.000	0.4317	15.00	0.0	-154.8E-6	0.0
	26.000	-36.000	15.000	0.4621	15.00	0.0	-175.0E-6	0.0
	26.000	-34.000	15.000	0.4943	15.00	0.0	-198.4E-6	0.0
	26.000	-32.000	15.000	0.5281	15.00	0.0	-225.7E-6	0.0
	26.000	-30.000	15.000	0.5634	15.00	0.0	-257.5E-6	0.0
	26.000	-28.000	15.000	0.6001	15.00	0.0	-294.6E-6	0.0
	26.000	-26.000	15.000	0.6378	15.00	0.0	-337.6E-6	0.0
	26.000	-24.000	15.000	0.6761	15.00	0.0	-387.2E-6	0.0
	26.000	-22.000	15.000	0.7144	15.00	0.0	-443.5E-6	0.0
	26.000	-20.000	15.000	0.7522	15.00	0.0	-506.5E-6	0.0
	26.000	-18.000	15.000	0.7887	15.00	0.0	-574.8E-6	0.0
	26.000	-16.000	15.000	0.8235	15.00	0.0	-646.2E-6	0.0
	26.000	-14.000	15.000	0.8560	15.00	0.0	-717.6E-6	0.0
	26.000	-12.000	15.000	0.8858	15.00	0.0	-785.4E-6	0.0
	26.000	-10.000	15.000	0.9124	15.00	0.0	-846.3E-6	0.0
	26.000	-8.000	15.000	0.9353	15.00	0.0	-897.9E-6	0.0
	26.000	-6.000	15.000	0.9539	15.00	0.0	-938.7E-6	0.0
	26.000	-4.000	15.000	0.9676	15.00	0.0	-968.0E-6	0.0
	26.000	-2.000	15.000	0.9760	15.00	0.0	-985.6E-6	0.0
	26.000	0.000	15.000	0.9798	15.00	0.0	-991.5E-6	0.0
	26.000	2.000	15.000	0.9760	15.00	0.0	-985.6E-6	0.0
	26.000	4.000	15.000	0.9676	15.00	0.0	-968.0E-6	0.0
	26.000	6.000	15.000	0.9539	15.00	0.0	-938.7E-6	0.0
	26.000	8.000	15.000	0.9353	15.00	0.0	-897.9E-6	0.0
	26.000	10.000	15.000	0.9124	15.00	0.0	-846.3E-6	0.0
	26.000	12.000	15.000	0.8858	15.00	0.0	-785.4E-6	0.0
	26.000	14.000	15.000	0.8560	15.00	0.0	-717.6E-6	0.0
	26.000	16.000	15.000	0.8235	15.00	0.0	-646.2E-6	0.0
	26.000	18.000	15.000	0.7887	15.00	0.0	-574.8E-6	0.0
	26.000	20.000	15.000	0.7522	15.00	0.0	-506.5E-6	0.0
	26.000	22.000	15.000	0.7144	15.00	0.0	-443.5E-6	0.0
	26.000	24.000	15.000	0.6761	15.00	0.0	-387.2E-6	0.0
	26.000	26.000	15.000	0.6378	15.00	0.0	-337.6E-6	0.0
	26.000	28.000	15.000	0.6001	15.00	0.0	-294.6E-6	0.0
	26.000	30.000	15.000	0.5634	15.00	0.0	-257.5E-6	0.0
	26.000	32.000	15.000	0.5281	15.00	0.0	-225.7E-6	0.0
	26.000	34.000	15.000	0.4943	15.00	0.0	-198.4E-6	0.0
	26.000	36.000	15.000	0.4621	15.00	0.0	-175.0E-6	0.0
	26.000	38.000	15.000	0.4317	15.00	0.0	-154.8E-6	0.0
	26.000	40.000	15.000	0.4831	15.00	0.0	-137.5E-6	0.0
	28.000	-40.000	15.000	0.3847	15.00	0.0	-127.1E-6	0.0
	28.000	-38.000	15.000	0.4111	15.00	0.0	-142.2E-6	0.0
	28.000	-36.000	15.000	0.4391	15.00	0.0	-159.5E-6	0.0
	28.000	-34.000	15.000	0.4685	15.00	0.0	-179.4E-6	0.0
	28.000	-32.000	15.000	0.4994	15.00	0.0	-202.2E-6	0.0
	28.000	-30.000	15.000	0.5315	15.00	0.0	-228.3E-6	0.0
	28.000	-28.000	15.000	0.5648	15.00	0.0	-258.1E-6	0.0
	28.000	-26.000	15.000	0.5988	15.00	0.0	-292.0E-6	0.0
	28.000	-24.000	15.000	0.6333	15.00	0.0	-330.1E-6	0.0
	28.000	-22.000	15.000	0.6679	15.00	0.0	-372.4E-6	0.0
	28.000	-20.000	15.000	0.7021	15.00	0.0	-418.4E-6	0.0
	28.000	-18.000	15.000	0.7353	15.00	0.0	-467.3E-6	0.0
	28.000	-16.000	15.000	0.7670	15.00	0.0	-517.5E-6	0.0
	28.000	-14.000	15.000	0.7967	15.00	0.0	-567.2E-6	0.0
	28.000	-12.000	15.000	0.8238	15.00	0.0	-614.3E-6	0.0
	28.000	-10.000	15.000	0.8489	15.00	0.0	-656.9E-6	0.0
	28.000	-8.000	15.000	0.8686	15.00	0.0	-693.3E-6	0.0
	28.000	-6.000	15.000	0.8852	15.00	0.0	-722.4E-6	0.0
	28.000	-4.000	15.000	0.8974	15.00	0.0	-743.5E-6	0.0
	28.000	-2.000	15.000	0.9048	15.00	0.0	-756.3E-6	0.0
	28.000	0.000	15.000	0.9073	15.00	0.0	-760.6E-6	0.0
	28.000	2.000	15.000	0.9048	15.00	0.0	-756.3E-6	0.0
	28.000	4.000	15.000	0.8974	15.00	0.0	-743.5E-6	0.0
	28.000	6.000	15.000	0.8852	15.00	0.0	-722.4E-6	0.0
	28.000	8.000	15.000	0.8686	15.00	0.0	-693.3E-6	0.0
	28.000	10.000	15.000	0.8489	15.00	0.0	-656.9E-6	0.0
	28.000	12.000	15.000	0.8238	15.00	0.0	-614.3E-6	0.0
	28.000	14.000	15.000	0.7967	15.00	0.0	-567.2E-6	0.0
	28.000	16.000	15.000	0.7670	15.00	0.0	-517.5E-6	0.0
	28.000	18.000	15.000	0.7353	15.00	0.0	-467.3E-6	0.0
	28.000	20.000	15.000	0.7021	15.00	0.0	-418.4E-6	0.0
	28.000	22.000	15.000	0.6679	15.00	0.0	-372.4E-6	0.0
	28.000	24.000	15.000	0.6333	15.00	0.0	-330.1E-6	0.0
	28.000	26.000	15.000	0.5988	15.00	0.0	-292.0E-6	0.0
	28.000	28.000	15.000	0.5648	15.00	0.0	-258.1E-6	0.0
	28.000	30.000	15.000	0.5315	15.00	0.0	-228.3E-6	0.0
	28.000	32.000	15.000	0.4994	15.00	0.0	-202.2E-6	0.0
	28.000	34.000	15.000	0.4685	15.00	0.0	-179.4E-6	0.0
	28.000	36.000	15.000	0.4391	15.00	0.0	-159.5E-6	0.0
	28.000	38.000	15.000	0.4111	15.00	0.0	-142.2E-6	0.0
	28.000	40.000	15.000	0.3847	15.00	0.0	-127.1E-6	0.0
	30.000	-40.000	15.000	0.3665	15.00	0.0	-117.3E-6	0.0
	30.000	-38.000	15.000	0.3908	15.00	0.0	-130.4E-6	0.0
	30.000	-36.000	15.000	0.4164	15.00	0.0	-145.3E-6	0.0
	30.000	-34.000	15.000	0.4433	15.00	0.0	-162.1E-6	0.0
	30.000	-32.000	15.000	0.4714	15.00	0.0	-181.2E-6	0.0
	30.000	-30.000	15.000	0.5005	15.00	0.0	-202.7E-6	0.0
	30.000	-28.000	15.000	0.5305	15.00	0.0	-226.8E-6	0.0
	30.000	-26.000	15.000	0.5611	15.00	0.0	-253.6E-6	0.0
	30.000	-24.000	15.000	0.5920	15.00	0.0	-283.3E-6	0.0
	30.000	-22.000	15.000	0.6230	15.00	0.0	-315.5E-6	0.0
	30.000	-20.000						



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Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	Location		Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Stresses		Vert Strain [.]
	X [m]	Y [m]				Vert Stress [kN/m²]	Sum Princ [kN/m²]	
	32.000	-30.000	15.000	0.4705	15.00	0.0	-180.2E-6	0.0
	32.000	-28.000	15.000	0.4975	15.00	0.0	-199.8E-6	0.0
	32.000	-26.000	15.000	0.5249	15.00	0.0	-221.3E-6	0.0
	32.000	-24.000	15.000	0.5526	15.00	0.0	-244.6E-6	0.0
	32.000	-22.000	15.000	0.5802	15.00	0.0	-269.5E-6	0.0
	32.000	-20.000	15.000	0.6073	15.00	0.0	-295.7E-6	0.0
	32.000	-18.000	15.000	0.6336	15.00	0.0	-322.7E-6	0.0
	32.000	-16.000	15.000	0.6586	15.00	0.0	-349.7E-6	0.0
	32.000	-14.000	15.000	0.6820	15.00	0.0	-376.1E-6	0.0
	32.000	-12.000	15.000	0.7033	15.00	0.0	-400.9E-6	0.0
	32.000	-10.000	15.000	0.7222	15.00	0.0	-423.3E-6	0.0
	32.000	-8.000	15.000	0.7382	15.00	0.0	-442.6E-6	0.0
	32.000	-6.000	15.000	0.7510	15.00	0.0	-458.2E-6	0.0
	32.000	-4.000	15.000	0.7603	15.00	0.0	-469.6E-6	0.0
	32.000	-2.000	15.000	0.7660	15.00	0.0	-476.5E-6	0.0
	32.000	0.000	15.000	0.7679	15.00	0.0	-478.9E-6	0.0
	32.000	2.000	15.000	0.7660	15.00	0.0	-476.5E-6	0.0
	32.000	4.000	15.000	0.7603	15.00	0.0	-469.6E-6	0.0
	32.000	6.000	15.000	0.7510	15.00	0.0	-458.2E-6	0.0
	32.000	8.000	15.000	0.7382	15.00	0.0	-442.6E-6	0.0
	32.000	10.000	15.000	0.7222	15.00	0.0	-423.3E-6	0.0
	32.000	12.000	15.000	0.7033	15.00	0.0	-400.9E-6	0.0
	32.000	14.000	15.000	0.6820	15.00	0.0	-376.1E-6	0.0
	32.000	16.000	15.000	0.6586	15.00	0.0	-349.7E-6	0.0
	32.000	18.000	15.000	0.6336	15.00	0.0	-322.7E-6	0.0
	32.000	20.000	15.000	0.6073	15.00	0.0	-295.7E-6	0.0
	32.000	22.000	15.000	0.5802	15.00	0.0	-269.5E-6	0.0
	32.000	24.000	15.000	0.5526	15.00	0.0	-244.6E-6	0.0
	32.000	26.000	15.000	0.5249	15.00	0.0	-221.3E-6	0.0
	32.000	28.000	15.000	0.4975	15.00	0.0	-199.8E-6	0.0
	32.000	30.000	15.000	0.4705	15.00	0.0	-180.2E-6	0.0
	32.000	32.000	15.000	0.4442	15.00	0.0	-162.5E-6	0.0
	32.000	34.000	15.000	0.4187	15.00	0.0	-146.6E-6	0.0
	32.000	36.000	15.000	0.3943	15.00	0.0	-132.3E-6	0.0
	32.000	38.000	15.000	0.3700	15.00	0.0	-119.5E-6	0.0
	32.000	40.000	15.000	0.3485	15.00	0.0	-108.1E-6	0.0
	34.000	-40.000	15.000	0.3310	15.00	0.0	-99.62E-6	0.0
	34.000	-38.000	15.000	0.3514	15.00	0.0	-109.5E-6	0.0
	34.000	-36.000	15.000	0.3728	15.00	0.0	-120.4E-6	0.0
	34.000	-34.000	15.000	0.3950	15.00	0.0	-132.6E-6	0.0
	34.000	-32.000	15.000	0.4181	15.00	0.0	-145.9E-6	0.0
	34.000	-30.000	15.000	0.4418	15.00	0.0	-160.6E-6	0.0
	34.000	-28.000	15.000	0.4660	15.00	0.0	-176.6E-6	0.0
	34.000	-26.000	15.000	0.4906	15.00	0.0	-193.9E-6	0.0
	34.000	-24.000	15.000	0.5152	15.00	0.0	-212.4E-6	0.0
	34.000	-22.000	15.000	0.5397	15.00	0.0	-231.9E-6	0.0
	34.000	-20.000	15.000	0.5638	15.00	0.0	-252.2E-6	0.0
	34.000	-18.000	15.000	0.5870	15.00	0.0	-272.8E-6	0.0
	34.000	-16.000	15.000	0.6090	15.00	0.0	-293.3E-6	0.0
	34.000	-14.000	15.000	0.6296	15.00	0.0	-313.2E-6	0.0
	34.000	-12.000	15.000	0.6483	15.00	0.0	-331.7E-6	0.0
	34.000	-10.000	15.000	0.6648	15.00	0.0	-348.5E-6	0.0
	34.000	-8.000	15.000	0.6788	15.00	0.0	-362.9E-6	0.0
	34.000	-6.000	15.000	0.6899	15.00	0.0	-374.6E-6	0.0
	34.000	-4.000	15.000	0.6981	15.00	0.0	-383.1E-6	0.0
	34.000	-2.000	15.000	0.7030	15.00	0.0	-388.4E-6	0.0
	34.000	0.000	15.000	0.7047	15.00	0.0	-390.1E-6	0.0
	34.000	2.000	15.000	0.7030	15.00	0.0	-388.4E-6	0.0
	34.000	4.000	15.000	0.6981	15.00	0.0	-383.1E-6	0.0
	34.000	6.000	15.000	0.6899	15.00	0.0	-374.6E-6	0.0
	34.000	8.000	15.000	0.6788	15.00	0.0	-362.9E-6	0.0
	34.000	10.000	15.000	0.6648	15.00	0.0	-348.5E-6	0.0
	34.000	12.000	15.000	0.6483	15.00	0.0	-331.7E-6	0.0
	34.000	14.000	15.000	0.6296	15.00	0.0	-313.2E-6	0.0
	34.000	16.000	15.000	0.6090	15.00	0.0	-293.3E-6	0.0
	34.000	18.000	15.000	0.5870	15.00	0.0	-272.8E-6	0.0
	34.000	20.000	15.000	0.5638	15.00	0.0	-252.2E-6	0.0
	34.000	22.000	15.000	0.5397	15.00	0.0	-231.9E-6	0.0
	34.000	24.000	15.000	0.5152	15.00	0.0	-212.4E-6	0.0
	34.000	26.000	15.000	0.4906	15.00	0.0	-193.9E-6	0.0
	34.000	28.000	15.000	0.4660	15.00	0.0	-176.6E-6	0.0
	34.000	30.000	15.000	0.4418	15.00	0.0	-160.6E-6	0.0
	34.000	32.000	15.000	0.4181	15.00	0.0	-145.9E-6	0.0
	34.000	34.000	15.000	0.3950	15.00	0.0	-132.6E-6	0.0
	34.000	36.000	15.000	0.3728	15.00	0.0	-120.4E-6	0.0
	34.000	38.000	15.000	0.3514	15.00	0.0	-109.5E-6	0.0
	34.000	40.000	15.000	0.3310	15.00	0.0	-99.62E-6	0.0
	36.000	-40.000	15.000	0.3139	15.00	0.0	-91.76E-6	0.0
	36.000	-38.000	15.000	0.3326	15.00	0.0	-100.3E-6	0.0
	36.000	-36.000	15.000	0.3520	15.00	0.0	-109.7E-6	0.0
	36.000	-34.000	15.000	0.3722	15.00	0.0	-120.0E-6	0.0
	36.000	-32.000	15.000	0.3930	15.00	0.0	-131.2E-6	0.0
	36.000	-30.000	15.000	0.4144	15.00	0.0	-143.4E-6	0.0
	36.000	-28.000	15.000	0.4361	15.00	0.0	-156.6E-6	0.0
	36.000	-26.000	15.000	0.4581	15.00	0.0	-170.0E-6	0.0
	36.000	-24.000	15.000	0.4800	15.00	0.0	-185.5E-6	0.0
	36.000	-22.000	15.000	0.5018	15.00	0.0	-200.9E-6	0.0
	36.000	-20.000	15.000	0.5230	15.00	0.0	-216.8E-6	0.0
	36.000	-18.000	15.000	0.5435	15.00	0.0	-232.9E-6	0.0
	36.000	-16.000	15.000	0.5629	15.00	0.0	-248.7E-6	0.0
	36.000	-14.000	15.000	0.5809	15.00	0.0	-263.8E-6	0.0
	36.000	-12.000	15.000	0.5973	15.00	0.0	-278.0E-6	0.0
	36.000	-10.000	15.000	0.6117	15.00	0.0	-290.7E-6	0.0
	36.000	-8.000	15.000	0.6239	15.00	0.0	-301.7E-6	0.0
	36.000	-6.000	15.000	0.6336	15.00	0.0	-310.5E-6	0.0
	36.000	-4.000	15.000	0.6407	15.00	0.0	-317.0E-6	0.0
	36.000	-2.000	15.000	0.6450	15.00	0.0	-321.0E-6	0.0
	36.000	0.000	15.000	0.6465	15.00	0.0	-322.3E-6	0.0
	36.000	2.000	15.000	0.6450	15.00	0.0	-321.0E-6	0.0
	36.000	4.000	15.000	0.6407	15.00	0.0	-317.0E-6	0.0
	36.000	6.000	15.000	0.6336	15.00	0.0	-310.5E-6	0.0
	36.000	8.000	15.000	0.6239	15.00	0.0	-301.7E-6	0.0
	36.000	10.000	15.000	0.6117	15.00	0.0	-290.7E-6	0.0
	36.000	12.000	15.000	0.5973	15.00	0.0	-278.0E-6	0.0
	36.000	14.000	15.000	0.5809	15.00	0.0	-263.8E-6	0.0
	36.000	16.000	15.000	0.5629	15.00	0.0	-248.7E-6	0.0
	36.000	18.000	15.000	0.5435	15.00	0.0	-232.9E-6	0.0
	36.000	20.000	15.000	0.5230	15.00	0.0	-216.8E-6	0.0
	36.000	22.000	15.000	0.5018	15.00	0.0	-200.9E-6	0.0
	36.000	24.000	15.000	0.4800	15.00	0.0	-185.5E-6	0.0
	36.000	26.000	15.000	0.4581	15.00	0.0	-170.0E-6	0.0
	36.000	28.000	15.000	0.4361	15.00	0.0	-156.6E-6	0.0
	36.000	30.000	15.000	0.4144	15.00	0.0	-143.4E-6	0.0
	36.000	32.000	15.000	0.3930	15.00	0.0	-131.2E-6	0.0
	36.000	34.000	15.000	0.3722	15.00	0.0	-120.0E-6	0.0
	36.000	36.000	15.000	0.3520	15.00	0.0	-109.7E-6	0.0
	36.000	38.000	15.000	0.3326	15.00	0.0	-100.3E-6	0.0
	36.000	40.000	15.000	0.31326				



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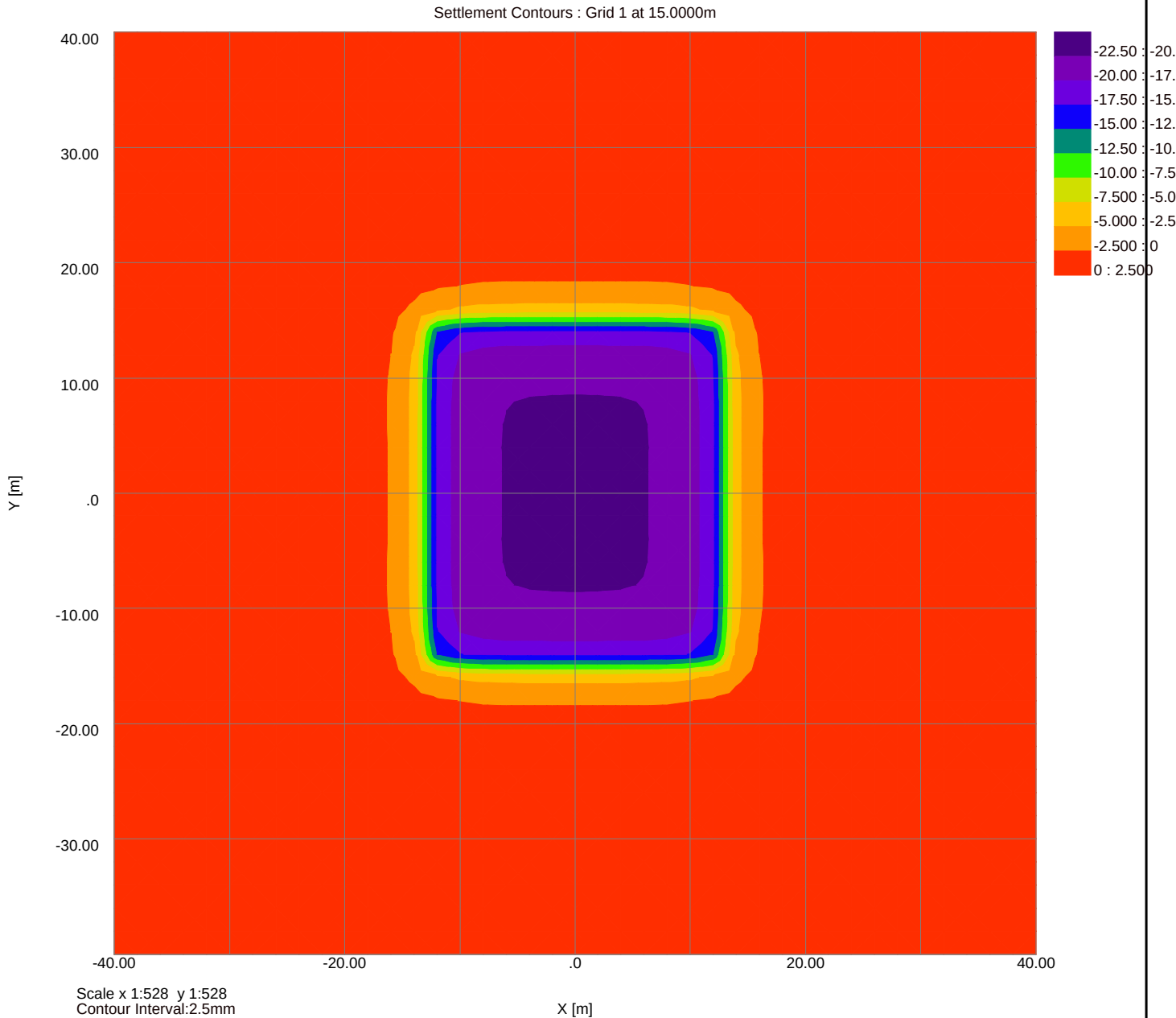
Heave Calculation

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Name	X [m]	Location Y [m]	Z[Level] [mOD]	Z [mm]	Calc Level [mOD]	Vert Stress [kN/m²]	Stresses Sum Princ [kN/m²]	Vert Strain [-]
	38.000	6.000	15.000	0.5820	15.00	0.0	-260.5E-6	0.0
	38.000	8.000	15.000	0.5735	15.00	0.0	-253.7E-6	0.0
	38.000	10.000	15.000	0.5629	15.00	0.0	-245.3E-6	0.0
	38.000	12.000	15.000	0.5503	15.00	0.0	-235.5E-6	0.0
	38.000	14.000	15.000	0.5360	15.00	0.0	-224.5E-6	0.0
	38.000	16.000	15.000	0.5202	15.00	0.0	-212.7E-6	0.0
	38.000	18.000	15.000	0.5031	15.00	0.0	-200.4E-6	0.0
	38.000	20.000	15.000	0.4851	15.00	0.0	-187.8E-6	0.0
	38.000	22.000	15.000	0.4663	15.00	0.0	-175.2E-6	0.0
	38.000	24.000	15.000	0.4470	15.00	0.0	-162.8E-6	0.0
	38.000	26.000	15.000	0.4275	15.00	0.0	-150.8E-6	0.0
	38.000	28.000	15.000	0.4079	15.00	0.0	-139.3E-6	0.0
	38.000	30.000	15.000	0.3884	15.00	0.0	-128.4E-6	0.0
	38.000	32.000	15.000	0.3692	15.00	0.0	-118.3E-6	0.0
	38.000	34.000	15.000	0.3504	15.00	0.0	-108.8E-6	0.0
	38.000	36.000	15.000	0.3321	15.00	0.0	-100.0E-6	0.0
	38.000	38.000	15.000	0.3144	15.00	0.0	-91.94E-6	0.0
	38.000	40.000	15.000	0.2974	15.00	0.0	-84.52E-6	0.0
	40.000	-40.000	15.000	0.2815	15.00	0.0	-77.87E-6	0.0
	40.000	-38.000	15.000	0.2970	15.00	0.0	-84.31E-6	0.0
	40.000	-36.000	15.000	0.3131	15.00	0.0	-91.26E-6	0.0
	40.000	-34.000	15.000	0.3297	15.00	0.0	-98.74E-6	0.0
	40.000	-32.000	15.000	0.3466	15.00	0.0	-106.8E-6	0.0
	40.000	-30.000	15.000	0.3639	15.00	0.0	-115.3E-6	0.0
	40.000	-28.000	15.000	0.3813	15.00	0.0	-124.3E-6	0.0
	40.000	-26.000	15.000	0.3988	15.00	0.0	-133.8E-6	0.0
	40.000	-24.000	15.000	0.4162	15.00	0.0	-143.5E-6	0.0
	40.000	-22.000	15.000	0.4332	15.00	0.0	-153.6E-6	0.0
	40.000	-20.000	15.000	0.4498	15.00	0.0	-163.7E-6	0.0
	40.000	-18.000	15.000	0.4657	15.00	0.0	-173.7E-6	0.0
	40.000	-16.000	15.000	0.4807	15.00	0.0	-183.5E-6	0.0
	40.000	-14.000	15.000	0.4946	15.00	0.0	-192.7E-6	0.0
	40.000	-12.000	15.000	0.5072	15.00	0.0	-201.3E-6	0.0
	40.000	-10.000	15.000	0.5181	15.00	0.0	-209.0E-6	0.0
	40.000	-8.000	15.000	0.5274	15.00	0.0	-215.5E-6	0.0
	40.000	-6.000	15.000	0.5348	15.00	0.0	-220.8E-6	0.0
	40.000	-4.000	15.000	0.5402	15.00	0.0	-224.7E-6	0.0
	40.000	-2.000	15.000	0.5435	15.00	0.0	-227.1E-6	0.0
	40.000	0.000	15.000	0.5446	15.00	0.0	-227.9E-6	0.0
	40.000	2.000	15.000	0.5435	15.00	0.0	-227.1E-6	0.0
	40.000	4.000	15.000	0.5402	15.00	0.0	-224.7E-6	0.0
	40.000	6.000	15.000	0.5348	15.00	0.0	-220.8E-6	0.0
	40.000	8.000	15.000	0.5274	15.00	0.0	-215.5E-6	0.0
	40.000	10.000	15.000	0.5181	15.00	0.0	-209.0E-6	0.0
	40.000	12.000	15.000	0.5072	15.00	0.0	-201.3E-6	0.0
	40.000	14.000	15.000	0.4946	15.00	0.0	-192.7E-6	0.0
	40.000	16.000	15.000	0.4807	15.00	0.0	-183.5E-6	0.0
	40.000	18.000	15.000	0.4657	15.00	0.0	-173.7E-6	0.0
	40.000	20.000	15.000	0.4498	15.00	0.0	-163.7E-6	0.0
	40.000	22.000	15.000	0.4332	15.00	0.0	-153.6E-6	0.0
	40.000	24.000	15.000	0.4162	15.00	0.0	-143.5E-6	0.0
	40.000	26.000	15.000	0.3988	15.00	0.0	-133.8E-6	0.0
	40.000	28.000	15.000	0.3813	15.00	0.0	-124.3E-6	0.0
	40.000	30.000	15.000	0.3639	15.00	0.0	-115.3E-6	0.0
	40.000	32.000	15.000	0.3466	15.00	0.0	-106.8E-6	0.0
	40.000	34.000	15.000	0.3297	15.00	0.0	-98.74E-6	0.0
	40.000	36.000	15.000	0.3131	15.00	0.0	-91.26E-6	0.0
	40.000	38.000	15.000	0.2970	15.00	0.0	-84.31E-6	0.0
	40.000	40.000	15.000	0.2815	15.00	0.0	-77.87E-6	0.0

Job No.	Sheet No.	Rev.
LO1254a		
Drg. Ref.		
Made by SS	Date	Checked

Heave Calculation





BIA Review - Land between 26 Gordon Sq and 15 Gordon Street - PDISP

LizBrown@campbellreith.com, Jeremy
Brendan O'Boyle to: Jones (Jeremy.Jones@curtins.com),
 Stefano.Strazzullo@curtins.com, John
 Cc: Kelvin Higgins, Phil Smith

21/08/2015 18:28

4 attachments



UCL SC_LongTerm rev.1plot.pdf



UCL SC_ShortTerm rev.1 plot.pdf



UCL SC_LongTerm rev.1.pdf



UCL SC_Short Term rev.1.pdf

Dear Liz,

Please find attached our revised PDISP plots with input/output files. All of these calculated movements are taken at the basement level. PDISP suggests the difference in the short term movements and long term movements are around 10mm (heave) outside the excavation.

In the short term PDISP model we just modelled the removal of the 10m of soil. In the long term we added the weight of the building as an equivalent raft at 2/3 the length of the preliminary piles. The weight of the building was taken as 85.8MN or 110kPa over the raft area.

The stiffness and Poisson's ratios which we have used are as follows

Made Ground : 10MPa and $\mu' = 0.2$

River Terrace : Deposits: 50MPa and $\mu' = 0.2$

London Clay: Burland and Kalra (1986) where $E_u = 10 + 5.2z$ and $E' = 7.5 + 3.9z$
where $\mu = 0.5$ and $\mu' = 0.2$

Lambeth Group (top) : $E_u = 550 p'$ assuming a K_0 of 1 and $E' = 0.8 E_u$

Lambeth Group (bottom): $E_u = 1100 p'$ and $E' = 0.8 E_u$
where $\mu = 0.5$ and $\mu' = 0.2$

Thanet Sands : $E' = 900 p'$

A rigid boundary was taken at -21mOD and it was assumed that the groundwater was hydrostatic from +24mOD.

It can be seen that time dependent movements outside the excavation are small.

It is my understanding that excluding the effect of installation of the wall, movements occur outside an excavation in stiff clay due to horizontal stress relief (the bowing out of the wall) and vertical stress relief (at the bottom of the excavation). The CIRIA C580 curve for "ground surface movements— due to excavation in front of wall in stiff clay" accounts for the short term components of both of these stress reliefs and was derived from a database of observed settlements with the installation effects removed.

In this case the retaining wall will act as stiff box and will tend to restrain any time dependent heave

to inside the excavation. It is also worth noting that elastic analyses tend to overestimate the extent and magnitude of movement beyond the loaded/unloaded area. This is based on the small strain studies by Jardine et al (1986). This combined with reductions in effective stress adjacent to the excavations would indicate there would be very little change in settlements in the long term.

We therefore consider the use of the XDISP C580s curves sufficient for this building damage assessment. However if you are considering the PDISP movements, the time dependent movements which are around 10mm (heave) would only serve to negate the short term settlements predicted by C580.

Please give me a call if you have any queries.

Kind Regards,
Brendan

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