Part of the CTS Group

Iesis Special Structures Ltd

Crown Trading Centre, Clayton Road - Hayes

Detailed Canal Wall Stability Assessment – Revision 1

April, 2023

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		1	April 2023

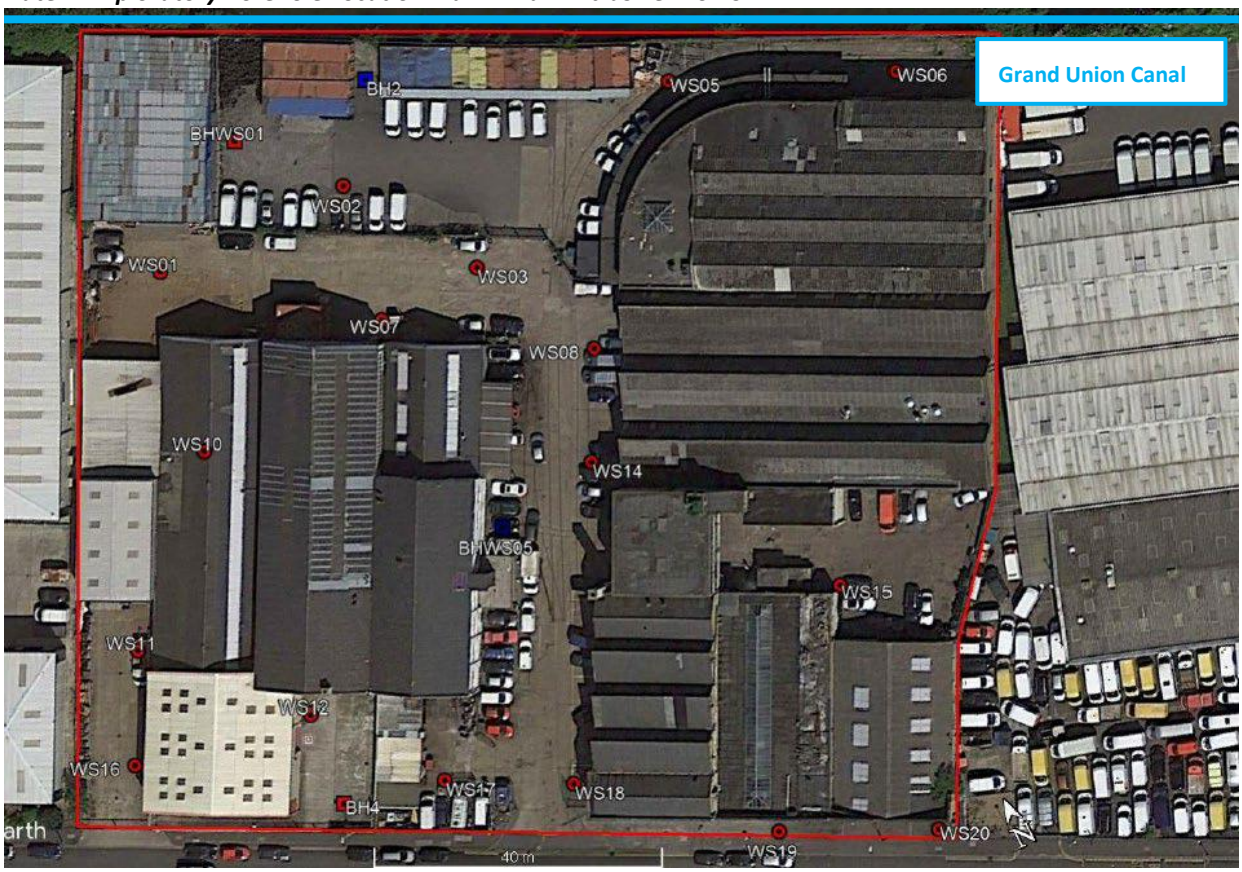
Contents

1. INTRODUCTION

Between December 2022 and March 2023, on a geotechnical advisory role, Card Geotechnics Limited (CGL) cursory reviewed available site investigation and canal wall details by others at the request of Iesis Special Structures Limited. A brief factual summary of the works undertaken to date is presented below:

- Soils Limited[1] undertook the main phase of intrusive works in May 2019 comprising 19no windowless and 2no cable percussive boreholes (see Plate 1) down to 3m and 25m below ground level (mbgl), respectively, together with in-situ and laboratory geotechnical testing. The above works were completed primarily to aid and better inform the foundation optioneering process being held at the time to decide, based on the ground and groundwater conditions present, on the most suitable foundation solution for the proposed residential development to be constructed on site.

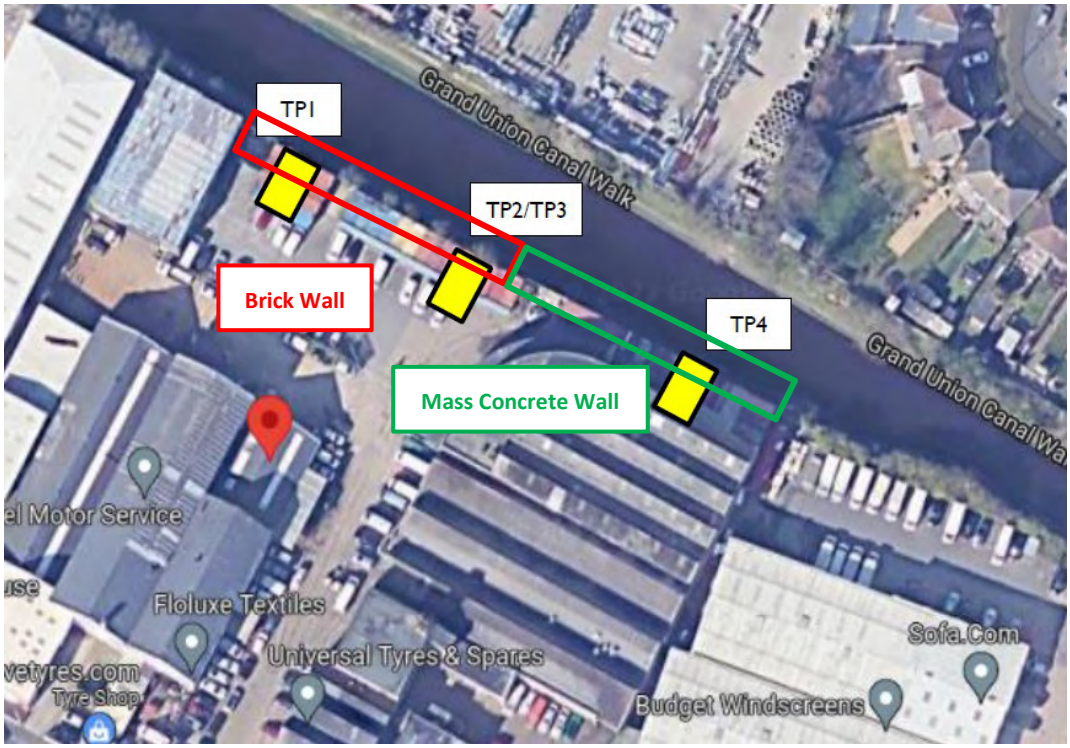
Plate 1. Exploratory Borehole Location Plan – Main Intrusive Works



[1] *Soils Limited (May 2019). Main Investigation Report - Crown Trading Estate, Clayton Road, Hayes. Ref. 17424/MIR_R27*

- Squibb Group completed additional intrusive works in August 2022, adjacent to the existing canal wall, comprising five trial pits to depths ranging 1.30mbgl and 1.45mbgl (see Plate 2) to expose the existing canal wall structures and allow the definition of representative cross-sections. The following is noted:
    - These additional trial pitting did not reveal the existing canal wall geometry down to formation level, but it did clarify that the existing canal wall is divided into two main sections, a stock brick section and a more recent mass concrete section.

Plate 2. Trial Hole Location Plan – Additional Intrusive Works (trial pits)



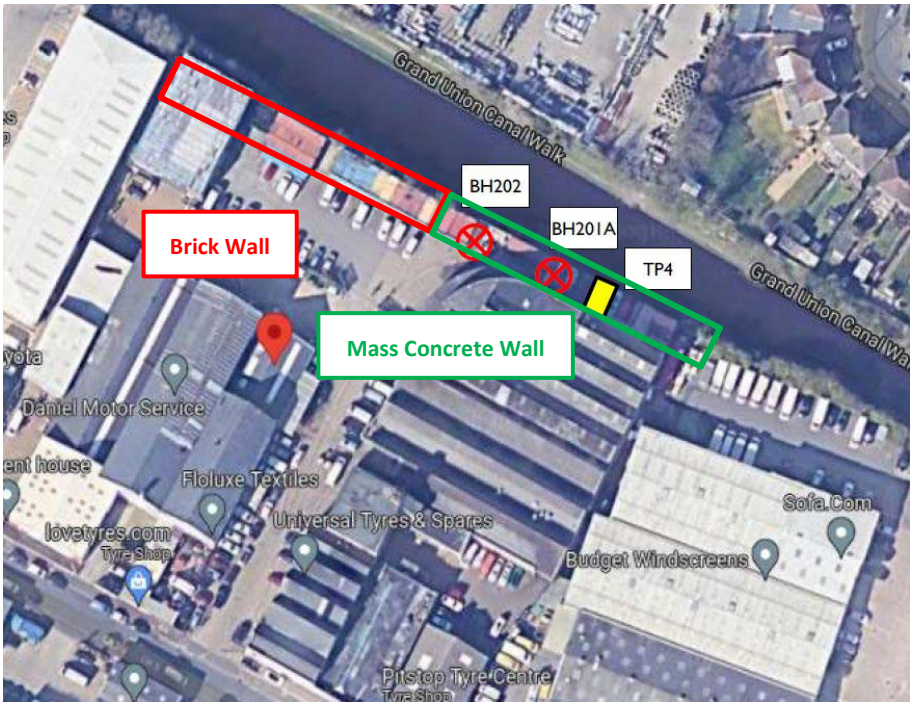
- In light of the above, and given that the existing mass concrete portion of the canal is currently stable, in February 2023 (included in factual report within Appendix A)[2], additional intrusive works were commissioned to finalise determining the existing geometry of canal wall sections. These final intrusive works comprised 2no cable percussive boreholes and additional deep trial pits (see Plate 3).

- The project team has confirmed the intention to retain the existing mass concrete section and to construct a replacement RC concrete wall immediately behind the existing brick wall, the front face of which (towards the canal) is to be repaired and maintained.

[2] *Soils Limited (April 2023). Crown Trading Centre, Clayton Road, Hayes UB3 1DU. Combined Factual Report. Rev1.*

- The factual ground investigation report by soils is included in Appendix A.

Plate 3. Trial Hole Location Plan – Final Intrusive Works



Following on from CGL's initial technical advisory role, and based on the findings from the final canal wall specific intrusive works undertaken by Soils Limited[2], CGL has been instructed by Iesis Special Structures Limited (the client) to undertake a detailed stability assessment of the canal wall at the proposed Crown Trading Centre development at Clayton Road, Hayes, UB3 IDU.

The scope of this assessment and report includes the following:

- Analysis of hydrogeological and geotechnical canal wall specific ground and groundwater conditions and independent derivation of moderately conservative representative geotechnical design parameters;
- Stability assessment of the canal wall, based on the existing and proposed wall geometries defined for the existing mass concrete and proposed replacement RC concrete sections, respectively; and,
- A summary of potential/remaining risks and provision of appropriate recommendations.

It is noted that final detailed structural capacity/design of the existing/proposed canal wall sections in the temporary and permanent condition is beyond the scope of this reports.

2. GROUND AND GROUNDWATER CONDITIONS

2.1 Ground Conditions

Canal wall-specific intrusive works have been carried out by Soils Limited and others in February 2023[2]. The information from the relevant boreholes (BH201 and BH202 presented in Appendix A) located closest to the canal has been used to inform the ground model and soil parameters adopted within this assessment.

The available information indicates surficial Made Ground of variable nature is present in the local area, which is directly underlain by the London Clay (proven down to 15mbgl). A summary of the typical rationalised/conservative ground conditions anticipated is presented in Table 1 below.

Table 1. Summary of relevant site investigation data

Strata	*Depth to strata top mbgl[a]*	*Thickness (m)*
Soft gravelly sandy CLAY. *In BH201A, the top 0.8m was mostly comprised of clayey SAND.* **[MADE GROUND - COHESIVE]**	0.00	2.00
Slightly clayey gravelly fine to coarse SAND. **[MADE GROUND – GRANULAR]**	2.00	3.50
Stiff sandy slightly fissured CLAY **[LONDON CLAY - COHESIVE]**	5.50	Proven to 15mbgl

Notes:

a. mbgl – metres below ground level

SPT in-situ testing was carried out at regular intervals at each exploratory hole location considered above. These are presented in Plate 4 below.

These have been correlated to undrained shear strengths based on a f1 value of 5, which is validated by available triaxial testing results specific to samples of the above boreholes. The results for undrained shear strength from these tests are plotted on Plate 5.

Plate 4. Uncorrected SPT – N – vs Depth (mbgl)

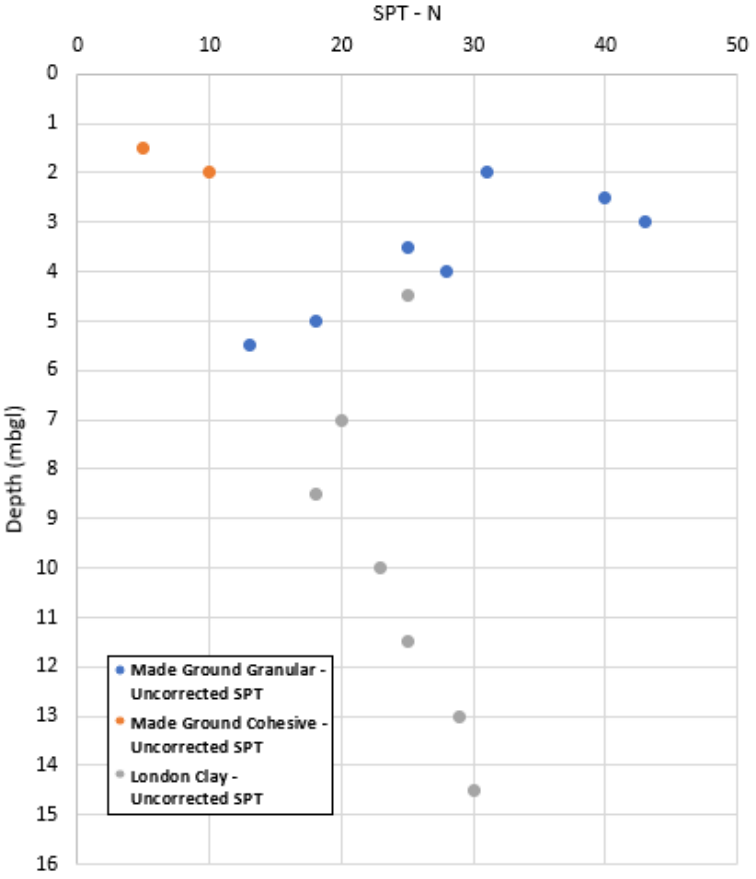
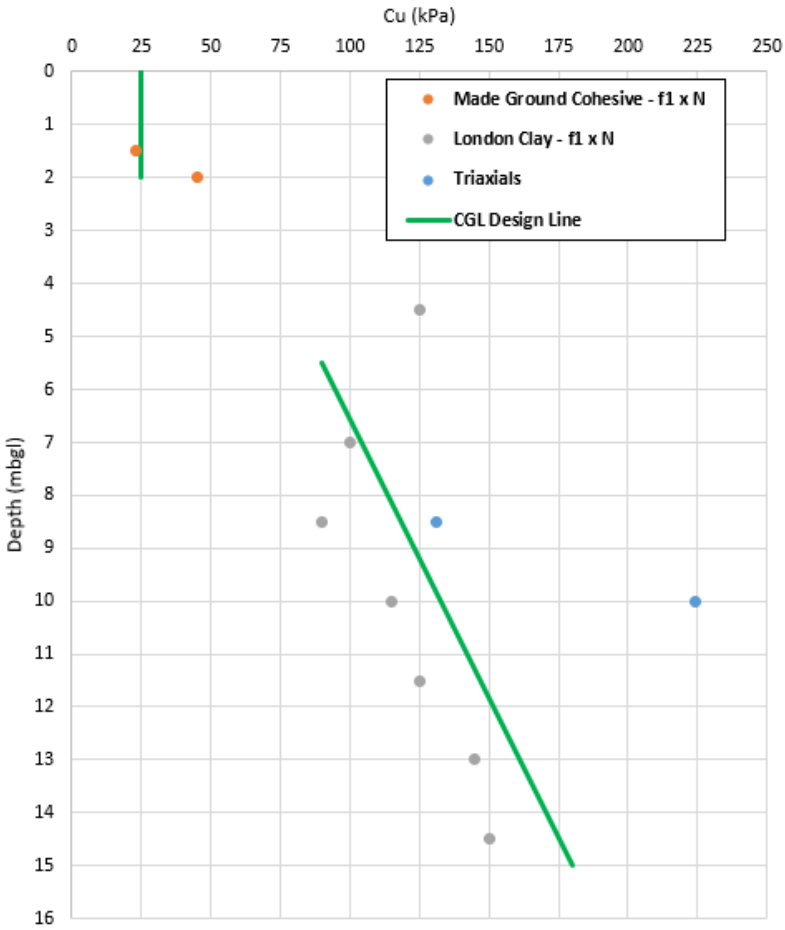


Plate 5. Undrained shear strength vs Depth (mbgl)



2.2 Geotechnical Design Parameters

Geotechnical design parameters for the soils on site are summarised in Table 2 below. The parameters in Table 2 are unfactored (Serviceability Limit State) and are considered to be 'moderately conservative' typical characteristic design values.

Table 2. Ground Model & Geotechnical Design Parameters - General

Strata	*Depth (mbgl)*	*Level (mOD)[e]*	*γ (kN/m³)*	*Cu (kPa)*	*c' (kPa)*	*φ' (°)*
Made Ground - Cohesive	0	+0.00	18[a]	25[d]	0	23[a]
Made Ground - Granular	2	-2.00	18[a]	N/A	0	35[a]
London Clay - Cohesive	5.5	-5.50	20[a]	80 + 10.5z[c,d]	5[b]	25[a]

Notes:

a. *British Standards (2015). Code of practice for earth retaining structures. BS 8002-2015.*
b. *Burland, Standing J.R., and Jardine F.M. (eds) (2001), Building response to tunnelling, case studies from construction of the Jubilee Line Extension London, CIRIA Special Publication 200.*
c. *z = depth below surface of the London Clay*
d. *Based upon moderately conservative (initial SPT 'N' value) where (c_u = SPT 'N' x f_1) where f_1 = 5.0, CIRIA R143 (1995), The Standard Penetration Test – Methods and Use. Peck, R.B., Hanson, W.E., and Thornburn, T.H., Foundation Engineering, 2nd Edn. John Wiley, New York, (1967); Stroud, M.A., The standard penetration test in insensitive clays and soft rocks, proceedings of the European symposium on penetration; White et al, 2019, An update of the SPT-cu correlation proposed by M. Stroud in 1974, Proceedings of the XVII ECSMGE 2019.*
e. *Assumed existing ground level to be +0.00mOD*

2.3 Groundwater

The following information has been collated with regards to groundwater and canal water:

- Groundwater was encountered between 1.90mbgl and 2.30mbgl in boreholes BH201A and BH202, respectively[2];
- The canal bed was found to be circa 3.5m below retained ground level, with free water level ranging between 0.4m (3.10mbgl) to 0.8m (2.70mbgl) above the canal bed; and,
- It is CGL's understanding that the groundwater level on the active side of the canal wall will likely have reached the equilibrium state with the free water in the canal over time and the canal wall does not provide a continuous effective impermeable groundwater barrier from later or vertical seepage; and as such, adopting a single groundwater level in both the canal and the active side of the wall is deemed appropriate.

In light of the above, and for the purpose of this assessment, CGL has conservatively carried forward the worst-case design groundwater level at 2.70mbgl, in line with the highest free water recorded in the canal.

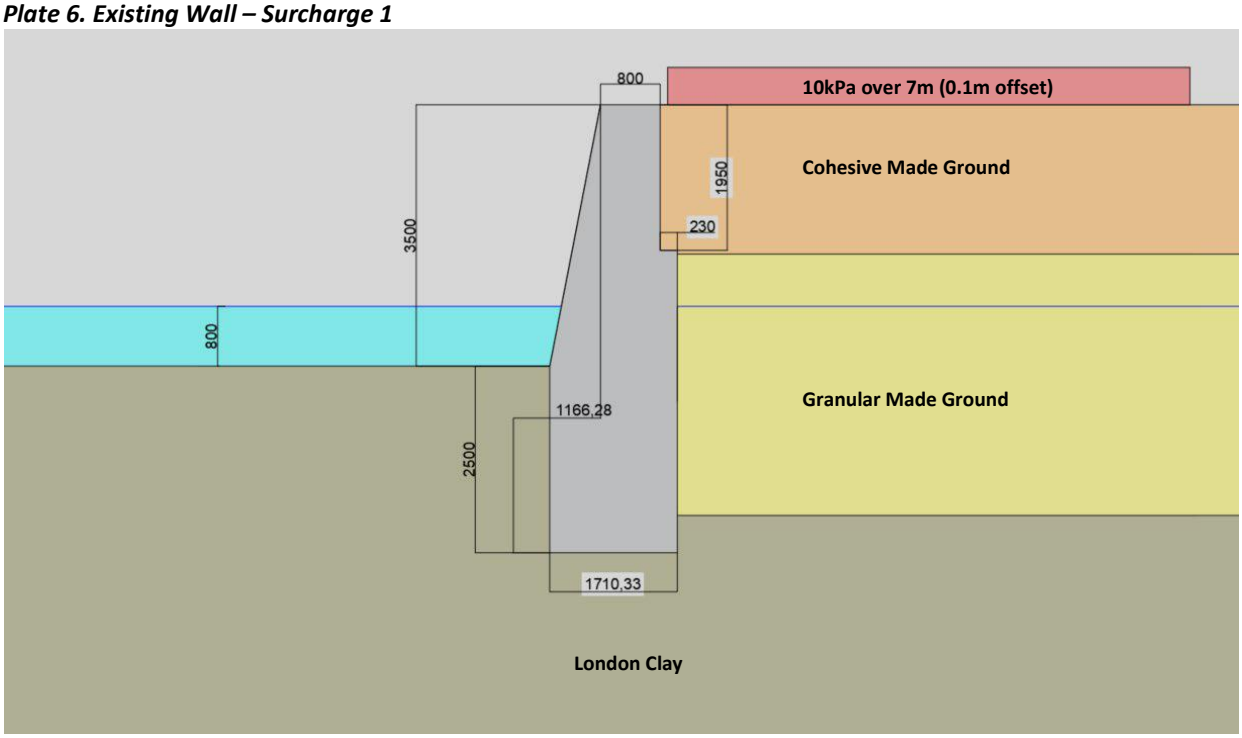
3. CANAL WALL – DESIGN SECTIONS

3.1 Existing Mass Concrete Canal Wall

Based on e-mail correspondence with the client and in line with the latest information provided[2], the following scenario, 'Existing Wall - Surcharge 1' shown in Plate 6, has been considered:

- Wall geometry is in line with the findings from the deep trial pits undertaken as part of the final intrusive works and is assumed to be constructed of mass concrete;
- It is assumed that the canal bed will be directly underlain by London Clay Formation; and,
- An allowance has been made for a variable blanket surcharge of 10kPa over 7m with a nominal offset of 0.1m behind the wall.

Plate 6. Existing Wall – Surcharge 1



Additionally, the following sensitivity checks have been undertaken:

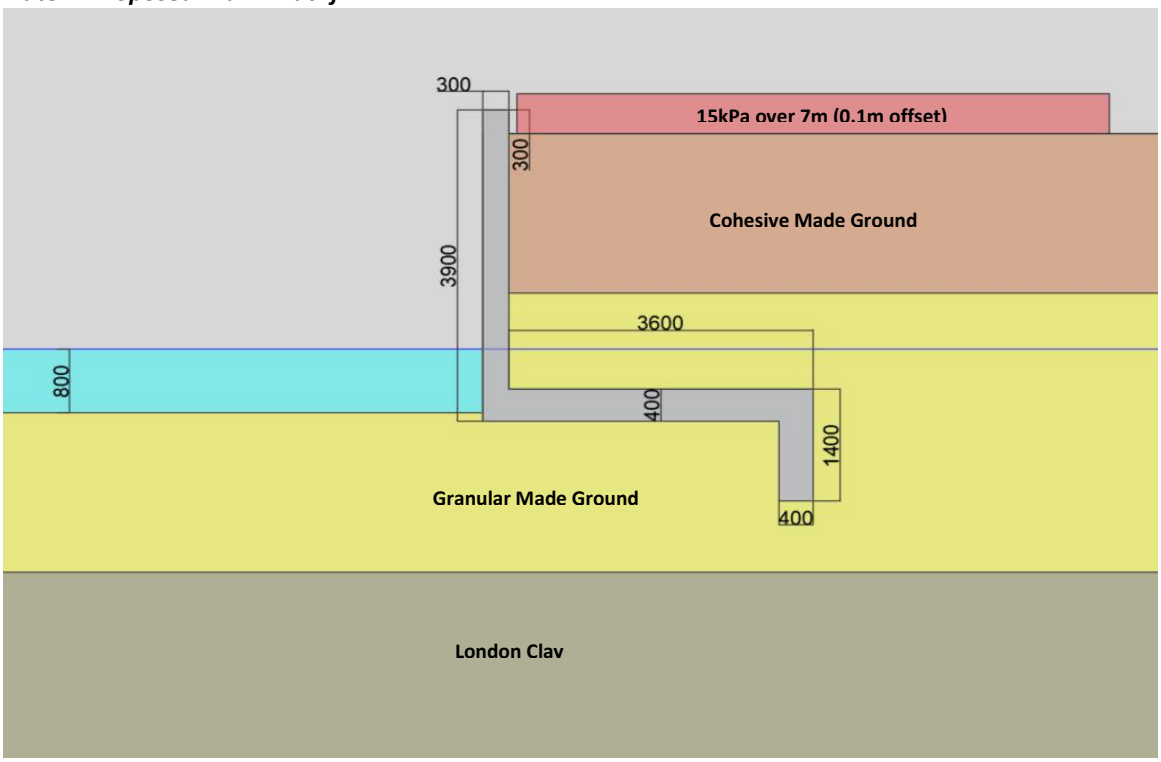
- Same as 'Existing Wall - Surcharge 1', but with a 5kPa of permanent surcharge over 2m and 15kPa of variable surcharge over 5m ('Existing Wall - Surcharge 2');
- Same as the general case 'Existing Wall - Surcharge 1', but with granular Made Ground directly beneath the canal bed on the passive side ('Existing Wall – Sensitivity Check').

3.2 Proposed RC Canal Wall – Replacement Wall

Based on e-mail correspondence with the client and in line with the latest information provided[2], the following scenario, 'Proposed Wall - Backfill 1', has been considered:

- Wall geometry is in line with the geometry proposed by the client and is assumed to be of reinforced concrete;
- Due to limitations of the software adopted, it is not possible to model a different strata at the toe level in the active and passive sides of the wall. Hence, saturated granular Made Ground has conservatively been modelled directly beneath the canal bed; and,
- An allowance has been made for a variable blanket surcharge of 15kPa over 7m with an offset of 0.1m behind the wall.

Plate 7. Proposed Wall – Backfill 1



Additionally, the following sensitivity checks have been undertaken:

- Same as 'Proposed Wall - Backfill 1', but the retained material modelled as a cohesionless engineered fill with a friction angle of 30˚ ('Proposed Wall – Backfill 2'); and,
- Same as the general case 'Proposed Wall – Backfill 2', but conservatively assuming cohesive Made Ground directly beneath the canal bed on the passive side and beneath the cohesionless engineered fill ('Proposed Wall – Sensitivity Check').

4. CANAL WALL STABILITY ASSESSMENT

4.1 General

The local stability assessment of the walls has been undertaken using Greta Oasys Ltd software. Greta is used for analysing gravity retaining walls and performs calculations which assess the overall stability of the wall with respect to sliding and overturning.

The global stability assessment has been undertaken using RocScience Slide2. Slide2 is a 2D limit equilibrium slope stability program for evaluating the safety factor of circular/non-circular failure surfaces in soil or rock slopes using Bishop's method of slices.

The current design checks are based on the partial safety factor approach outlined in in BS EN 1997-1:2004 Eurocode 7: Geotechnical Design[3] (and UK National Annex)[4] in the drained condition only. As the analyses include Eurocode 7 DA1-C2 partial factoring, a minimum factor of safety of at least 1 is required.

CGL has also run the same analyses based on unfactored SLS soil parameters and loads, which have resulted in minimum factors of safety of at least ~1.30, which is considered to be acceptable for the purpose of this assessment. For simplicity, outputs that correspond to the ULS checks have been presented in this report. However, detailed outputs for both Greta and Slide2 ULS and SLS checks undertaken for all scenarios defined in Section 3 for the existing mass concrete and the proposed replacement RC wall sections are presented in Appendix B to Appendix E, respectively.

4.2 Existing Mass Concrete Canal Wall

4.2.1 Local Stability - Greta

Factors of Safety against sliding and overturning in the ULS analyses undertaken are summarised in Table 3 below and presented in Plate 8 to Plate 10. Detailed Greta outputs are outlined in Appendix B.

Table 3. Existing Mass Concrete Wall – Sliding & Overturning Factors of Safety (ULS)

Reference	*FoS Sliding*	*FoS Overturning*
Existing Wall - Surcharge 1	1.9	1.4
Existing Wall - Surcharge 2	1.85	1.35
Existing Wall - Sensitivity Check	1.9	1.35

[3] BS EN 1997-1:2004 +A1:2013 Eurocode 7: Geotechnical Design
[4] UK National Annex to Eurocode 7: Geotechnical Design – Part 1: General Rules. NA+A1:2014

Average and peak bearing pressures predicted for the above three scenarios range between 260kPa to 295kPa and 335kPa to 390kPa, respectively. Bearing capacity checks have been undertaken separately and are discussed in detail in Section 5.

Plate 8. Existing Wall – Surcharge 1 (Greta ULS Output)

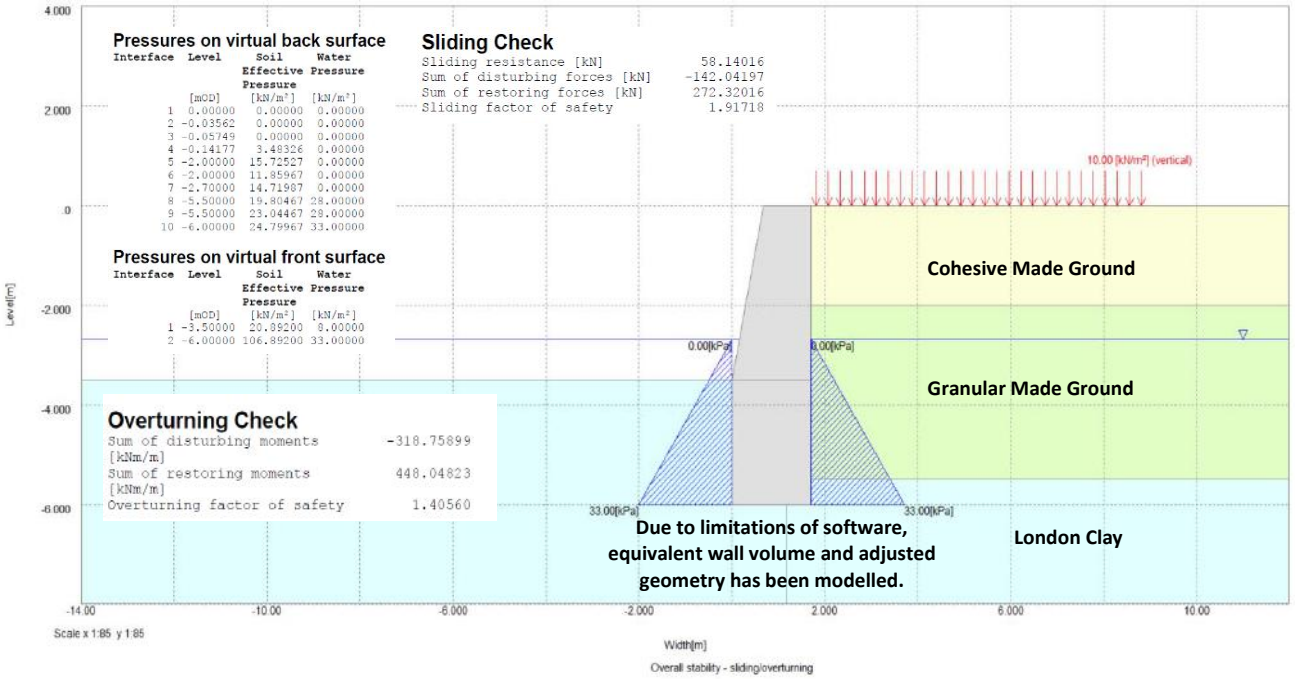


Plate 9. Existing Wall – Surcharge 2 (Greta ULS Output)

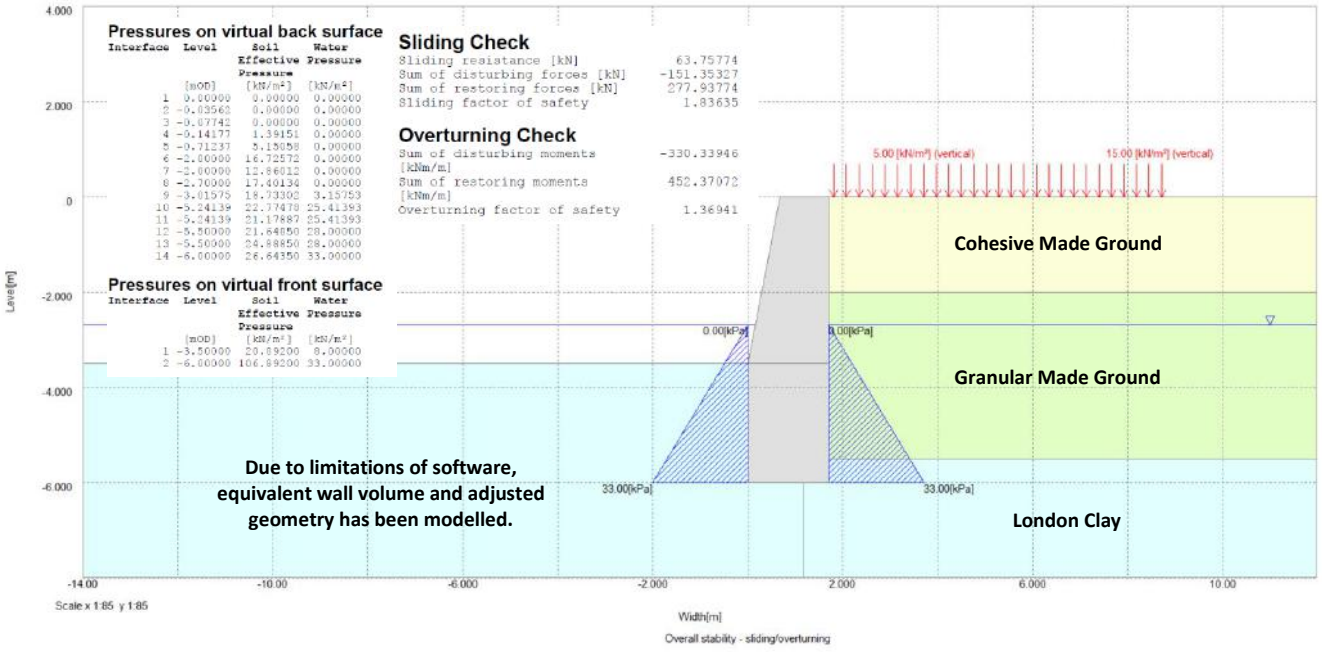
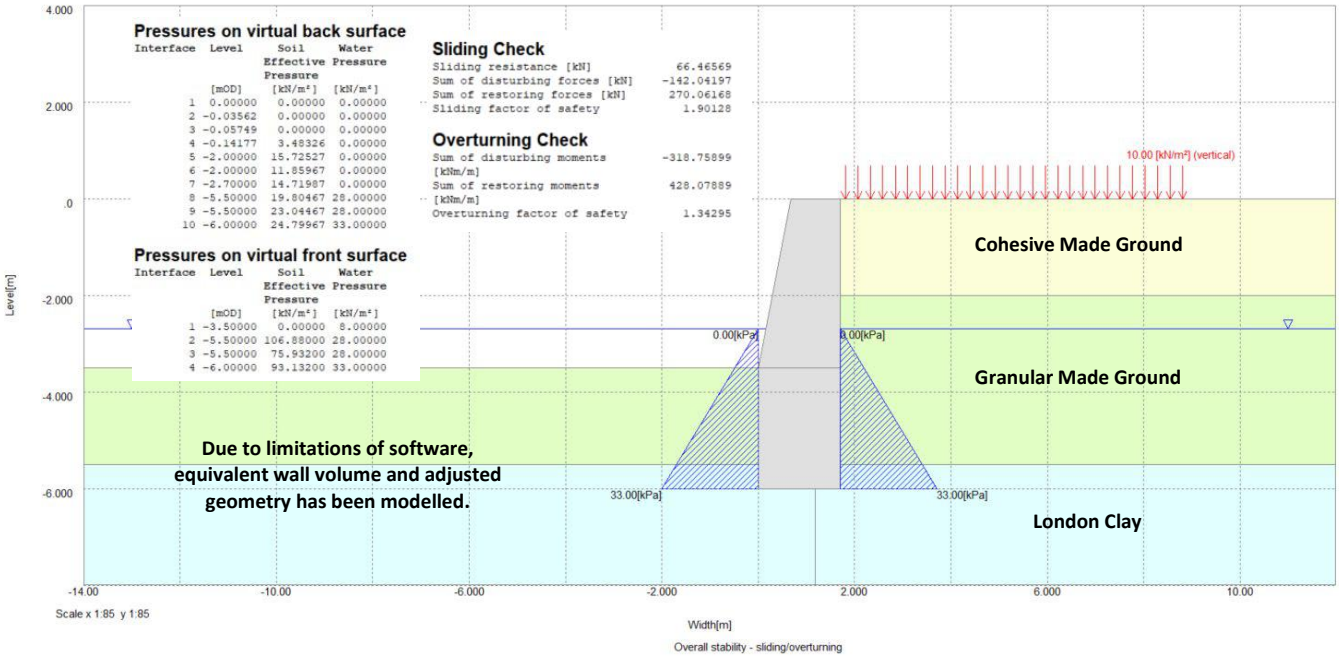


Plate 10. Existing Wall – Sensitivity Check (Greta ULS Output)



4.2.2 Global Stability – Slide2

The results of the ULS slope stability analyses for the three design scenarios defined in Section 3.1 are presented in Plate 11 to Plate 13. The following can be observed:

- Local instabilities with factors of safety ranging between 1 and 1.5 are present within the cohesive Made Ground directly beneath the surcharges. These localised slip surfaces are not critical and do not constitute a mechanism to induce failure at/around the existing wall and therefore can be ignored; and,

- Global factors of safety for the critical deep failure slip surfaces are generally > 1.5, which is found to be acceptable.

It is noted that SLS slope stability analyses outputs are not shown below; however, all global factors of safety were found to be well above 1.3, which is also deemed appropriate for the purpose of this assessment.

Detailed Slide2 outputs results are outlined in Appendix C.

Plate 11. Existing Wall – Surcharge 1 (Slide2 ULS Output)

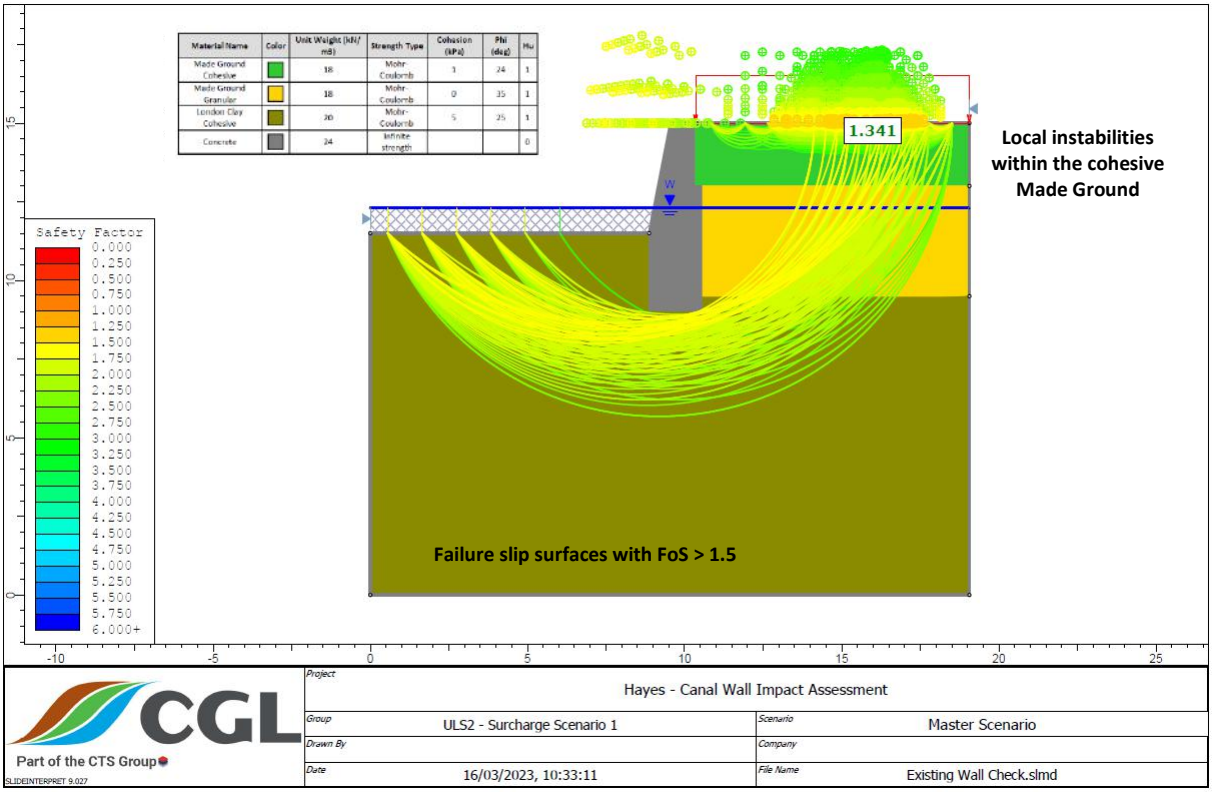


Plate 12. Existing Wall – Surcharge 2 (Slide2 ULS Output)

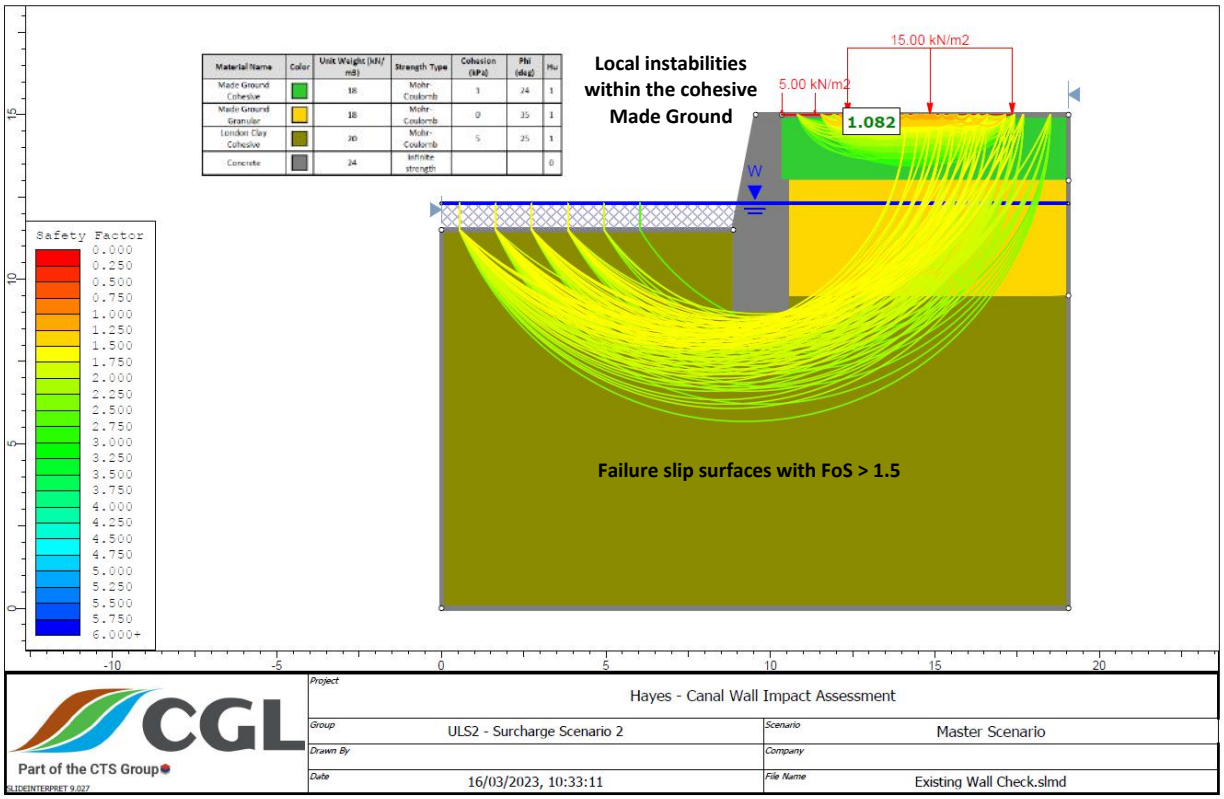
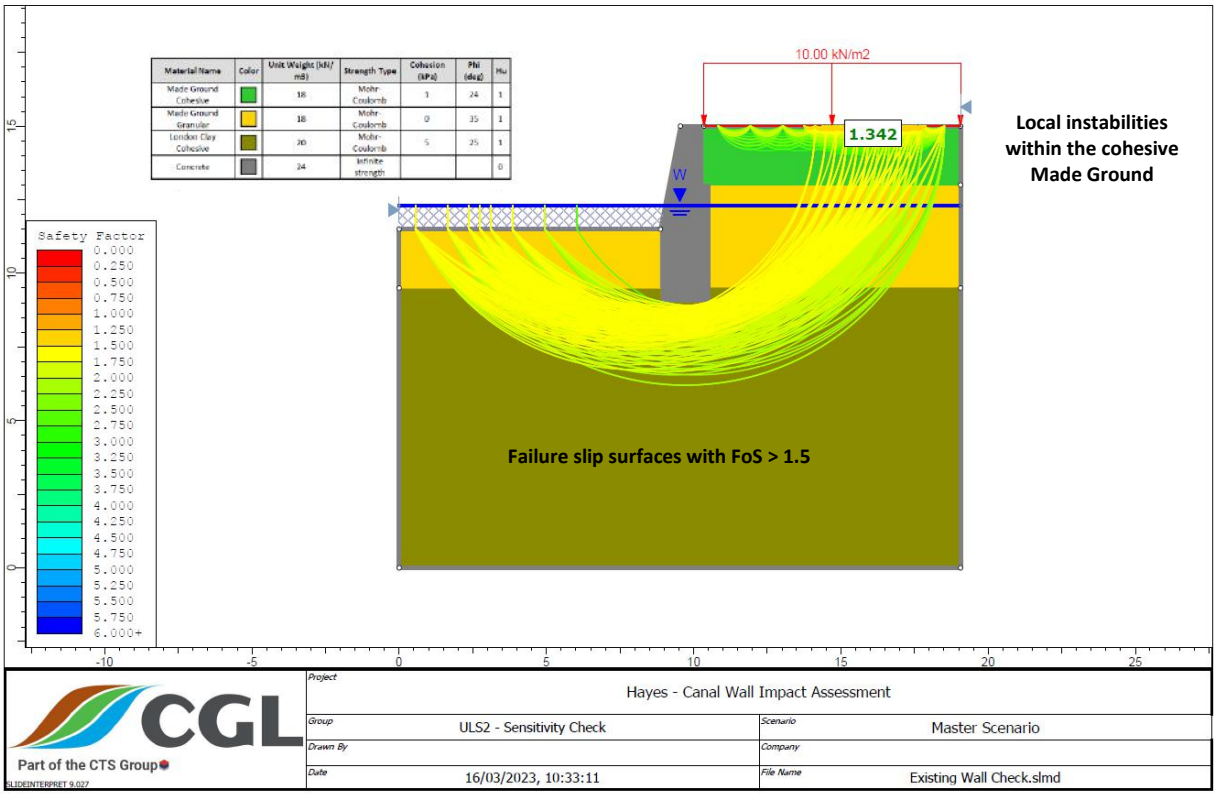


Plate 13. Existing Wall – Sensitivity Check (Slide2 ULS Output)



4.3 Proposed Replacement RC Canal Wall

4.3.1 Local Stability - Greta

Factors of Safety against sliding and overturning in the ULS analyses undertaken are summarised in Table 4 below and presented in Plate 14 to Plate 16. Detailed Greta outputs are outlined in Appendix D.

Table 4. Proposed Replacement RC Wall – Sliding & Overturning Factors of Safety (ULS)

Reference	*FoS Sliding*	*FoS Overturning*
Proposed Wall - Backfill 1	> 3	> 3
Proposed Wall - Backfill 2	> 3	> 3
Proposed Wall - Sensitivity Check	> 1.3	> 3

Net stresses resulting from the excavation, replacement wall construction and subsequent backfilling, together with relevant bearing capacity checks have been undertaken separately and are discussed in detail in Section 5.

Plate 14. Proposed Wall – Backfill 1 (GRETA ULS Output)

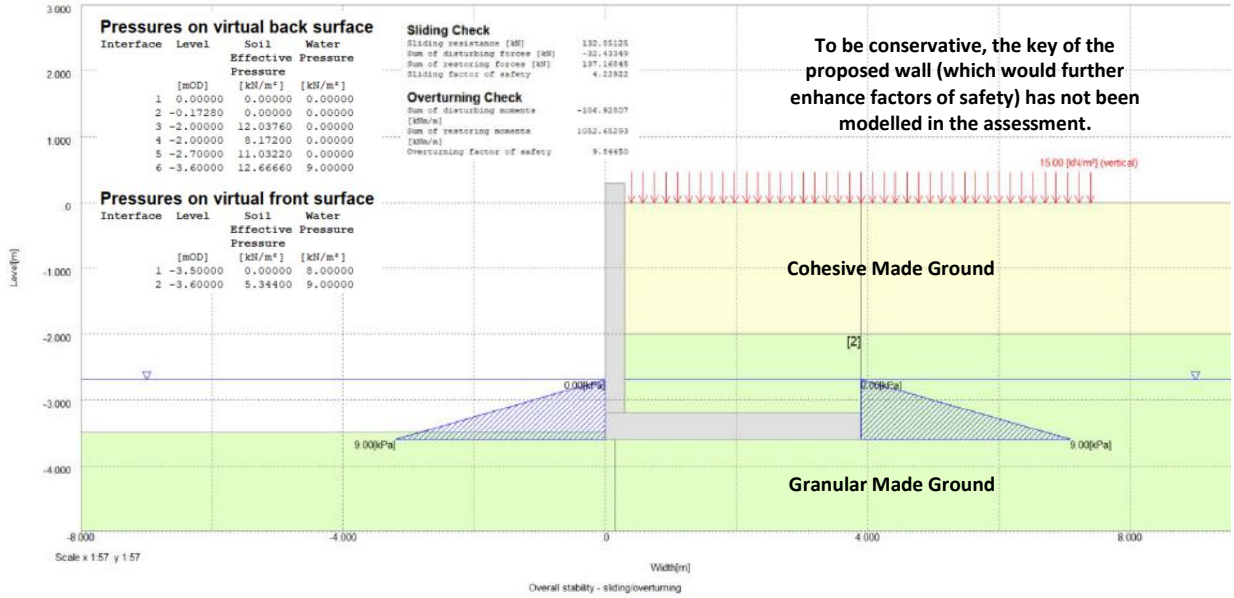
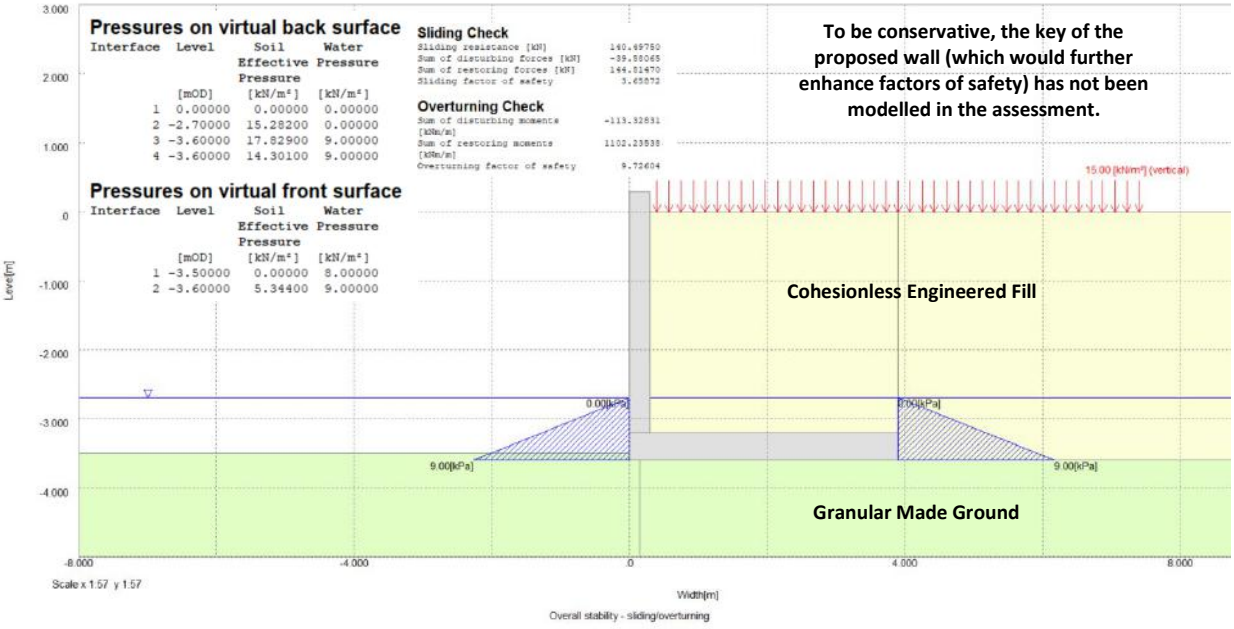
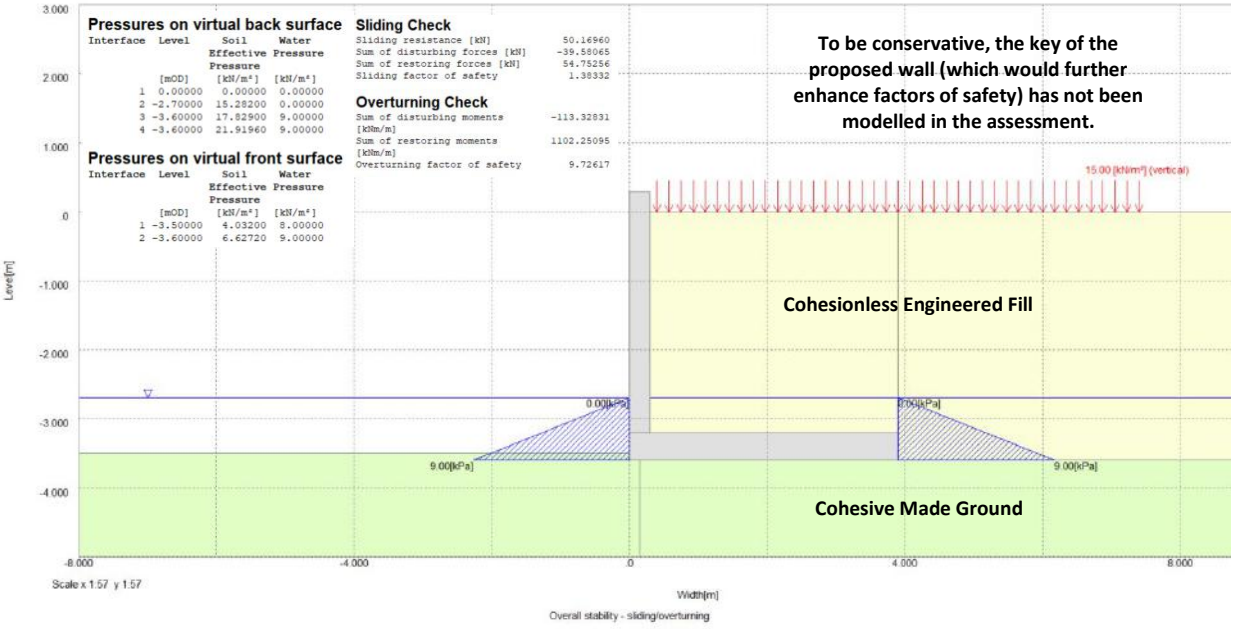


Plate 15. Proposed Wall – Backfill 2 (GRETA ULS Output)



It should be noted that default colours have been applied in the software for the top and bottom layers and the classification of the soil layers is not dictated by the colours adopted in the analysis therefore, the labels of the material in the plate represent the material modelled.

Plate 16. Proposed Wall – Sensitivity Check (GRETA ULS Output)



4.3.2 Global Stability – Slide2

The results of the ULS slope stability analyses for the three design scenarios defined in Section 3.2 are presented in Plate 17 to Plate 19. It can be observed that both local and global factors of safety are > 1, which is considered to be acceptable. It is noted that SLS slope stability analyses outputs are not shown below; however, all results were found to be above 1.3, which is also deemed appropriate for the purpose of this assessment. Detailed Slide2 outputs results are outlined in Appendix E.

Plate 17. Proposed Wall – Backfill 1 (Slide2 ULS Output)

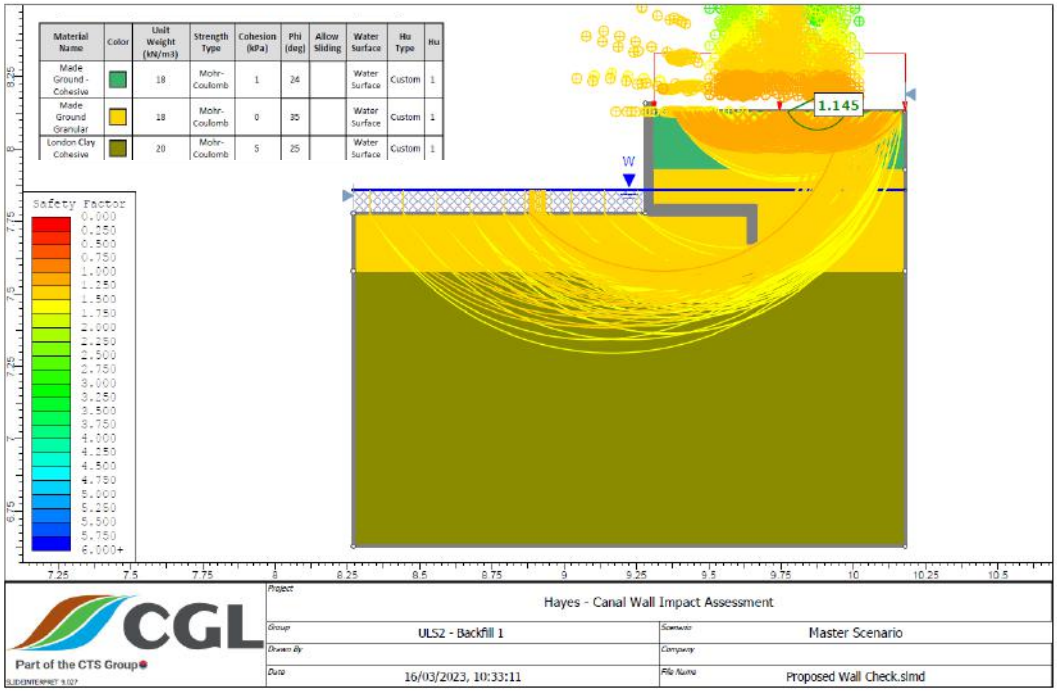


Plate 18. Proposed Wall – Backfill 2 (Slide2 ULS Output)

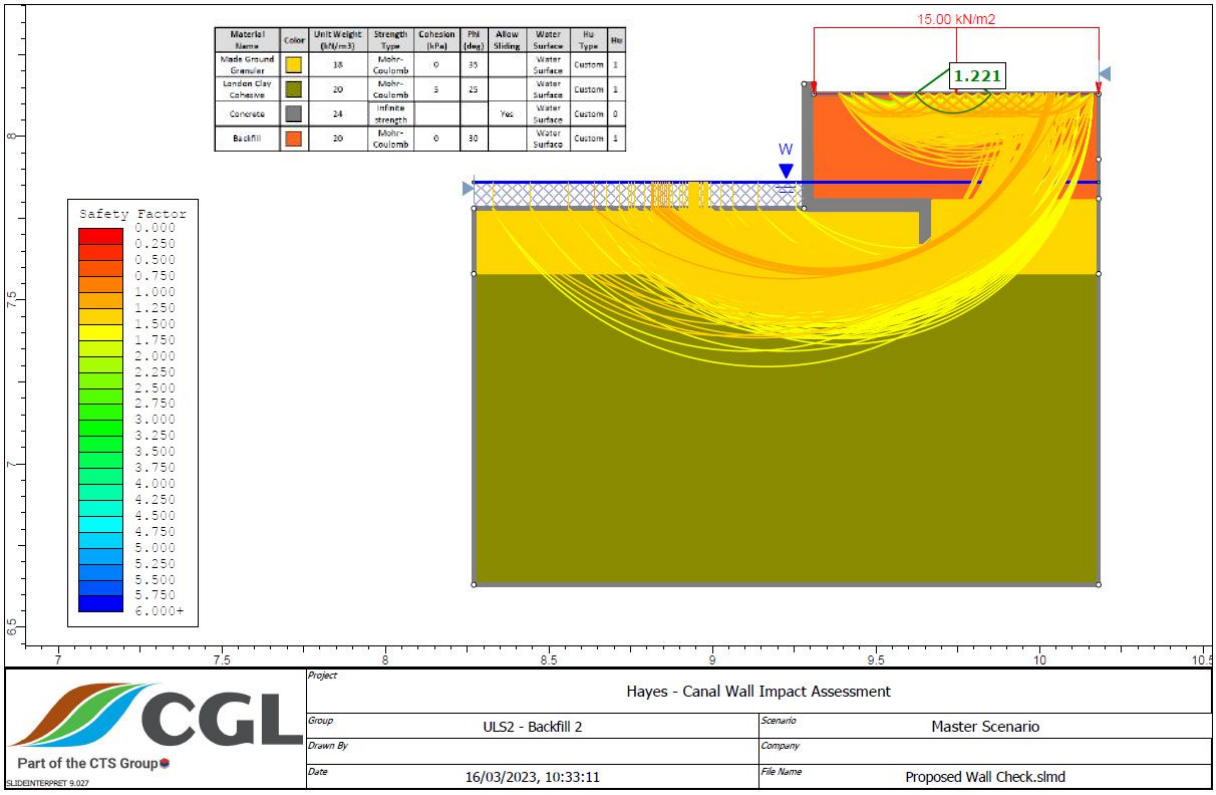
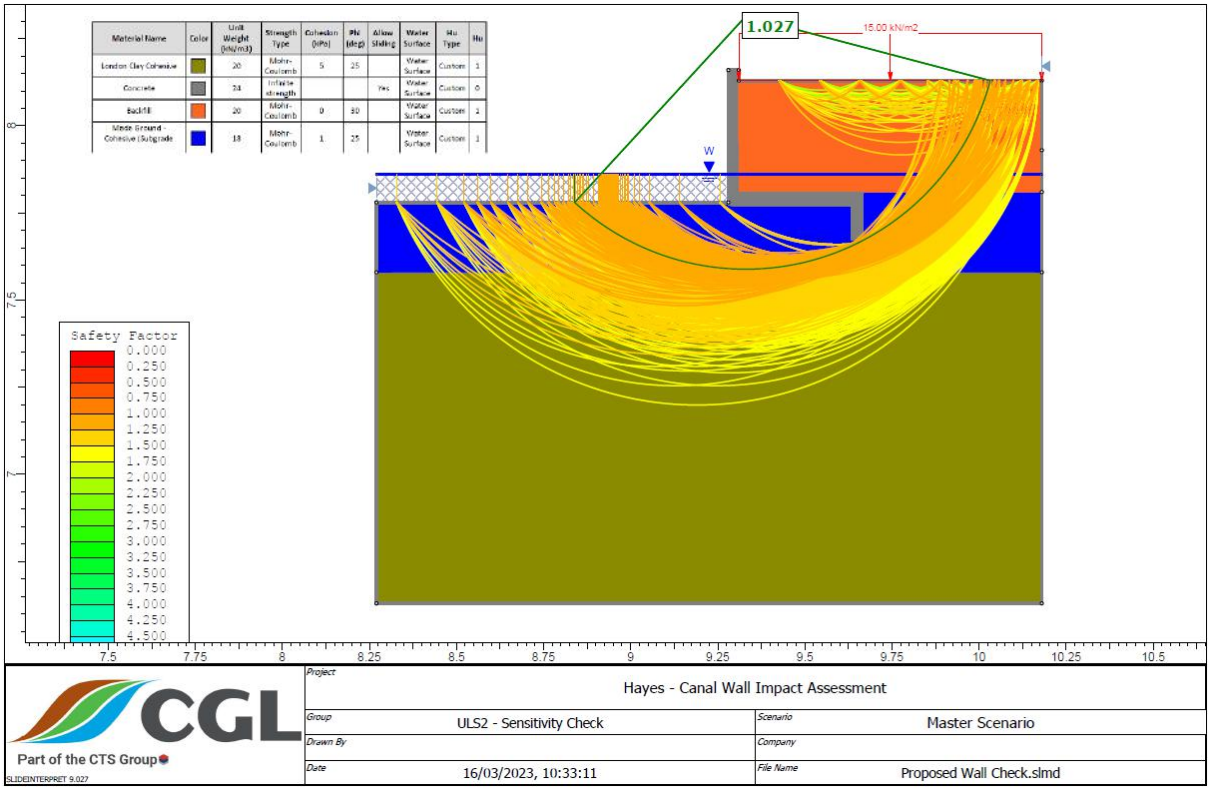


Plate 19. Proposed Wall – Sensitivity Check (Slide2 ULS Output)



5. BEARING CAPACITY CHECK

5.1 Existing Mass Concrete Canal Wall

Bearing capacity checks have been undertaken for the existing mass concrete wall assuming the following:

- Worst-case average and peak bearing pressures were predicted to be 295kPa and 390kPa, respectively.
- Bearing area of the existing wall is assumed to be 1.7m wide, with a depth of 6m;
- Given that the main stress bulb is anticipated to be circa 2 x 1.7 = ~ 3.4m, an undrained shear strength of 110kPa has been adopted for the cohesive subgrade capacity check; and,
- A global factor of safety of 2.2 and 3 have been allowed for the maximum worst-case peak and average stresses predicted at the underside of the wall, respectively. These are above the minimum lump global factor of safety required in accordance with recommendations set out in Eurocode 7[3].

Given that the resulting allowable bearing capacities (399kPa and 295kPa for a global factor of safety of 2.2 and 3 respectively) are greater than the worst-case maximum peak and average stresses predicted (390kPa and 295kPa), it can be concluded that the bearing capacity of the anticipated cohesive subgrade (London Clay) is acceptable. Detailed calculations are presented in Appendix F.

5.2 Proposed Replacement RC Canal Wall

Bearing capacity checks have been undertaken for the proposed replacement RC wall assuming the following:

- The net pressure anticipated at the underside of the proposed replacement RC wall is taken as:

$$\sigma_{existing} = 3.9\ x\ 18 = 70kPa$$

$$\sigma_{proposed} = 15 + 20\ x\ 3.5 + 0.4\ \ x\ 25 = 95kPa$$

$$\sigma_{net} = 95 - 70 = 25kPa$$

- CGL has slightly increased the net stress predicted above to account for some rotational effect from the retaining function of the wall that induces a peak gross stress increase at the heel of the

wall. Given that the client predicted a gross peak bearing stress of circa 110kPa[5], CGL has increased the proposed and as a result the net stress by 15kPa, resulting in a total net of 40kPa;

- Bearing area of the proposed replacement wall is assumed to be 3.6m wide, with a depth of 0.4m;
- Both cohesive (γ of 18kN/m^3 and cu of 30kPa) and granular (γ' of 10kN/m^3 and a ϕ' of 35˚) subgrades have been considered; and,
- A global factor of safety of 3 has been allowed for.

Given that the resulting allowable bearing capacities (91kPa and 114kPa for the cohesive and granular subgrades respectively) are greater than net stresses calculated (40kPa), it can be concluded that the bearing capacity of the anticipated cohesive and/or granular subgrades is acceptable, ***provided that***:

- The formation level of the proposed wall is inspected by a competent engineer and:
    - If cohesive Made Ground is encountered, then hand shear vane tests should be undertaken to confirm minimum undrained shear strength of 30kPa. If this is not verified, then all soft spots should be removed and backfilled with adequate well compacted granular engineered fill;
    - If granular Made Ground is encountered, then the formation level should be compacted (proof rolled or similar) adequately and where any localised weak or soft spots are identified across the formation the soil should be removed and backfilled with adequate well compacted engineered fill.
    - It also recommended that a minimum thickness of 150-200mm of 'bedding layer' comprising 6F2 or similar engineered granular fill is placed and compacted on the formation beneath the proposed RC wall to support with uniform bearing of the new wall and load spread onto the underlying Made Ground soil, and to also improve the friction between the sub soils and cast insitu RC wall.

Detailed calculations of the bearing capacity calculations undertaken are presented in Appendix F.

[5] *Iesis Special Structures (December 2022). Canal Wall Retaining Analysis and Design. Ref. SE1560. Rev. Draft*

6. CONCLUSIONS & RECOMMENDATIONS

- All ULS and SLS factors against sliding, rotational and global stability are above 1 and 1.3 for both the existing and the proposed replacement canal walls;
- Allowable bearing capacity calculated for the London Clay is greater than the average and peak stresses predicted at the underside of the existing wall with acceptable factors of safety; and,
- Allowable bearing capacities calculated are greater than the anticipated net stresses at the underside of the proposed replacement wall, ***provided that:***
- The formation of the proposed wall is inspected by a competent engineer and the following is verified:
    - If cohesive Made Ground is encountered, then hand shear vane tests should be undertaken to confirm minimum undrained shear strength of 30kPa. If this is not verified, then all soft spots should be removed and backfilled with adequate well compacted granular engineered fill;
    - If granular Made Ground is encountered, then the formation level should be compacted (proof rolled or similar) adequately and where any localised weak or soft spots are identified across the formation the soil should be removed and backfilled with adequate well compacted engineered fill.
- It also recommended that a minimum thickness of 150-200mm of 'bedding layer' comprising 6F2 or similar engineered granular fill is placed and compacted on the formation beneath the proposed RC wall to support with uniform bearing of the new wall and load spread onto the underlying Made Ground soil, and to also improve the friction between the sub soils and cast insitu RC wall.

APPENDIX A

Factual Ground Investigation Report

Combined Factual Report

at
Crown Trading Centre, Clayton Road, Hayes UB3 1DU

for
GS Hayes Owner Ltd

Reference: 20709/FR Rev1.0
April 2023

Control Document

Project
Crown Trading Centre, Clayton Road, Hayes UB3 1DU

Document Type
Combined Factual Report

Document Reference
20709/CFR

Document Status
Final

Date
April 2023

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Second check by
N J Lambert BSc (Hons), CEnv, FGS, MIEnvSci.

This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

This document comprises the Factual Report (FR) and incorporates the results to this intrusive works. General site data is recorded below:

Commission Record	
Client:	GS Hayes Owner Limited
Site Name:	Crown Trading Centre, Clayton Road, Hayes UB3 1DU
Grid Reference:	TQ 09427 79740
Soils Limited Quotation Ref:	N/A
Clients Purchase Order:	
Note(s): This report was commissioned by AECOM on behalf of Greystar as a summary package of all previous factual reporting prepared by Soils Limited for the site.	

Documents associated with this development that must be referred to are given below.

Record Of Associated Documents			
Reference	**Type**	**Date**	**Creator**
20227/LR	Letter Report	08/06/2022	Dr Valerio Tedesco
20227/LR_Rev1.01	Letter Report	12/07/2022	Dr Valerio Tedesco
20227/SIR Rev1.01	Supplementary Investigation Report	July 2022	Sam Bevins
20398/LR	Letter Report	29/11/2022	Dr Valerio Tedesco
20709/LR	Letter Report	10/03/2023	Dr Valerio Tedesco

However, following to a specific request from the Client about the provision of factual data, this report has been compiled to include factual data only from all of the above reports, where relevant.

Limitations and Disclaimers

The report was prepared solely for the brief described in Section 1.1 of this report.

The contents, recommendations and advice given in the report are subject to the Terms and Conditions given in Soils Limited's Quotation

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation was prepared for the sole benefit of the Client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report.

If the term "competent person" is used in this report or any Soils Limited document, it means an engineering geologist or civil engineer with a minimum of three years post graduate experience in the understanding and application of the appropriate codes of practice.

This report is a Factual Report and is not a Ground Investigation Report as defined by EC7 (Eurocode 7 Part 1, §3.4, Part 2, §6.1) or a Geotechnical Design Report (Eurocode 7 Part 1, §2.8) as defined by Eurocode 7 and as such may not characterise the ground conditions and additional works may be required to comply with the requirements of EC7.

Within the report reference to ground level relates to the site level at the time of the investigation, unless otherwise stated.

Exploratory hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to

produce an exploratory hole.

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) and/or K4 Soils Laboratory in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice were adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses were undertaken by Derwentside Environmental Testing Services (DETS) in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

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Section 1 Introduction

1.1 Objective of Investigation

The Client commissioned Soils Limited to undertake an intrusive ground investigation and to prepare a Factual Report to supply the Client and their designers with information regarding ground conditions.

We understand that the proposed development is to include a new retaining wall along the river-edge of the site, within the line of the existing canal wall. The area of this planned retaining wall has been the focus of site investigation works to date.

The investigation was to be undertaken to provide data for the proposed development. The investigation was to be made by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the exploratory holes.

The factual reports compiled within did not include any laboratory chemical testing of recovered samples.

1.2 Site Description

The Crown Trading Centre was a multi-occupancy hard-covered site comprising buildings of varying ages, heights and sizes dating from the 1930's to relatively modern redevelopments.

Former rail lines were present in parts of the site leading from Clayton Road to the south towards the Grand Union Canal to the north emplaced in concrete. The site included a variety of uses and users including small industrial, storage and commercial ventures including tyre replacement, printers, electronics, scaffolding, plastics, garage services and commercial offices.

No obvious vegetation was present on or around the site except for occasional mature trees / bushes / weeds alongside the canal which bounded the north of the site and some vegetation growing out of the canal wall cracks and joints. The remaining three sides were surrounded by light industrial units. The site was flat lying with no obvious slope noted, with a very gentle slope (<2°) dipping to the south / southeast noted across the wider area.

The site location plan is given in Figure 1. An aerial photograph of the site and its close environs has been included in Figure 2.

1.3 Proposed Development

The proposed development consists of two large concrete framed residential buildings ranging in height from a two-storey podium area to ten storeys, which will occupy much of the site area. The proposal includes access roads, parking areas, shared communal space and playground areas. No private residential gardens are proposed.

As part of this proposed development, a new retaining wall is to be constructed along the river edge, within the line of the existing canal wall.

1.4 Anticipated Geology

The 1:50,000 BGS map showed the site to be located upon the bedrock London Clay Formation with overlying superficial deposits of the Lynch Hill Gravel Member.

1.4.1 Lynch Hill Gravel Member

The rivers of the south-east of England, including the River Thames and its tributaries, have been subject to at least three changes of level since Pleistocene times. One result has been the formation of a complex series of River Terrace Gravels. These terraces represent ancient floodplain deposits that became isolated as the river cut downwards to lower levels.

The Lynch Hill Gravel approximates to the third level terrace gravel. The composition of the River Terrace Gravel varies greatly, depending on the source material available in the river's catchment. Deposits generally consist of sand and gravel of roughly bedded flint or chert gravel commonly in a matrix of silt and clay.

1.4.2 London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The upper boundary member of the London Clay Formation is known as the Claygate Member and marks the transition between the deep water, predominantly clay environment and succeeding shallow-water, sand environment of the Bagshot Formation.

The lower boundary is generally marked by a thin bed of well-rounded flint gravel and/or a glauconitic horizon. The formation overlies the Harwich Formation or where the Harwich Formation is absent the Lambeth Group.

In the north London area the upper part of the London Clay Formation has been disturbed by periglacial action and may contain pockets of sand and gravel.

Section 2 Site Works

2.1.1 Site Investigation Works Completed

Stage 1 of the site investigation was carried out between 16th May and 8th June 2022 and the results were presented in the Supplementary Investigation Report with reference number 20227/SIR Rev1.01, dated July 2022. The site works actually comprised:

- Service clearance of exploratory hole locations using GPR and EMF techniques
- Concrete coring of exploratory hole locations
- 7No. windowless sampler boreholes (WS01 to WS05, WSC01 and WSC02) to depths ranging between 0.70m and 5.00m below ground level (bgl)
- 6No. dynamic probes (DP01 to DP04, DPC1A – DPC1C and DPC2) to depths ranging between 0.40m and 7.00m bgl
- 2No. cable percussive boreholes to 25.00m (BHB) and 35.00m bgl (BHB) with in-situ testing at 1m intervals to 5m depth, then at 1.5m intervals
- 10No. in-situ CBR tests using a TRL DCP (DCP01 to DCP10)
- 1No. GPR survey
- Geotechnical laboratory testing.

On 16th May 2022 the exploratory hole locations were cleared for underground services using GPR and EMF techniques. On 16th and 17th May concrete coring of surfacing was undertaken.

On 17th to 20th May seven windowless sampler boreholes (WS01 to WS05 and WSC01 & WSC02) were drilled, using a Premier Compact 110 series windowless sampler and dynamic probing rig, to depths ranging between 0.70m and 5.00m below ground level (bgl) at locations selected by the Client's engineer. In some cases, these were slightly repositioned due to site constraints which was agreed with the Client prior to undertaking the works.

Six super heavy dynamic probes, (DP01 to DP04 and DPC01 & DPC02) were driven prior and adjacent to their corresponding windowless sampler borehole to depths ranging between 0.40m and 7.00m bgl.

Exploratory holes WS/DPC01 and WS/DPC02 were drilled adjacent to the canal wall, with the remaining locations undertaken across the site. It must be noted that WSC01 and DPC01 refused on an obstruction at very shallow depths of 0.70m and 0.40m bgl, which couldn't be safely penetrated with the equipment available. DPC01 was repositioned and attempted on three occasions (DPC01A-C), but on each attempt an obstruction was encountered at a maximum depth of 1.30m bgl. Borehole WS05 refused on a concrete slab at a depth of 0.90m bgl. The borehole was moved slightly, but this also refused on the concrete. Due to identified underground services in the vicinity it was not possible to safely re-position the borehole any further.

On 30th May to 8th June 2022 two boreholes (BHA & BHB) were drilled using a Dando light cable percussive rig, to depths of 35.00m and 25.00m bgl at locations selected by the client's engineer. These were slightly re-positioned due to site constraints and agreed with the Client prior to undertaking the works.

A single standpipe was installed within each borehole location (BHA & BHB) to allow for continued monitoring of both groundwater and ground gas.

Following completion of site works, soil cores were logged, and sub sampled so that samples could be sent to the laboratory for geotechnical testing.

All exploratory hole locations from Stage 1 of the site investigation are presented in Figure 3.

Information from windowless sampler boreholes WSC01 and WSC02 and the corresponding dynamic probes (DPC1A – DPC1C and DPC2), adjacent to the canal wall, was also used in the preparation of the letter reports with reference number 20227/LR, dated 8th June 2022, and 20227/LR/Rev1.01, dated 12th July 2022.

Stage 2 of the site investigation was carried out on 16th August 2022 and the results were presented in the Letter Report with reference number 20398/LR, dated 29th November 2022. The site works actually comprised:

- 5No. machine excavated trial pits (TP1, TP2, TP3, TP3A and TP4) to depths ranging between 1.30m and 1.45m bgl.

The trial pits were excavated by the Squibb Group, directly appointed by the Client, while the engineering logging activities were carried out by Soils Limited.

The five machine excavated trial pits (TP1, TP2, TP3, TP3A and TP4) were initially dug by Squibb Group on 16th August 2022 to depths ranging between 1.30m and 1.45m below ground level (bgl). Deeper excavation was not possible due to the presence of a concrete slab at the base of each of the pits, which was considered part of the canal wall. Two separate trial pits (TP3 and TP3A) were attempted at the same location to bypass the concrete slab but unsuccessfully. Squibb, therefore, terminated the excavations at the above depths out of concern that any further deepening could undermine the canal wall with a potential for collapse favoured by the ingress of water into the excavations.

The trial pits, however, were dug by Squibb Group at distances of 2.1m to 4.4m from the canal wall, therefore subsequently further excavations were carried out at TP1, TP2, TP3 and TP4 adjacent to the rear face of the wall. Trial pits TP2 and TP3 were joined into a single excavation, defined as TP2/TP3.

No laboratory testing was undertaken as part of Stage 2 of the site investigation, as this was not part of the brief.

All exploratory hole locations from Stage 2 of the site investigation are presented in Figure 4.

The third stage of the site investigation was carried out between 6th and 8th February 2023 and the results were presented in the Letter Report with reference number 20709/LR, dated March 2023. The actual site works undertaken comprised:

- Service clearance of exploratory hole locations using Cable Avoidance Tool (C.A.T.) and signal generator (GENNY)
- Site setup
- 2No. cable percussive boreholes to 15.00m bgl, with in-situ testing at 1m intervals to 5m depth, then at 1.5m intervals
- Geotechnical laboratory testing.

Two cable percussive boreholes (BH201A and BH202) were drilled between 6th and 8th February 2023 using a Dando 2000 drilling rig at locations selected by Soils Limited in order to describe the ground conditions at the back of the canal wall. Borehole BH201A replaced BH201, the drilling of which was aborted because of the presence of obstructions at 4.00m bgl.

Following completion of site works, soil cores were logged, and sub sampled so that samples could be sent to the laboratory for geotechnical testing.

Both the exploratory hole locations from Stage 3 of the site investigation are presented in Figure 5.

2.2 Ground Conditions

All exploratory holes were undertaken at locations agreed with the Client prior to mobilisation, unless, due to access constraints or site conditions, an alternate location agreed by Soils Limited and Clients' Engineer on-site.

The maximum depths of exploratory holes have been included in Table 2.1.

All exploratory holes by Soils Limited were scanned with a CAT and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 2.1 Final Depth of Exploratory Holes

Exploratory Hole	Depth (m bgl)	Exploratory Hole	Depth (m bgl)
WS01	4.00	DP01	4.70
WS02	2.00	DP02	6.00
WS03	1.60	DP03	1.70
WS04	4.00	DP04	6.00
WS05	0.90[1]	-	-
WSC01	0.70[1]	DPC01A – C	0.40 – 1.30
WSC02	5.00	DPC02	7.00
BHA (w)	35.00	BHB (w)	25.00
BH201A	15.00	BH202	15.00
TP1	1.30	TP3A	1.45
TP2	1.45	TP4	1.40

Exploratory Hole	Depth (m bgl)	Exploratory Hole	Depth (m bgl)
TP3	1.45		

Note(s): [W] - well installation. The depths given in this table are taken from the ground level on-site at the time of investigation. 1 Refused on shallow obstructions, couldn't safely be penetrated.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the exploratory hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For complete information on the ground conditions encountered see the exploratory hole logs presented in Appendix B.1.

Section 3 Groundwater & Ground Gas Monitoring

3.1 Groundwater

Groundwater was observed within 7No. of exploratory holes, with all other locations remaining dry during drilling/excavation. A summary of groundwater observations made during drilling/excavation are presented in Table 3.1.

Table 3.1 Groundwater Observations

Exploratory Hole	Strike Depth (m bgl)	Remarks
WS04	0.50	
BHB	6.00	
TP1	2.00	Approximately equal to the free water level in the canal
TP2/TP3	2.00	
TP4	2.00	
BH201A	2.30	
BH202	1.90	

63mm standpipe piezometers were installed into 2No. of the exploratory holes. The exploratory holes where standpipes were installed are outlined in Table 3.2.

Table 3.2 Monitoring Standpipe Locations

Hole No.	Diameter (mm)	Final Depth (m bgl)
BHA	63	10.00
BHB	63	10.00

Note(s): Diameter refers to the pipe's outer diameter

The ground investigation included 1No of groundwater monitoring visits. The groundwater observations undertaken have been presented below in Table 3.3.

Table 3.3 Groundwater Monitoring

Hole No.	Well Depth (m bgl)	Depth to Water (m bgl) 17/06/22
BHA	10.00	2.71
BHB	10.00	2.63

Section 4 Geotechnical In-Situ and Laboratory Testing

4.1 Standard Penetration Tests

A total of 40No. Standard Penetration Tests (SPTs) were undertaken at locations BH0A, BHB, BH201A and BH202. The SPT values are presented on the exploratory hole logs in Appendix B.1.

Table 4.1 presents the energy ratio for the SPT hammers.

Table 4.1 SPT Hammer Efficiency

SPT Hammer Ref	Energy Ratio Er (%)
BHA	63
BHB	63
BH201A	70
BH202	70

4.2 Dynamic Probe Tests

A total of 6No. super heavy dynamic probes (DP01 to DP04, DPC01 and DPC02) were undertaken prior and adjacent to their respective windowless sampler borehole. Three attempts were done at location DPC01 (DPC01A – DPC01C) due to scarce penetration. The dynamic probe logs are presented in Appendix B.1.

Table 4.1 presents the energy ratio for the rig hammers.

Table 4.2 Rig Hammer Efficiency

Rig Hammer Ref	Energy Ratio Er (%)
DP01	92.96
DP02	92.96
DP03	92.96
DP04	92.96
DPC01A – C	92.96
DPC02	92.96

4.3 Dynamic Cone Penetrometer Tests

A total of 10No. dynamic cone penetrometer tests (DCP01 to DCP10) were undertaken using the Transport Research Laboratory (TRL) Dynamic Cone Penetrometer (DCP). The dynamic probe logs are presented in Appendix C.1.

4.4 Moisture Content Tests

Moisture content testing was carried out on 5No. samples. Results of the moisture content testing are presented in Appendix C.2.

4.5 Atterberg Limit Tests

Atterberg Limit tests were carried out on 5No. samples.

Results of the Atterberg Limit tests are presented in Appendix C.2.

4.6 Particle Size Distribution Testing

Particle size distribution (PSD) testing was carried out on 4No. samples using the wet sieve method.

Results of the PSD tests are presented in Appendix C.2.

4.7 Quick Unconsolidated Undrained Triaxial Compression Testing

Quick Unconsolidated Undrained (QUU) triaxial compression tests were carried out on 5No samples.

The results of the triaxial compression testing are presented in Appendix C.2.

4.8 Consolidated Undrained Multistage Triaxial Compression Testing

Consolidated Undrained (CU) multistag triaxial compression tests were carried out on 2No samples.

The results of the triaxial compression testing are in Appendix C.2.

4.9 BRE Sulphate and pH Tests

5No. samples were submitted for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

The results of the sulphate and pH tests are presented in Appendix C.2.

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Figure 1 – Site Location Map

Job Number 20709	**Project** Crown Trading Centre, Clayton Road, Hayes UB3 1DU
Client GS Hayes Owner Ltd	**Date** April 2023

Figure 2 – Aerial Photograph

Project
Crown Trading Centre, Clayton Road, Hayes UB3 1DU

Client
GS Hayes Owner Ltd

Date
April 2023

Job Number
20709

N

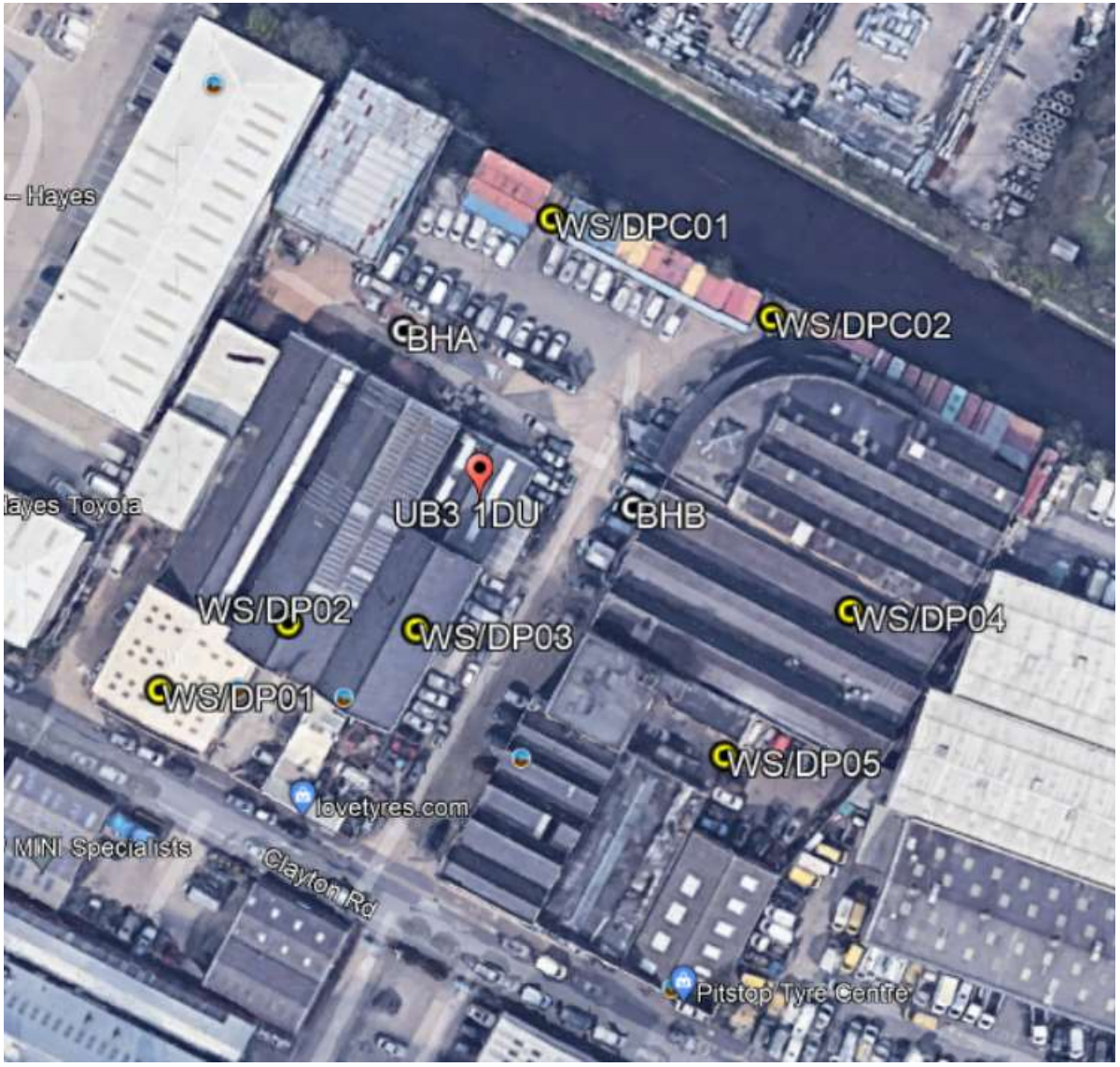


Figure 3 – Stage 1 – Exploratory Hole Plan

Project
Crown Trading Centre, Clayton Road, Hayes UB3 1DU

Client
GS Hayes Owner Ltd

Date
April 2023

Job Number
20709

Figure 4 – Stage 2 – Exploratory Hole Plan

Project
Crown Trading Centre, Clayton Road, Hayes UB3 1DU

Client
GS Hayes Owner Ltd

Date
April 2023

Job Number
20709

Figure 5 – Stage 3 – Exploratory Hole Plan

Project
Crown Trading Centre, Clayton Road, Hayes UB3 1DU

Client
GS Hayes Owner Ltd

Date
April 2023

Job Number
20709

Appendix A Standards and Resources

The site worksand geotechnical testing was undertaken in accordance with the following standards were applicable:

- BS 5930:2015 and BS EN ISO 22476-2 2005+A1:2011
- BS 5930:2015 and BS EN ISO 22476-2&3:2005+A1:2011
- BS 5930:2015 and BS EN ISO 22476-3:2005+A1:2011
- BS EN ISO 14688-1:2018 - Geotechnical investigation and testing - Identification and description
- BS EN ISO 14688-2:2018 - Geotechnical investigation and testing - Principles for a classification
- BS 1377:1990 Parts 1 to 8
- BRE Special Digest 1, 2005, ‘Concrete in Aggressive Ground’
- Google Earth
- British Geological Survey Website & iGeology App

Appendix B Site Works

Appendix B.1 Exploratory Hole Logs

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**BHA**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	30/05/22 - 01/06/22	CF	SB	FINAL	**CP**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 150	13/07/2022	1:50

Weather: | Termination: Hole complete | SPT Hammer: AR3828 Energy Ratio: 63% | Sheet 1 of 4

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.20 - 0.40	B			0.10		CONCRETE.		
0.40 - 0.80	B			(0.70)		Soft to firm dark brown mottled black and brown, slightly silty slightly cobbly slightly gravelly sandy CLAY. Gravel is angular to well-rounded fine to coarse flint, clinker, red brick, concrete, quartzite, chalk and sandstone. Cobbles are angular to sub-angular quartzite. Occasional coarse gravel-sized firm clay inclusions. Reworked material. MADE GROUND.		
0.80 - 1.20	B			0.80		Firm dark brown mottled brown, slightly silty slightly cobbly slightly gravelly sandy CLAY. Gravel is angular to well-rounded fine to coarse flint, clinker, red brick, concrete, quartzite, chalk, flagstone and sandstone. Cobbles are angular to sub-angular quartzite. Frequent black speckling. Occasional coarse gravel-sized firm clay inclusions. Occasional dark bluish grey with mild odour of decomposition. MADE GROUND.		
1.50	SPT	N=14 (1,1/3,4,3,4)		(0.70)				
1.50 - 1.95	C			1.50		Yellowish brown, slightly silty SAND AND GRAVEL. Gravel is sub-angular to rounded fine to coarse flint. Sand is predominantly medium to coarse. Rare clayey inclusion. LYNCH HILL GRAVEL MEMBER		
1.50 - 2.00	B							
2.50 - 2.95	C							
2.50 - 3.00	B			(2.40)				
3.50	SPT	N=11 (4,4/4,3,2,2)						
3.50 - 3.95	C							
3.50 - 4.00	B							
				3.90		Firm becoming stiff, brown mottled yellowish brown, slightly gravelly slightly sandy silty CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. LYNCH HILL GRAVEL MEMBER		
				(0.60)				
4.50	SPT	N=9 (1,1/1,2,3,3)		4.50		Stiff greyish brown mottled dark grey, slightly sandy silty extremely close-spaced fissured CLAY. Sand is predominantly fine. Occasional fine to medium sand-sized selenite crystals. Occasional calcic sand inclusions. Rare white and cream fine calcareous shell fragments. Rare sub-rounded fine to medium sandy siltstone gravel. LONDON CLAY FORMATION		
4.50 - 4.95	S							
4.50 - 5.00	B							
5.50	D							
6.00 - 6.45	U							
6.50	D							
7.00	D							
				(6.00)				
7.50	SPT	N=15 (2,3/3,4,3,5)						
7.50 - 7.95	S							
8.00	D							
8.50	D							
9.00 - 9.45	U							
9.50	D							
10.00	D							

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)
4.50	200

Remarks:
No rootlets observed.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
Crown Trading Centre	AECOM	**BHA**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	30/05/22 - 01/06/22	CF	SB	FINAL	**CP**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 150	13/07/2022	1:50

Weather: | Termination: Hole complete | SPT Hammer: AR3828 Energy Ratio: 63% |

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.50 10.50 - 10.95	SPT S	N=22 (3,3/4,6,6,6)		10.50		Stiff greyish brown mottled dark grey, slightly sandy silty extremely close-spaced fissured CLAY. Sand is predominantly fine. Occasional fine to medium sand-sized selenite crystals. Occasional calcic sand inclusions. Rare white and cream fine calcareous shell fragments. Rare sub-rounded fine to medium sandy siltstone gravel. LONDON CLAY FORMATION		
11.00	D					Very stiff greyish brown mottled grey, silty closely-spaced fissured CLAY. Rare fine sand-sized selenite crystals. Rare calcic sand inclusions. Rare white and off-white fine calcareous shell fragments. LONDON CLAY FORMATION		
11.50	D							
12.00 - 12.45	U							
12.50	D							
13.00	D							
13.50 13.50 - 13.95	SPT S	N=27 (3,4/4,7,9,7)						
14.00	D							
14.50	D							
15.00 - 15.45	U			(14.50)				
15.50	D							
16.00	D							
16.50 16.50 - 16.95	SPT S	N=29 (3,4/5,8,8,8)						
17.00	D							
17.50	D							
18.00 - 18.45	U							
18.50	D							
19.00	D							
19.50 19.50 - 19.95	SPT S	N=31 (3,4/6,8,8,9)						
20.00	D							

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)
4.50	200

Remarks:
No rootlets observed.

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
Crown Trading Centre	AECOM	**BHA**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	30/05/22 - 01/06/22	CF	SB	FINAL	**CP**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 150	13/07/2022	1:50

Weather: | Termination: Hole complete | SPT Hammer: AR3828 Energy Ratio: 63% |

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
20.50	D					Very stiff greyish brown mottled grey, silty closely-spaced fissured CLAY. Rare fine sand-sized selenite crystals. Rare calcic sand inclusions. Rare white and off-white fine calcareous shell fragments. LONDON CLAY FORMATION		
21.00 - 21.45	U	Ublow = 62						
21.50	D							
22.50	SPT	N=32 (3,5/5,7,10,10)						
22.50 - 22.95	S							
23.00	D							
23.50	D							
24.00 - 24.45	U	Ublow = 67						
24.50	D							
25.00	D			25.00				
25.50	SPT	N=35 (4,4/6,9,10,10)				Very stiff greyish brown mottled grey, very silty CLAY. Rare fine sand-sized selenite crystals. LONDON CLAY FORMATION		
25.50 - 25.95	S							
26.00	D							
26.50	D							
27.00 - 27.45	U	Ublow = 77						
27.50	D			(10.00)				
28.00	D							
28.50	SPT	N=42 (4,5/10,10,11,11)						
28.50 - 28.95	S							
29.00	D							
29.50	D							
30.00 - 30.45	U	Ublow = 100						

21 22 23 24 25 26 27 28 29 30

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)
4.50	200

Remarks:
No rootlets observed.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**BHA**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	30/05/22 - 01/06/22	CF	SB	FINAL	**CP**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 150	13/07/2022	1:50

Weather: | Termination: Hole complete | SPT Hammer: AR3828 Energy Ratio: 63% | Sheet 4 of 4

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
30.50	D					Very stiff greyish brown mottled grey, very silty CLAY. Rare fine sand-sized selenite crystals. LONDON CLAY FORMATION		
31.00	D							
31.50	SPT	N=49 (5,5/9,12,12,16)						
31.50 - 31.95	S							
32.00	D							
32.50	D							
33.00 - 33.45	U	Ublow = 100						
33.50	D							
34.00	D							
34.50	SPT	N=50 (5,6/9,13,13,15)						
34.50 - 34.95	S							
35.00	D			35.00		End of Borehole at 35.00m		

31 32 33 34 35 36 37 38 39 40

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
							4.50	200

Remarks:
No rootlets observed.

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**BHB**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	02/06/22 - 06/06/22	CF	SB	FINAL	**CP**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 150	13/07/2022	1:50

Weather: | Termination: Hole complete | SPT Hammer: AR3828 Energy Ratio: 63% | Sheet 1 of 3

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.20 - 0.40	B			0.20		CONCRETE.		
0.40 - 0.80	B			(0.60)		Soft to firm dark brown mottled brown, slightly silty slightly cobbly slightly gravelly sandy CLAY. Gravel is angular to well-rounded fine to coarse flint, red brick, clinker, concrete, quartzite, chalk, plaster and sandstone. Cobbles are angular to sub-angular red brick. Reworked material. MADE GROUND.		
0.80 - 1.20	B			0.80				
				(0.60)		Firm brown mottled greyish brown and dark greenish grey, slightly silty slightly sandy gravelly CLAY. Gravel is angular to rounded fine to coarse flint, clinker, red brick, concrete, quartzite, chalk, flagstone and sandstone. Frequent black speckling. Occasional coarse gravel-sized firm clay inclusions. Dark greenish grey with minor odour of decomposition. MADE GROUND.		
1.50	SPT	N=50 (1,2/50 for 285mm)		1.40		Yellowish brown, slightly silty SAND AND GRAVEL. Gravel is sub-angular to rounded fine to coarse flint. Sand is predominantly medium to coarse. Rare clayey inclusion. LYNCH HILL GRAVEL MEMBER		
1.50 - 1.95	C							
1.50 - 2.00	B							
2.50	SPT	N=25 (4,6/3,6,8,8)						
2.50 - 2.95	C							
2.50 - 3.00	B			(2.60)				
3.50	SPT	N=27 (4,5/6,6,7,8)						
3.50 - 3.95	C							
3.50 - 4.00	B							
				4.00		Yellowish brown, very gravelly SAND. Gravel is sub-angular to rounded fine to coarse flint. Sand is predominantly medium to coarse. Rare clayey inclusion. LYNCH HILL GRAVEL MEMBER		
4.50	SPT	N=25 (5,5/7,8,8,2)		(0.90)				
4.50 - 4.95	C							
4.50 - 5.00	B							
				4.90		Firm becoming stiff, brown mottled yellowish brown, slightly gravelly slightly sandy silty CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. Occasional band of orangish brown sand. LYNCH HILL GRAVEL MEMBER		
5.00 - 5.50	B			(0.90)				
5.50 - 6.00	B							
				5.80		Stiff greyish brown mottled dark grey, slightly sandy silty extremely close-spaced fissured CLAY. Sand is predominantly fine. Occasional fine to medium sand-sized selenite crystals. Occasional calcic sand inclusions. Rare white and cream fine calcareous shell fragments. Rare sub-rounded fine to medium sandy siltstone gravel. LONDON CLAY FORMATION		
6.00	SPT	N=17 (2,3/3,4,5,5)						
6.00 - 6.45	S							
6.50	D							
7.00	D							
7.50 - 7.95	U							
7.50 - 8.00	B							
				(5.20)				
8.50	D							
9.00	SPT	N=18 (2,3/4,4,5,5)						
9.00 - 9.45	S							
9.50	D							
10.00	D							

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
							9.00	200

Remarks:
No rootlets observed.

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.00	6.00	6.00	20	6.00	Groundwater strike at 6m bgl.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
Crown Trading Centre	AECOM	**BHB**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	02/06/22 - 06/06/22	CF	SB	FINAL	**CP**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 150	13/07/2022	1:50

Weather: | Termination: Hole complete | SPT Hammer: AR3828 Energy Ratio: 63% |

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
10.50 - 10.95	U					Stiff greyish brown mottled dark grey, slightly sandy silty extremely close-spaced fissured CLAY. Sand is predominantly fine. Occasional fine to medium sand-sized selenite crystals. Occasional calcic sand inclusions. Rare white and cream fine calcareous shell fragments. Rare sub-rounded fine to medium sandy siltstone gravel. LONDON CLAY FORMATION		
11.00	D			11.00		Very stiff greyish brown mottled grey, silty closely-spaced fissured CLAY. Rare fine sand-sized selenite crystals. Rare fine to medium gravel-sized calcic sand inclusions. Rare white and cream fine calcareous shell fragments. LONDON CLAY FORMATION		
11.50	D							
12.00	SPT	N=23 (3,4/3,6,6,8)						
12.00 - 12.45	S							
12.50	D							
13.00	D							
13.50 - 13.95	U							
14.00	D							
14.50	D							
15.00	SPT	N=27 (4,4/6,6,7,8)						
15.00 - 15.45	S			(14.00)				
16.00	D							
16.50 - 16.95	U							
17.00	D							
18.00	SPT	N=29 (4,4/6,7,8,8)						
18.00 - 18.45	S							
18.50	D							
19.00	D							
19.50 - 19.95	U							
20.00	D							

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)
9.00	200

Remarks:
No rootlets observed.

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.00	6.00	6.00	20	6.00	Groundwater strike at 6m bgl.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
Crown Trading Centre	AECOM	**BHB**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	02/06/22 - 06/06/22	CF	SB	FINAL	**CP**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 150	13/07/2022	1:50

Weather: | Termination: Hole complete | SPT Hammer: AR3828 Energy Ratio: 63% |

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
20.50	D					Very stiff greyish brown mottled grey, silty closely-spaced fissured CLAY. Rare fine sand-sized selenite crystals. Rare fine to medium gravel-sized calcic sand inclusions. Rare white and cream fine calcareous shell fragments. LONDON CLAY FORMATION		
21.00 21.00 - 21.45	SPT S	N=32 (4,5/6,8,9,9)						
21.50	D							
22.00	D							
22.50 - 22.95	U							
23.00	D							
23.50	D							
24.00 24.00 - 24.45	SPT S	N=34 (4,4/6,8,9,11)						
24.50	D							
25.00	D			25.00		End of Borehole at 25.00m		

21 22 23 24 25 26 27 28 29 30

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
							9.00	200

Remarks:
No rootlets observed.

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	10.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.00	6.00	6.00	20	6.00	Groundwater strike at 6m bgl.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
CTC Hayes - Canal Wall 2		AECOM			**BH201**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20709	07/02/23	AN	DT	FINAL	**CP**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 2000	01/03/2023	1:50

Weather: | Termination: Encountered obstruction | Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(4.00)		Stiff dark grey mottled brown slightly sandy, gravelly CLAY. Sand is fine to medium. Gravel is angular to subangular, fine to medium flint, concrete and brick. MADE GROUND.		
						Solid obstruction.		
4.00	B			4.00		End of Borehole at 4.00m		

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:
Awaiting machine for breaking out hardstanding 10:30-12:00, 1.5 hours.

Chiselling			
From (m)	To (m)	Duration	Remarks
0.40	0.70	00:30	

Installation			
Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
CTC Hayes - Canal Wall 2		AECOM			**BH201A**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20709	07/02/23 - 08/02/23	AN	DT	FINAL	**CP**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 2000	01/03/2023	1:50

Weather: | Termination: Reached proposed depth | SPT Hammer: SDA1 Energy Ratio: 70% | Sheet 1 of 2

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.40	D			(0.80)		Dark grey slightly clayey gravelly SAND. Sand is fine to medium. Gravel is angular to sub angular, fine to coarse flint with fragments of 10-50mm of concrete and brick. MADE GROUND		
0.40 - 0.80	B							
0.80	D			0.80				
0.80 - 1.30	B			1.00		Soft greyish brown sandy gravelly CLAY. Sand is fine to medium. Gravel is angular to sub rounded, fine to coarse flint. MADE GROUND.		
1.50	D					Soft greyish brown mottled light orangish brown gravelly sandy Clay. Sand is fine to medium. Gravel is angular to subangular, fine to coarse flint. MADE GROUND.		
1.50 - 2.00	B							
	U	Ublow = 20		(1.50)				
2.00	SPT	N=10 (1,2/2,3,2,3)						
2.00 - 2.45	D							
2.50	SPT	N=30 (4,6/6,7,8,9)		2.50		Yellowish brown SAND AND GRAVEL. Sand is fine to coarse. Gravel is angular to subangular, fine to coarse flint. MADE GROUND.		
2.50 - 3.00	D B							
3.00	D							
				(1.50)				
3.50	SPT	N=40 (6,8/9,10,10,11)						
3.50 - 4.00	B							
4.00	D			4.00		Yellowish brown slightly gravelly SAND. Sand is fine to medium. Gravel is angular to subangular, fine to coarse flint. MADE GROUND.		
4.50	SPT D	N=25 (5,5/6,6,6,7)						
4.50 - 5.00	B			(1.50)				
5.00	D							
5.50	D			5.50		Brown sandy CLAY. LONDON CLAY FORMATION.		
	U	Ublow = 80		(0.50)				
5.95 - 6.00	D			6.00		Stiff dark grey slightly fissured CLAY. LONDON CLAY FORMATION.		
6.00	D							
6.00 - 6.50	B							
7.00	SPT D	N=20 (2,3/4,5,5,6)						
8.00	D			(5.00)				
8.50 - 8.95	U	Ublow = 65						
8.95 - 9.00	D							
9.00	D							
10.00	SPT D	N=23 (3,3/5,5,6,7)						

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)

Remarks:
Waiting for machine to backfill around the location 12:15-12:30, 15 minutes.
Filling water drums 30 minutes.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.50	2.00	6.00	20	2.30	Groundwater encountered

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
CTC Hayes - Canal Wall 2	AECOM	**BH201A**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20709	07/02/23 - 08/02/23	AN	DT	FINAL	**CP**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 2000	01/03/2023	1:50

Weather: | Termination: Reached proposed depth | SPT Hammer: SDA1 Energy Ratio: 70% | Sheet 2 of 2

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
						Stiff dark grey slightly fissured CLAY. LONDON CLAY FORMATION.		
11.00	D			11.00				
						Stiff dark brown slightly fissured CLAY. LONDON CLAY FORMATION.		
11.50 - 11.95	U	Ublow = 59						
11.95 - 12.00	D							
12.00	D							
13.00	SPT	N=29 (3,4/6,7,7,9)		(4.00)				
	D							
14.00	D							
14.50 - 14.95	U	Ublow = 90						
14.95 - 15.00	D							
15.00	D			15.00		End of Borehole at 15.00m		

11 12 13 14 15 16 17 18 19 20

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:
Waiting for machine to backfill around the location 12:15-12:30, 15 minutes.
Filling water drums 30 minutes.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.50	2.00	6.00	20	2.30	Groundwater encountered

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
CTC Hayes - Canal Wall 2		AECOM			**BH202**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20709	06/02/23 - 07/02/23	AN	DT	FINAL	**CP**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 2000	01/03/2023	1:50

Weather: | Termination: Reached proposed depth | SPT Hammer: SDA1 Energy Ratio: 70% | Sheet 1 of 2

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.30	D			(1.50)		Soft dark brown gravelly sandy CLAY. Sand is fine to medium. Gravel is angular to sub angular, fine to coarse flint with fragments of 10 to 50 mm sized concrete and brick. Rare angular, medium slate gravel. MADE GROUND.		
0.30 - 0.80	B							
1.00	D							
1.50	SPT	N=5 (1,0/1,1,1,2)		1.50		Soft brown mottled grey gravelly sandy CLAY. Sand is fine to medium. Gravel is angular to sub angular, fine to coarse flint with fragments of 10 to 30 mm sized concrete and brick. MADE GROUND.		
	D							
1.50 - 2.00	B			(0.50)				
2.00	SPT	N=31 (4,6/7,7,8,9)		2.00		Yellowish brown gravelly SAND. Sand is fine to coarse. Gravel is fine angular, fine to coarse flint. MADE GROUND.		
	D							
2.00 - 2.50	B							
3.00	SPT	N=43 (9,9/10,10,11,12)		(2.00)				
	D							
3.00 - 3.50	B							
4.00	SPT	N=28 (3,4/6,7,7,8)		4.00		Dark brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is fine angular, fine to coarse flint. MADE GROUND.		
	D							
4.00 - 4.50	B							
5.00	SPT	N=18 (1,2/2,5,5,6)		(1.80)				
	D							
5.00 - 5.50	B							
5.50	SPT	N=13 (1,2/2,3,4,4)						
5.50 - 5.95	D							
5.50 - 6.00	B							
5.80	D			5.80		Stiff dark grey slightly fissured CLAY. LONDON CLAY FORMATION.		
7.00	D							
7.00 - 7.45	U	Ublow = 48						
7.45 - 7.50	D							
8.00	D							
8.50	SPT	N=18 (2,3/3,4,5,6)						
8.50 - 8.95	D							
9.00	D							
10.00	D							
10.00 - 10.45	U	Ublow = 55						

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:
Awaiting induction 08:00-09:00, 1 hour.
Waiting for location to be broken out 10:00-11:30, 1.5 hours.
Filling water drums 40 minutes.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.00	2.00	7.00	20	1.90	Groundwater encountered

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
CTC Hayes - Canal Wall 2	AECOM	**BH202**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20709	06/02/23 - 07/02/23	AN	DT	FINAL	**CP**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Dando 2000	01/03/2023	1:50

Weather: | Termination: Reached proposed depth | SPT Hammer: SDA1 Energy Ratio: 70% |

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
						Stiff dark grey slightly fissured CLAY. LONDON CLAY FORMATION.		
10.45 - 10.50	D							
11.00	D							
11.50	SPT	N=25 (3,5/5,6,7,7)						
	D							
12.00	D							
				(9.20)				
13.00	D							
13.00 - 13.45	U	Ublow = 59						
13.45 - 13.50	D							
14.00	D							
14.50	SPT	N=30 (3,5/6,7,8,9)						
14.50 - 14.95	D							
15.00	D			15.00		End of Borehole at 15.00m		

11 12 13 14 15 16 17 18 19 20

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:
Awaiting induction 08:00-09:00, 1 hour.
Waiting for location to be broken out 10:00-11:30, 1.5 hours.
Filling water drums 40 minutes.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.00	2.00	7.00	20	1.90	Groundwater encountered

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
Crown Trading Centre	AECOM	**WS01**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	17/05/22	CF	SB	FINAL	**WS**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Premier 1	13/07/2022	1:50

Weather: | Termination: Hole complete |

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.30	ES			(0.45)		Concrete overlying light brown silty very sandy GRAVEL. Gravel is angular to sub-rounded fine to coarse concrete, flint, red brick and clinker. Occasional sub-angular concrete cobble. MADE GROUND.		
0.50	ES			0.45		Firm brown mottled dark grey, slightly gravelly sandy CLAY. Gravel is angular to rounded fine to coarse flint, red brick, concrete, clinker, slate, chalk, charcoal and rare plastic fragments. Occasional black speckling. MADE GROUND.		
1.00	ES			(1.15)		*Yellowish brown lens of gravelly SAND. Sub-angular fine to medium flint gravel.*		
1.50	ES			1.60				
1.70	ES			(0.40)		Firm brown mottled yellowish brown, sandy very gravelly CLAY. Gravel is angular to rounded fine to coarse flint, fine red brick and clinker. Occasional sand inclusions. MADE GROUND.		
2.20	ES			2.00 (0.45)		Yellowish brown mottled brownish grey, silty very gravelly SAND. Gravel is angular to sub-rounded fine to coarse flint, fine to medium red brick and clinker. MADE GROUND.		
2.60	ES			2.45		*Band of gravelly SAND. Gravel is sub-angular fine to medium flint.*		
2.80	ES			2.70 (0.50)		Firm brown mottled grey, slightly gravelly sandy CLAY. Gravel is sub-angular to rounded fine to coarse flint, red brick, fine clinker and chalk. Occasional sub-rounded flint cobble. MADE GROUND. Yellowish brown slightly gravelly very silty becoming slightly silty SAND. Gravel is sub-angular fine flint. Sand is predominantly fine to medium. LYNCH HILL GRAVEL MEMBER		
3.30	D			3.20 (0.50)		Yellowish brown mottled brownish grey slightly gravelly silty SAND. Gravel is sub-angular fine flint. Sand is predominantly fine to medium. LYNCH HILL GRAVEL MEMBER	▼	
3.80	D			3.70 (0.30)		Yellowish brown very gravelly SAND. Gravel is sub-angular to sub-rounded fine to coarse flint. LYNCH HILL GRAVEL MEMBER		
				4.00		End of Borehole at 4.00m		

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:
No rootlets observed. DP01 driven prior and adjacent to WS01.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
3.50			20	3.50	No rise observed

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**WS02**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	17/05/22	CF	SB	FINAL	**WS**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Premier 1	13/07/2022	1:50

Weather: | Termination: Refused on dense soils | Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.30	ES			(0.35)		Concrete overlying light brown silty very sandy GRAVEL. Gravel is angular to sub-rounded fine to coarse concrete, red brick, flint and clinker. MADE GROUND.		
0.40	ES			0.35		Firm dark brown mottled orangish brown , slightly gravelly sandy CLAY. Gravel is sub-angular to sub-rounded fine to coarse red brick, flint, fine clinker, chalk and porcelain. MADE GROUND.		
0.70	ES			0.55		*Sub-angular red brick cobble.*		
1.00	ES			(0.30)		*Fining with depth.*		
				0.85		Firm orangish brown becoming dark brown sandy SILT. Sand is fine. Occasional black speckling. Rare sub-angular fine chalk, red brick and clinker gravel. MADE GROUND.		
1.40	D			(0.45)		Stiff orangish brown slightly sandy slightly gravelly becoming very gravelly CLAY. Gravel is sub-angular to sub-rounded fine to coarse flint. Occasional black speckling. LYNCH HILL GRAVEL MEMBER		
				1.30		*Band of sandy GRAVEL. Gravel is sub-angular red brick, flint and clinker.*		
1.90	D			(0.70)		Orange brown and yellowish brown slightly silty very gravelly SAND. Gravel is sub-angular to sub-rounded fine to coarse flint. Occasional clayey inclusions. Rare black speckling. LYNCH HILL GRAVEL MEMBER		
				2.00		End of Borehole at 2.00m		

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:
No rootlets observed. DP02 driven prior and adjacent to WS02.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**WS03**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	19/05/22	DW	SB	FINAL	**WS**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Premier 1	13/07/2022	1:50

Weather: | Termination: Refused on dense soils | Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(0.40)		CONCRETE		
0.50	ES			0.40		Firm greyish brown mottled reddish brown, slightly sandy silty CLAY. Occasional sub-angular fine to medium flint, clinker and brick gravel. MADE GROUND.		
0.80	ES			0.65		Firm yellowish brown slightly sandy slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse brick, flint, and clinker. MADE GROUND.		
1.00	ES			0.85		Firm brown mottled yellowish brown slightly sandy, gravelly CLAY. Gravel is angular to well rounded, fine to coarse flint with rare brick and clinker. Strong hydrocarbon odour from 1.0m bgl. MADE GROUND.		
1.30	ES			(0.35)		Firm to stiff brown slightly silty, sandy CLAY. Occasional black speckling. Rare becoming frequent at base of stratum, sub-angular fine flint gravel. LYNCH HILL GRAVEL MEMBER		
1.50	ES			1.20		Yellowish brown mottled brown, slightly clayey very sandy GRAVEL. Gravel is angular to sub-angular, fine to coarse flint. Rare fine lignite. LYNCH HILL GRAVEL MEMBER		
				1.40		End of Borehole at 1.60m		
				1.60				

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:
DP03 driven prior and adjacent to WS03.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:	Client:	Hole ID:
Crown Trading Centre	AECOM	**WS04**

Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	19/05/22	DW	SB	FINAL	**WS**

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Premier 1	13/07/2022	1:50

Weather: | Termination: Hole complete | Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				0.25		CONCRETE		
0.30	ES			0.40		Firm greyish brown mottled grey slightly gravelly silty CLAY. Gravel is angular to sub-angular, fine to medium flint chalk, clinker, and rare brick. MADE GROUND.		
0.50	ES			(0.80)		Firm to stiff brown slightly silty, sandy CLAY. Occasional black speckling. Rare desiccated rootlets. LYNCH HILL GRAVEL MEMBER		
0.90	ES			1.20				
1.30	ES			1.40		Orangish brown banded brown slightly clayey fine to medium SAND interbedded with firm sandy CLAY. Sand is fine to medium, predominantly medium. Rare sub-angular to rounded, fine to medium flint gravel. LYNCH HILL GRAVEL MEMBER		
1.60	ES			(0.60)		Yellowish brown mottled brown, slightly clayey SAND AND GRAVEL. Gravel is sub-angular fine to coarse flint. Very faint hydrocarbon odour. LYNCH HILL GRAVEL MEMBER		
				2.00		*Gravelly SAND BAND* *Thick gravelly clay lamination.*		
2.20	ES			(1.00)		Brown becoming dark grey with depth slightly silty very gravelly SAND. Gravel is sub-angular to rounded, fine to coarse flint. Very strong hydrocarbon odour with grey soils. LYNCH HILL GRAVEL MEMBER *Zone with strongest staining and hydrocarbon odour.*		
2.60	ES			3.00				
3.10	ES			(0.90)		Grey becoming greyish brown with depth, slightly silty, very sandy angular to well rounded fine to coarse flint GRAVEL. Very strong hydrocarbon odour with grey soils. LYNCH HILL GRAVEL MEMBER *Zone with strongest staining and hydrocarbon odour.*		
3.50	ES			3.90				
3.95	ES			4.00		Yellowish brown silty fine to medium SAND. LYNCH HILL GRAVEL MEMBER End of Borehole at 4.00m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:
DP04 driven prior and adjacent to WS04.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
0.50			20	0.50	No rise observed

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**WS05**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	19/05/22	DW	SB	FINAL	**WS**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Premier 1	13/07/2022	1:50

Weather: | Termination: Refused on obstruction | Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				0.20		Concrete floor slab cored. MADE GROUND.		
0.30	ES			(0.70)		Soft dark grey orange mottled brown slightly silty gravelly sandy CLAY. Frequent angular to sub-angular, fine to coarse brick, flint, clinker, slate, concrete, and ceramics, gravel. Frequent ash. Rare concrete boulders. Brick found below concrete floor slab, potentially housing services.		
0.60	ES							
0.80	ES			0.90		End of Borehole at 0.90m		

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:
Solid CONCRETE found at 0.9m BL/GL at base of first core and continue and rises across base of second core to 0.75m BL/GL. MADE GROUND. Potential services below.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**WSC01**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	20/05/22	GB	SB	FINAL	**WS**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Premier 1	13/07/2022	1:50

Weather: | Termination: Refused on obstruction | Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.20	ES			0.20		Broken cobble sized pieces of concrete.		
0.30	D			(0.50)		Dark brown mottled very dark grey slightly sandy silty GRAVEL. Gravel is angular to sub-rounded fine to coarse brick, clinker, sandstone, concrete, flint and rare cloth fragments. Occasional rootlets. MADE GROUND		
0.60	ES					*Cobble sized piece of concrete.*		
				0.70		End of Borehole at 0.70m		

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:
Rootlets observed to 0.7m bgl.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered.

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

soils LIMITED

Contract Name:		Client:			Hole ID:
Crown Trading Centre		AECOM			**WSC02**
Contract Number:	Start and End Date:	Logged By:	Checked By:	Status:	Hole Type:
20227	20/05/22	GB	SB	FINAL	**WS**
Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
			Premier 1	13/07/2022	1:50

Weather: | Termination: Hole complete | Sheet 1 of 1

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(0.50)		Concrete Slab		
				0.50		Brown slightly clayey sandy GRAVEL. Gravel is angular to rounded fine to coarse brick, clinker and sandstone. MADE GROUND		
0.60	ES							
0.80	ES							
0.90	D							
				(1.25)				
1.30	ES							
1.40	D							
				1.75		Firm light brown gravelly CLAY. Gravel is angular to rounded fine to coarse flint and clinker. MADE GROUND		
1.80	ES			2.00		Greyish brown and dark grey gravelly SAND. Gravel is angular to sub-rounded fine to coarse clinker, brick and flint. MADE GROUND		
1.90	D					*Mild hydrocarbon odour.*		
2.20	ES							
2.30	D							
2.70	ES							
2.80	D							
3.20	ES							
3.30	D							
				(3.00)				
3.70	ES					*Moderate hydrocarbon odour.*		
3.80	D							
4.20	ES							
4.30	D							
4.70	ES							
4.80	D					*Moderate hydrocarbon odour.*		
				5.00		End of Borehole at 5.00m		

1 2 3 4 5 6 7 8 9 10

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:
No rootlets observed.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

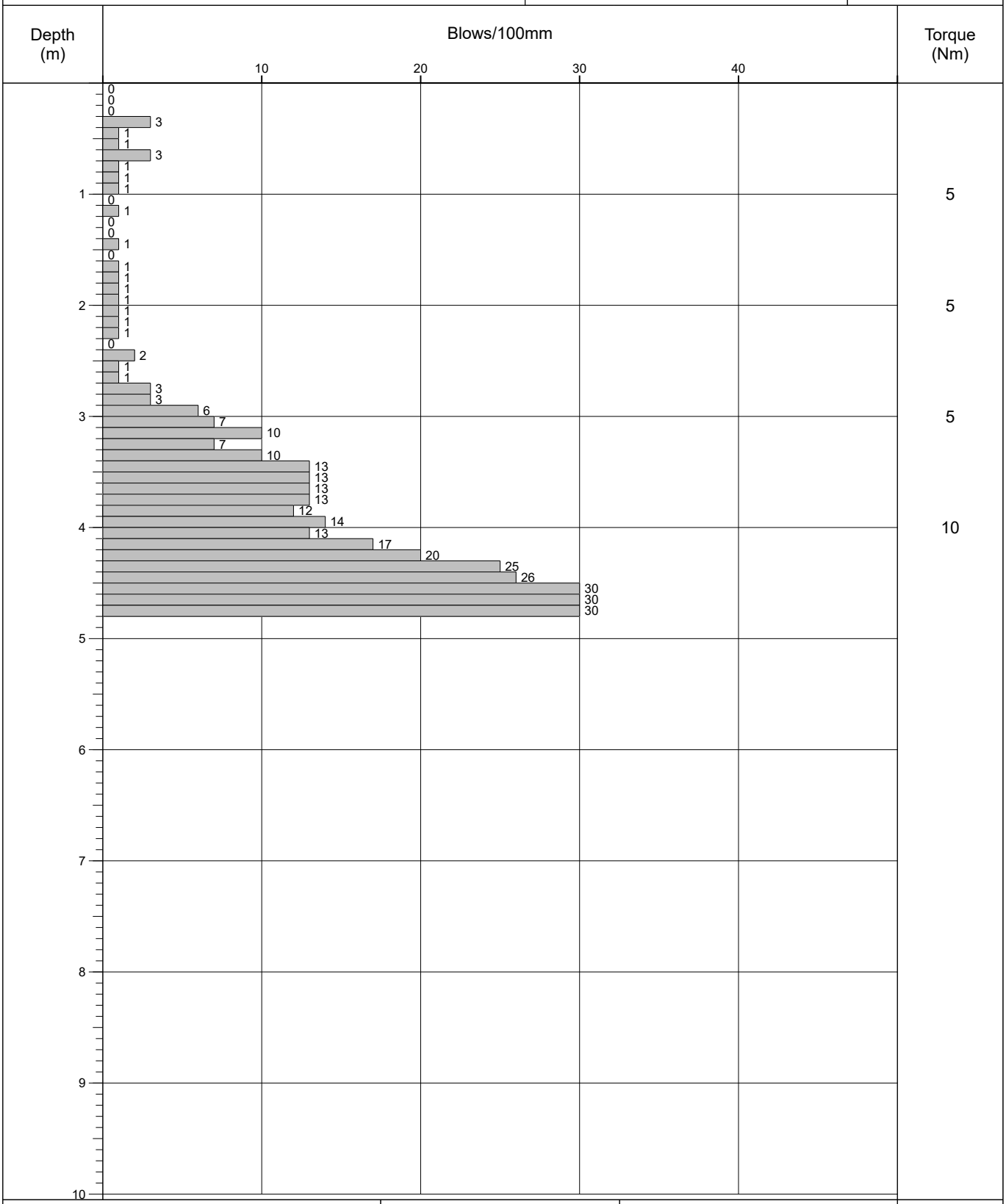
Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
			0	0.00	Groundwater not encountered,

Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP01** Sheet 1 of 1

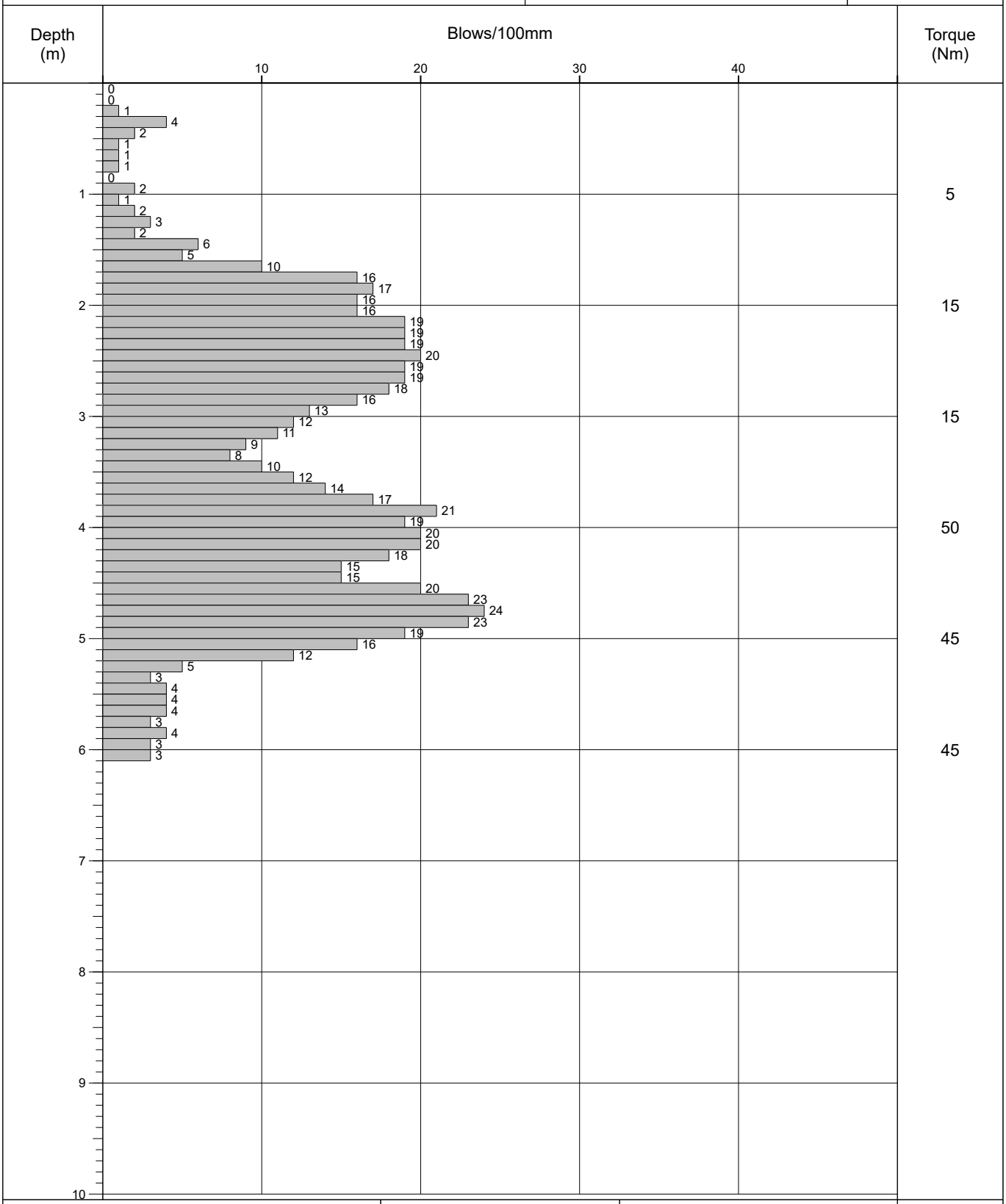
Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 17/05/2022	Logged By



Remarks DP01 driven prior and adjacent to WS01.	Fall Height	760mm	Cone Base Diameter	mm	AGS REGISTERED USER 2020
	Hammer Weight	64kg	Final Depth	4.7m	
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP02** Sheet 1 of 1

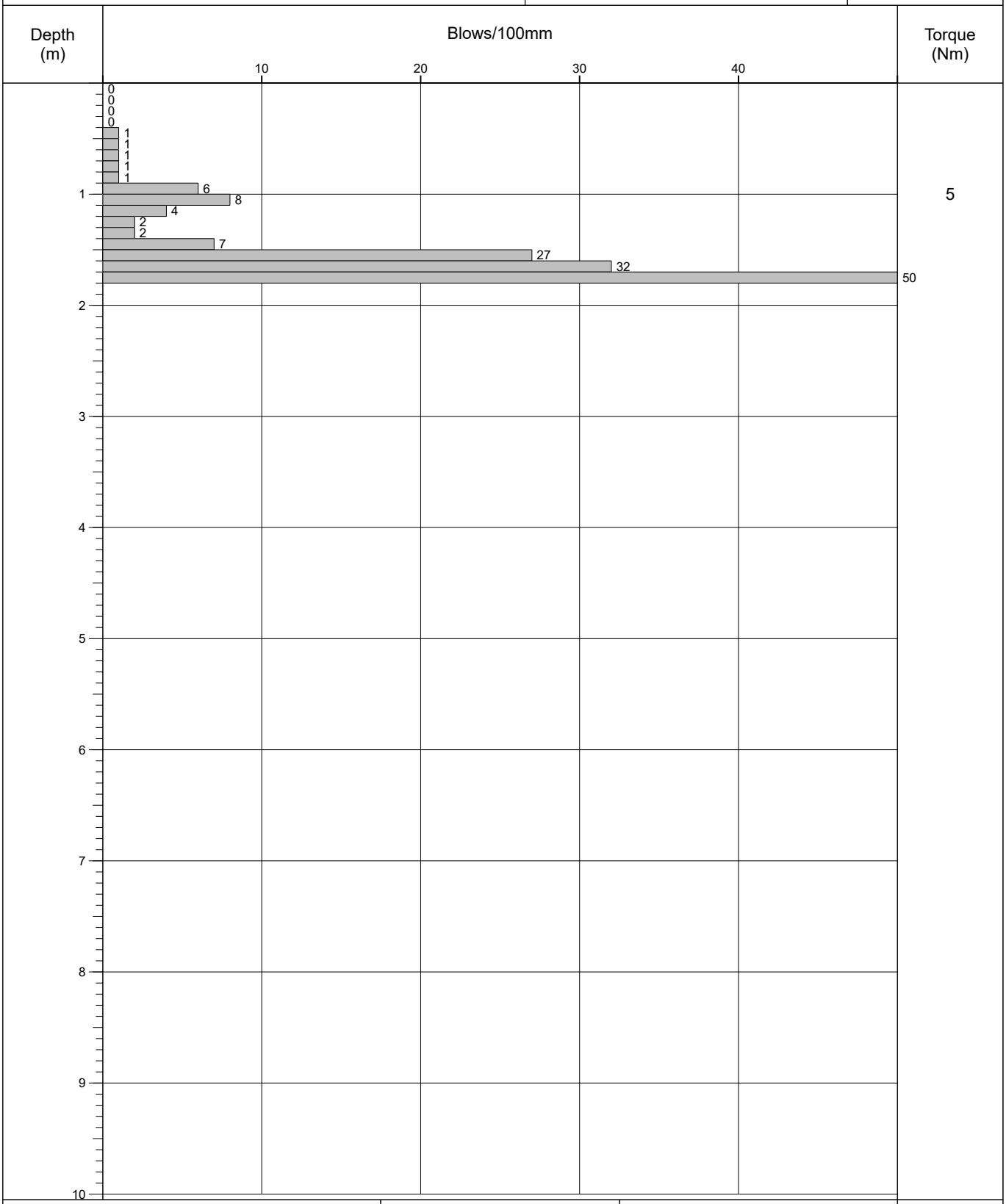
Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 17/05/2022	Logged By



Remarks DP02 driven prior and adjacent to WS02.	Fall Height	760mm	Cone Base Diameter	mm	AGS REGISTERED USER 2020
	Hammer Weight	64kg	Final Depth	6m	
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP03** Sheet 1 of 1

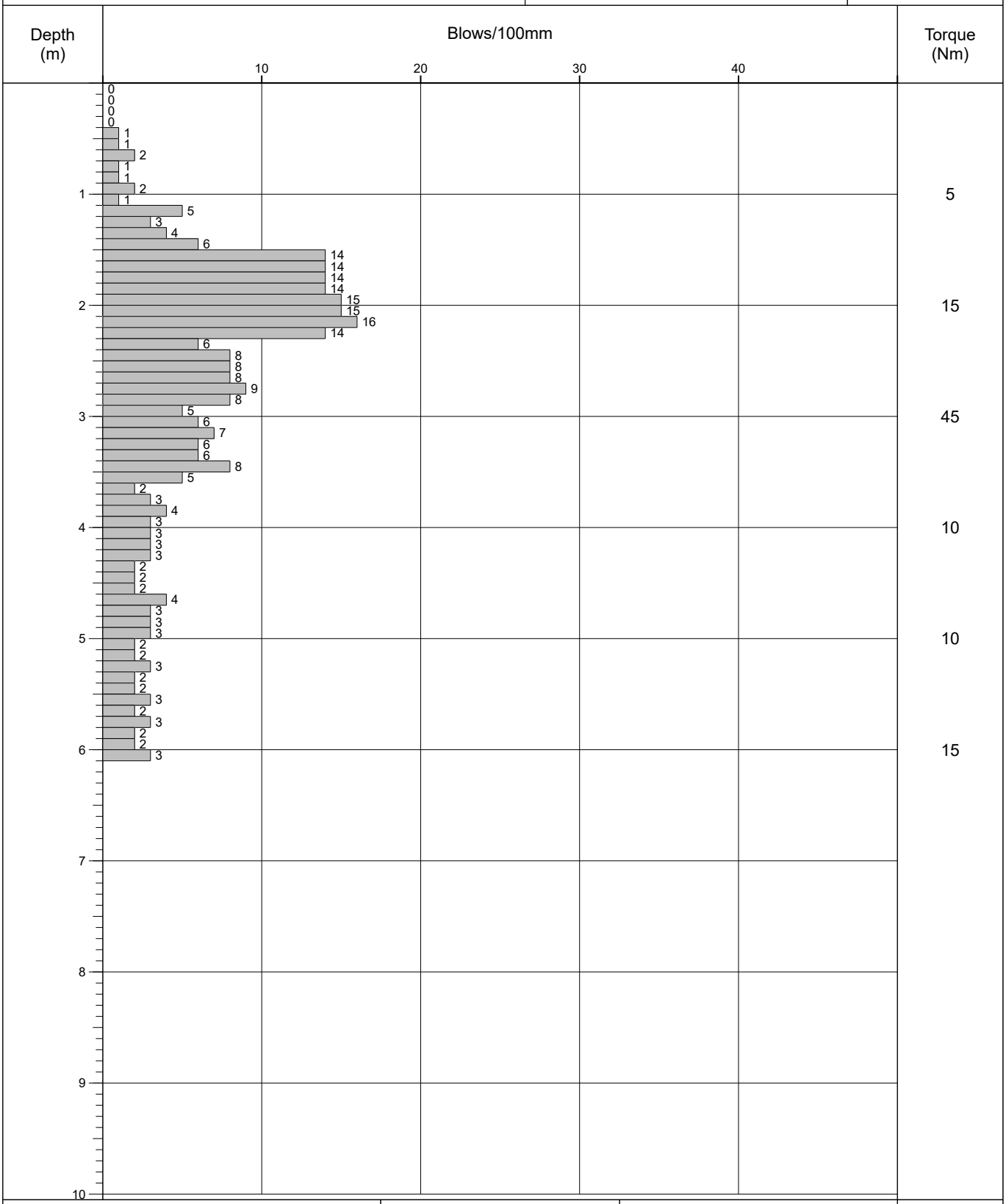
Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 18/05/2022	Logged By



Remarks DP03 driven prior and adjacent to WS01.	Fall Height	760mm	Cone Base Diameter	mm	AGS REGISTERED USER 2020
	Hammer Weight	64kg	Final Depth	1.7m	
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DP04** Sheet 1 of 1

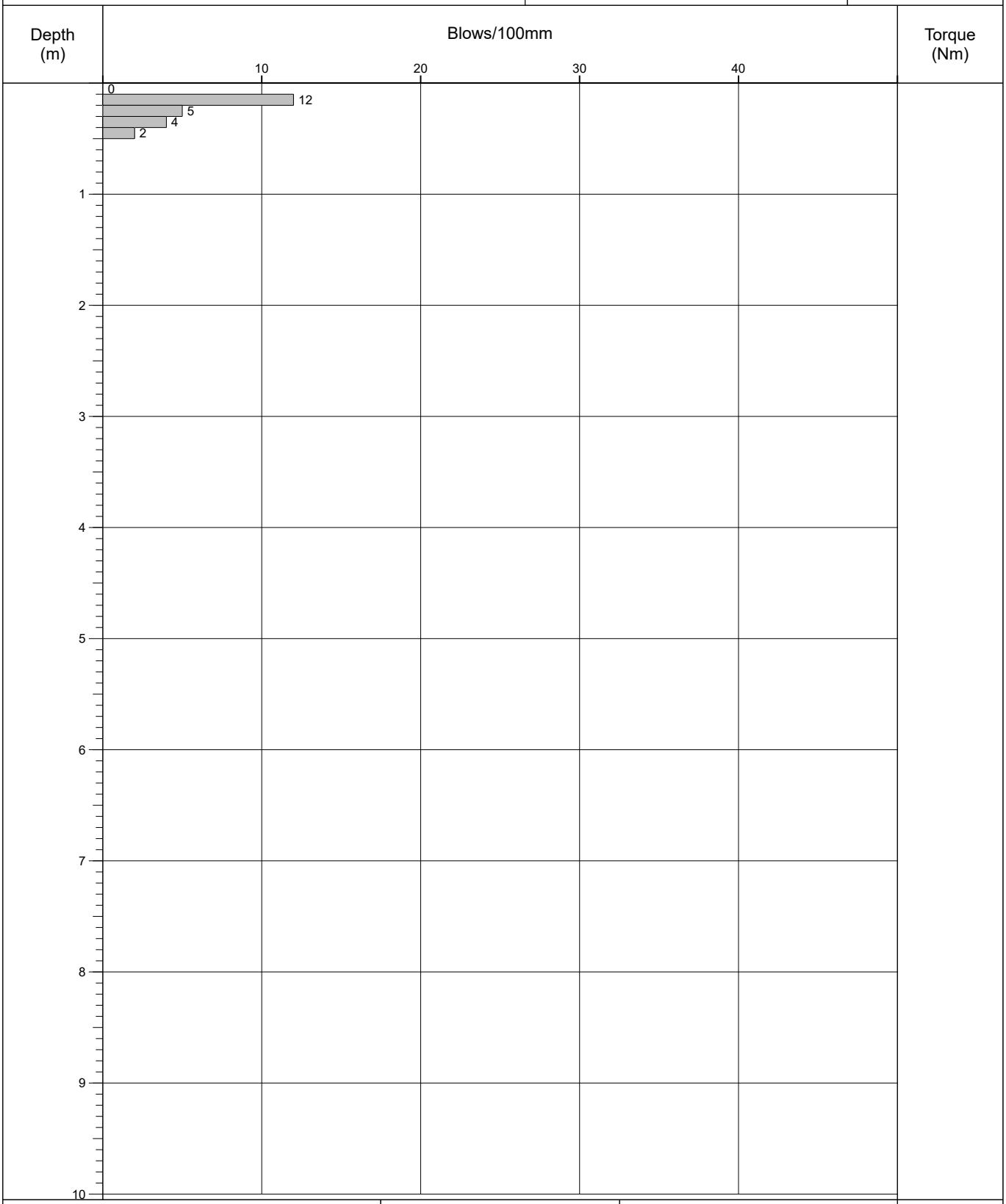
Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 18/05/2022	Logged By



Remarks					
DP04 driven prior and adjacent to WS04	Fall Height	760mm	Cone Base Diameter	mm	AGS REGISTERED USER 2020
	Hammer Weight	64kg	Final Depth	6m	
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DPC1A** Sheet 1 of 1

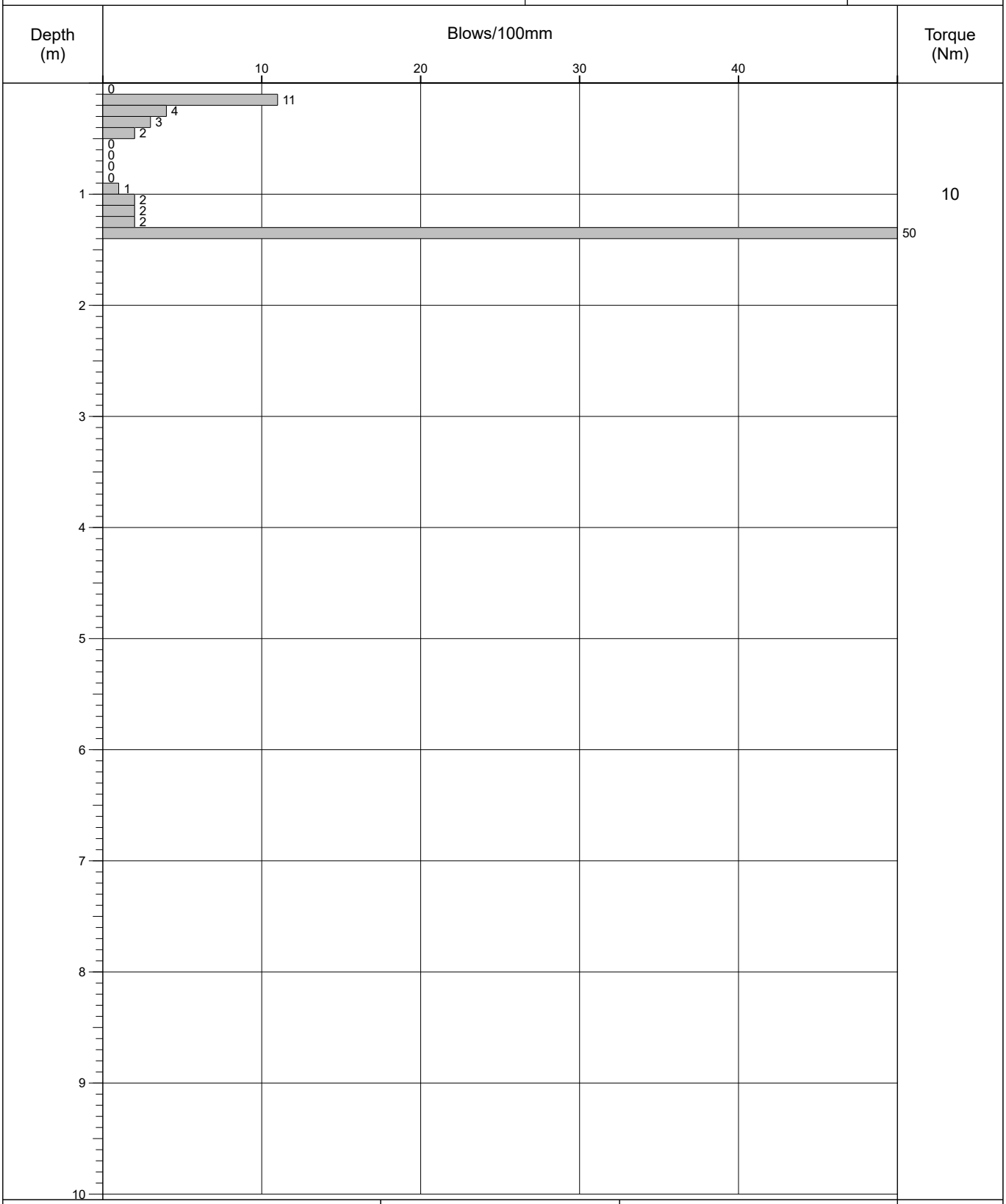
Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 17/05/2022	Logged By



Remarks					
DPC01A driven prior and adjacent to WSC01	Fall Height	760mm	Cone Base Diameter	mm	AGS REGISTERED USER 2020
	Hammer Weight	64kg	Final Depth	0.4m	
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk		**Probe Log**	Probe No. **DPC1B** Sheet 1 of 1

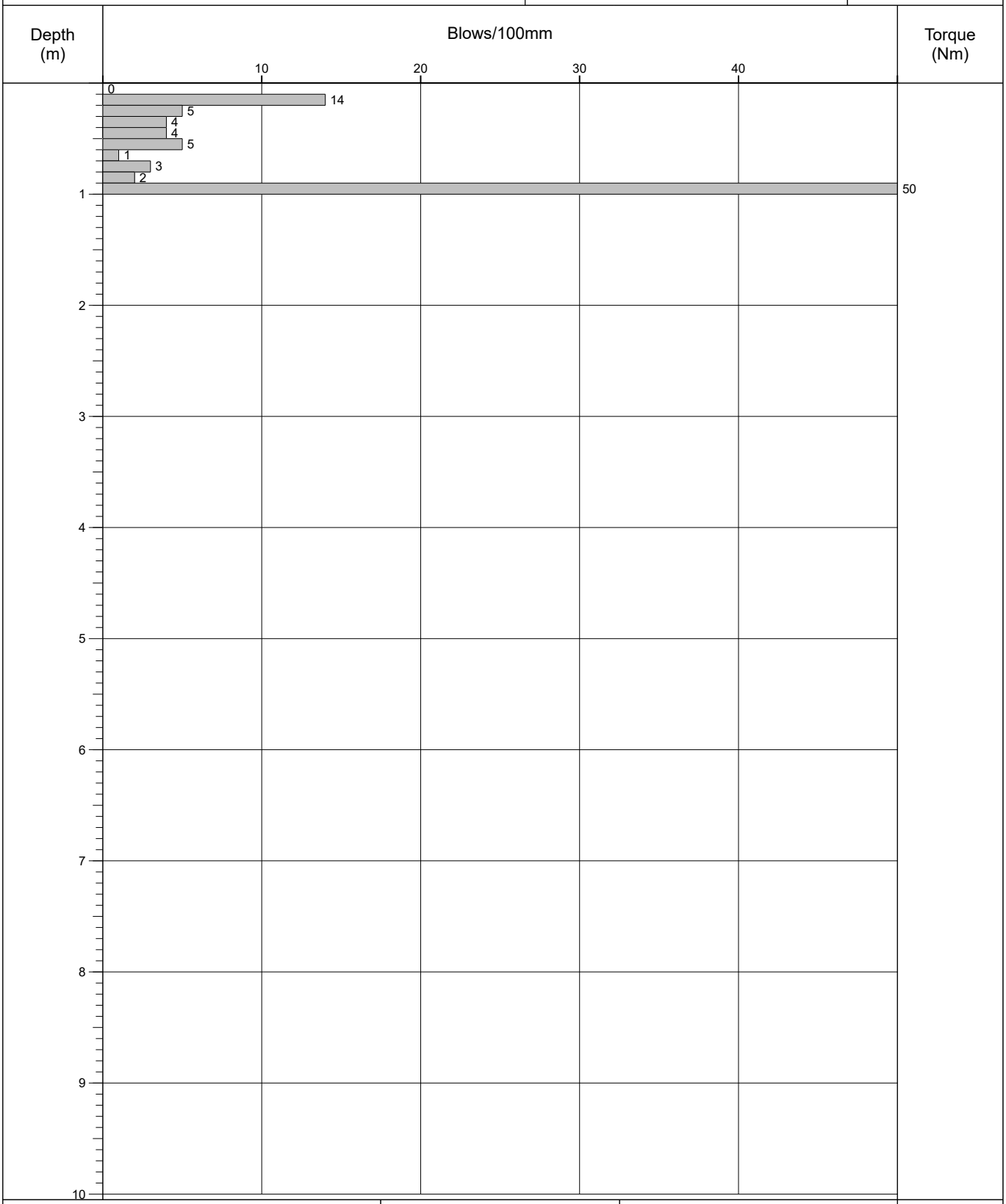
Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 17/05/2022	Logged By



Remarks DPC01B driven prior and adjacent to WSC01	Fall Height	760mm	Cone Base Diameter	mm	AGS REGISTERED USER 2020
	Hammer Weight	64kg	Final Depth	1.3m	
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%	

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DPC1C** Sheet 1 of 1

Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 17/05/2022	Logged By

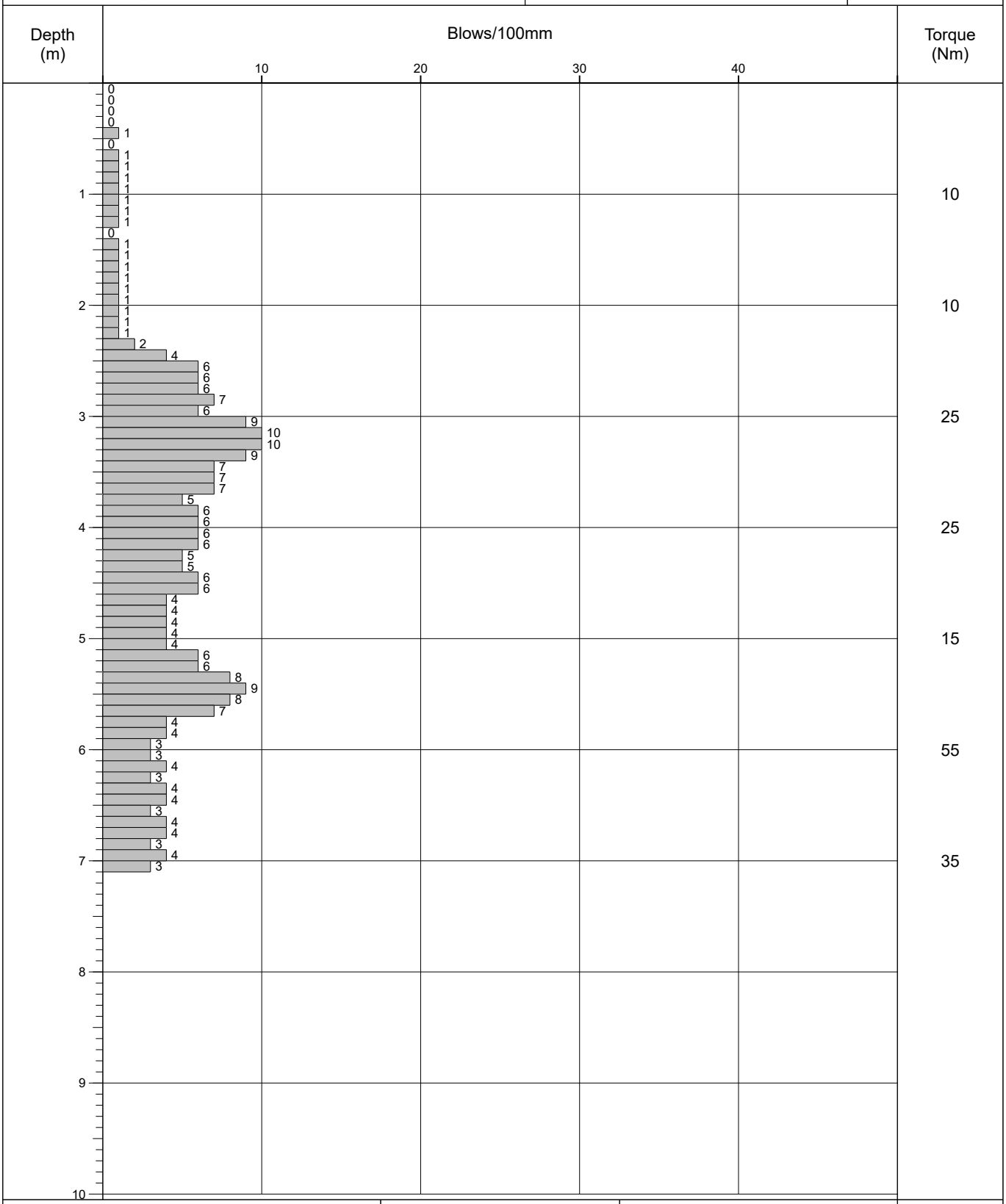


Remarks				
DPC01C driven prior and adjacent to WSC01	Fall Height	760mm	Cone Base Diameter	mm
	Hammer Weight	64kg	Final Depth	0.9m
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%

AGS REGISTERED USER 2020

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk	**Probe Log**	Probe No. **DPC2** Sheet 1 of 1

Project Name:	Crown Trading Centre	Project No. 20227	Co-ords:	Hole Type DP
Location:	Hayes, Greater London, UB3 1DU		Level: m AOD	Scale 1:50
Client:	AECOM		Dates: 17/05/2022	Logged By



Remarks					
DPC02 driven prior and adjacent to WSC02	Fall Height	760mm	Cone Base Diameter	mm	AGS REGISTERED USER 2020
	Hammer Weight	64kg	Final Depth	7m	
	Probe Type	DPSH-B	Energy Ratio (Er)	92.96%	

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Trial Pit Log

Trial Pit No. **TP1** Sheet 1 of 1

Project Name: Crown Trading Centre, Harlow	Project No.: 20398	Method:	Hole Type: TP
Location: Crown Trading Centre, Harlow		Plant: 13t	
		Support: None	Scale: 1:25
Client: GS Hayes Owner Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 16/08/2022	Level:	Co-ords:	Logged By: LW

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
				0.12			TARMAC. MADE GROUND
	0.20	D					Fine to Boulder dark orangish grey brown slightly silty slightly sandy GRAVEL demo fill. Frequent fine to Boulder angular to sub angular concrete, brick fragments. Occasional fine to coarse angular to sub angular flint gravel. Occasional rebar, metal fragments. Rare rootlets to 0.3m blg. Sand is fine to coarse. Sides of pit unstable. MADE GROUND.
	0.50	D					
	0.90	D					
	1.30	D		1.30			Flat CONCRETE slab, potentially canal retaining wall. MADE GROUND
				1.30			End of Pit at 1.300m

1
2
3
4
5

General Remarks:
Roots observed to 0.30m bgl

Groundwater Remarks: No groundwater encountered

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

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Trial Pit Log

Trial Pit No. **TP2** Sheet 1 of 1

Project Name: Crown Trading Centre, Harlow	Project No.: 20398	Method:	Hole Type: TP
Location: Crown Trading Centre, Harlow		Plant: 13t	Scale: 1:25
Client: GS Hayes Owner Ltd	Trial Pit Length: m	Support: None / Trial Pit Width: m	Logged By: LW
Dates: 16/08/2022	Level:	Co-ords:	

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
				0.06			Fine to coarse dark grey angular to sub-angular slightly silty demo rubble/ crush GRAVEL. Occasional fine angular to sub angular concrete, tarmac fragments. MADE GROUND.
				0.13			TARMAC. MADE GROUND
	0.30	D					Fine to Boulder dark orangish grey brown slightly silty slightly sandy GRAVEL demo fill. Frequent fine to Boulder angular to sub angular concrete, brick fragments. Rare fine slate, ceramic fragments. Occasional fine to coarse angular to sub angular flint gravel. Occasional rebar, metal fragments. Rare rootlets to 0.6m blg. Sand is fine to coarse. Sides of pit unstable. MADE GROUND.
	0.60	D					
	1.00	D					
	1.45	D		1.45			Flat CONCRETE slab, potentially canal retaining wall. MADE GROUND
				1.45			End of Pit at 1.450m

General Remarks:
Roots observed to 0.6m bgl

Groundwater Remarks: No groundwater encountered

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

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Trial Pit Log

Trial Pit No. **TP3** Sheet 1 of 1

Project Name: Crown Trading Centre, Harlow	Project No.: 20398	Method:	Hole Type: TP
Location: Crown Trading Centre, Harlow		Plant: 13t	Scale: 1:25
Client: GS Hayes Owner Ltd	Trial Pit Length: m	Support: None / Trial Pit Width: m	Logged By: LW
Dates: 16/08/2022	Level:	Co-ords:	

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
	0.20	D		0.06			Fine to coarse dark grey angular to sub-angular slightly silty demo rubble/ crush GRAVEL. Occasional fine angular to sub angular concrete, tarmac fragments. MADE GROUND.
				0.13			TARMAC. MADE GROUND
	0.50	D					Fine to Boulder dark orangish grey brown slightly silty slightly sandy GRAVEL demo fill. Frequent fine to Boulder angular to sub angular concrete, brick fragments. Occasional fine to coarse angular to sub angular flint gravel. Rare fine wood fragments. Occasional rebar, metal fragments. Rare rootlets to 0.6m blg. Sand is fine to coarse. Sides of pit unstable. MADE GROUND.
	1.00	D					
	1.40	D					
				1.45			Flat CONCRETE slab, potentially canal retaining wall. MADE GROUND
				1.45			End of Pit at 1.450m

General Remarks:

Groundwater Remarks: No groundwater encountered

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

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Trial Pit Log

Trial Pit No. **TP3A** Sheet 1 of 1

Project Name: Crown Trading Centre, Harlow	Project No.: 20398	Method:	Hole Type: TP
Location: Crown Trading Centre, Harlow		Plant: 13t	Scale: 1:25
Client: GS Hayes Owner Ltd	Trial Pit Length: m	Support: None / Trial Pit Width: m	Logged By: LW
Dates: 16/08/2022	Level:	Co-ords:	

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
	0.20	D		0.06 0.13			Fine to coarse dark grey angular to sub-angular slightly silty demo rubble/ crush GRAVEL. Occasional fine angular to sub angular concrete, tarmac fragments. MADE GROUND.
							TARMAC. MADE GROUND
	0.50	D					Fine to Boulder dark orangish grey brown slightly silty slightly sandy GRAVEL demo fill. Frequent fine to Boulder angular to sub angular concrete, brick fragments. Occasional fine to coarse angular to sub angular flint gravel. Rare fine wood fragments. Occasional rebar, metal fragments. Rare rootlets to 0.6m blg. Sand is fine to coarse. Sides of pit very unstable. MADE GROUND.
	1.00	D					
	1.40	D		1.45			Flat CONCRETE slab, potentially canal retaining wall. MADE GROUND
				1.45			End of Pit at 1.450m

1 2 3 4 5

General Remarks:

Groundwater Remarks: No groundwater encountered

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

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Tel: 01737 814221 Email: admin@soilslimited.co.uk

Trial Pit Log

Trial Pit No. **TP4** Sheet 1 of 1

Project Name: Crown Trading Centre, Harlow	Project No.: 20398	Method:	Hole Type: TP
Location: Crown Trading Centre, Harlow		Plant: 13t	
		Support: None	Scale: 1:25
Client: GS Hayes Owner Ltd	Trial Pit Length: m	Trial Pit Width: m	
Dates: 16/08/2022	Level:	Co-ords:	Logged By: LW

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
				0.10			Fine to coarse dark grey angular to sub-angular slightly silty demo rubble/ crush GRAVEL. Occasional fine angular to sub angular concrete, tarmac fragments. MADE GROUND.
	0.20	D		0.18			TARMAC. MADE GROUND
	0.50	D+J					One side of pit is brick housing down to 1.4m BL/GL. Other side of pit is fine to coarse medium orangish grey brown angular to sub-angular slightly clayey, slightly sandy, slightly silty flint GRAVEL. Rare fine roots. Occasional rootlets. Occasional fine to coarse ash, brick fragments. MADE GROUND
				0.60			MADE GROUND comprising fine to coarse black crushed CHARCOAL. Frequent rootlets.
	0.90	D					
	1.40	D		1.40			Flat CONCRETE slab, potentially Canal retaining wall. MADE GROUND
				1.40			End of Pit at 1.400m

1 2 3 4 5

General Remarks:
Roots observed to 1.4m bgl

Groundwater Remarks: No groundwater encountered

Sample Type
D: Disturbed
B: Bulk
J: Jar
W: Water

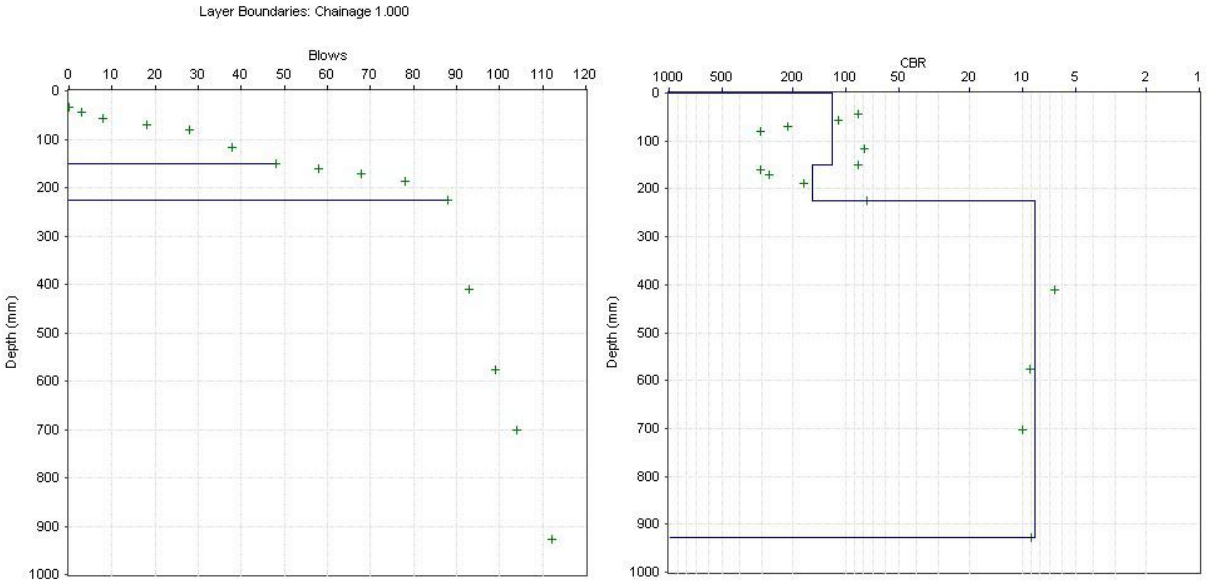
Appendix C Geotechnical In-Situ and Laboratory Testing

Appendix C.1 Dynamic Cone Penetrometer Results

DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	1.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart

CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	2.42	119	150	150
2	1.88	155	75	225
3	29.25	9	702	927

CBR Relationship:

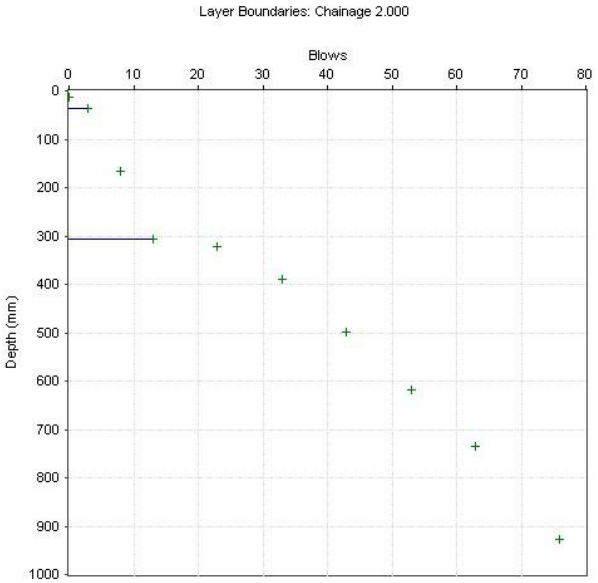
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

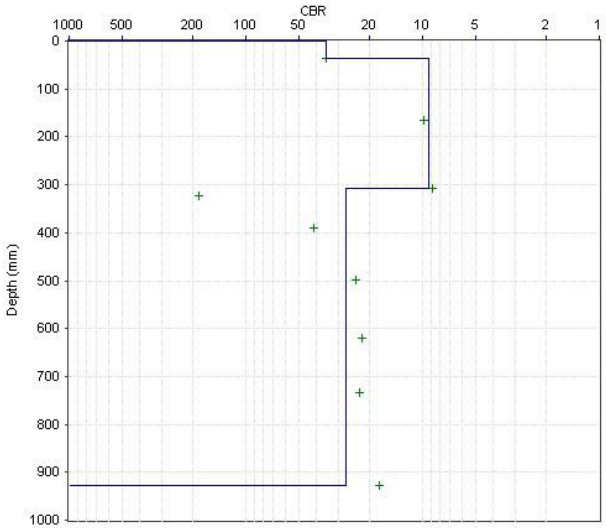
DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	2.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	7.67	35	37	37
2	27.00	9	270	307
3	9.84	27	620	927

CBR Relationship:

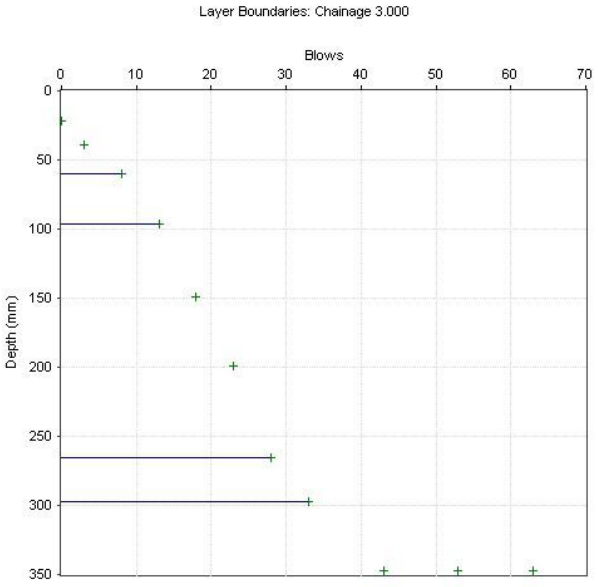
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

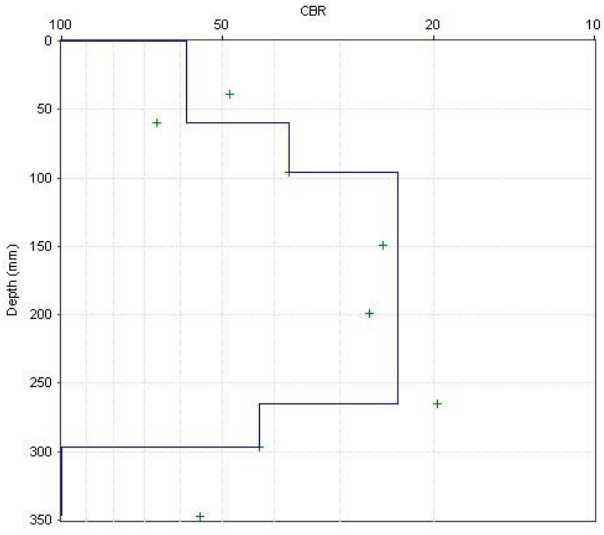
DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	3.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	4.75	58	60	60
2	7.20	37	36	96
3	11.27	23	169	265
4	6.40	42	32	297
5	1.67	176	50	347

CBR Relationship:

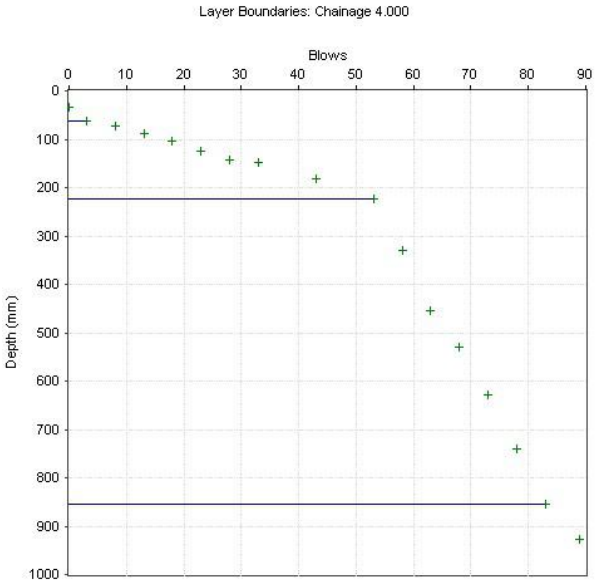
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

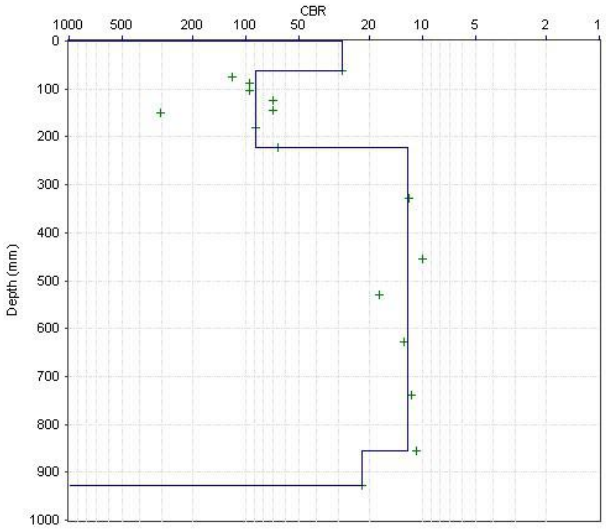
DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	4.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	9.33	28	62	62
2	3.22	88	161	223
3	21.07	12	632	855
4	12.00	22	72	927

CBR Relationship:

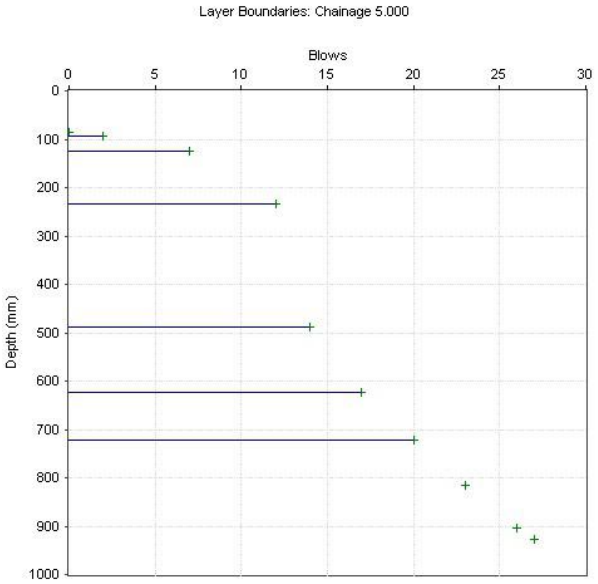
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

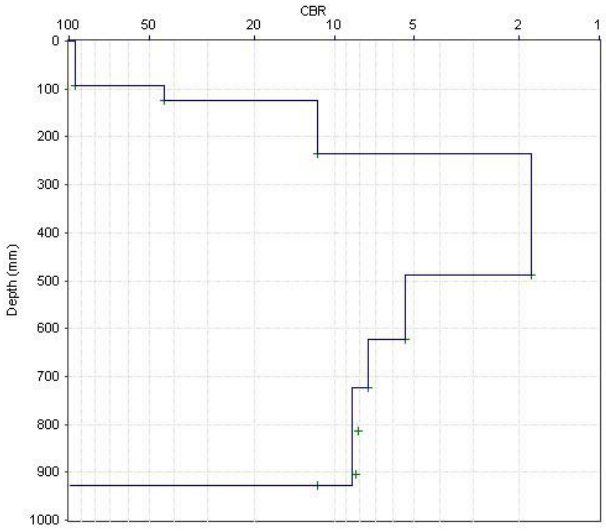
DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	5.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	3.00	95	93	93
2	6.20	44	31	124
3	22.00	12	110	234
4	127.00	2	254	488
5	45.00	5	135	623
6	33.33	7	100	723
7	29.14	9	204	927

CBR Relationship:

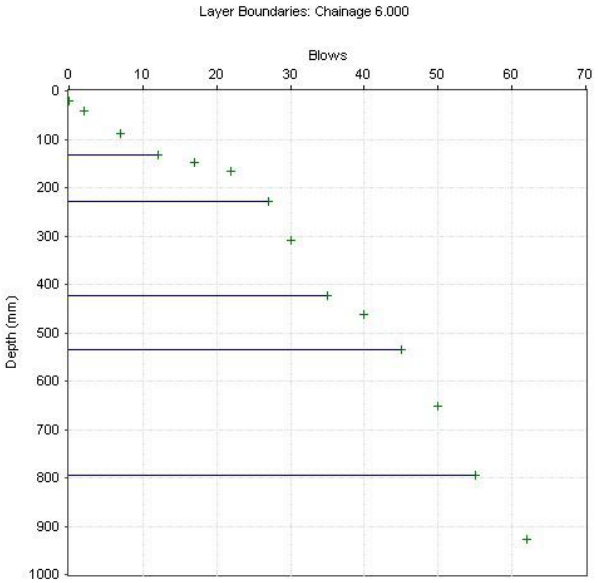
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

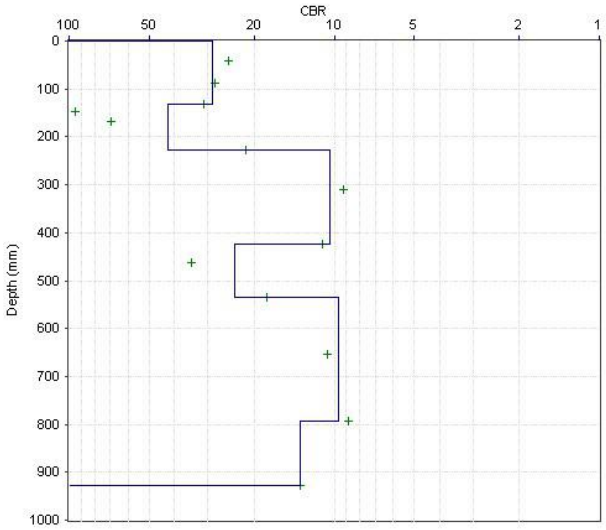
DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	6.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	9.25	29	132	132
2	6.40	42	96	228
3	24.38	10	195	423
4	11.10	24	111	534
5	26.00	10	260	794
6	19.00	13	133	927

CBR Relationship:

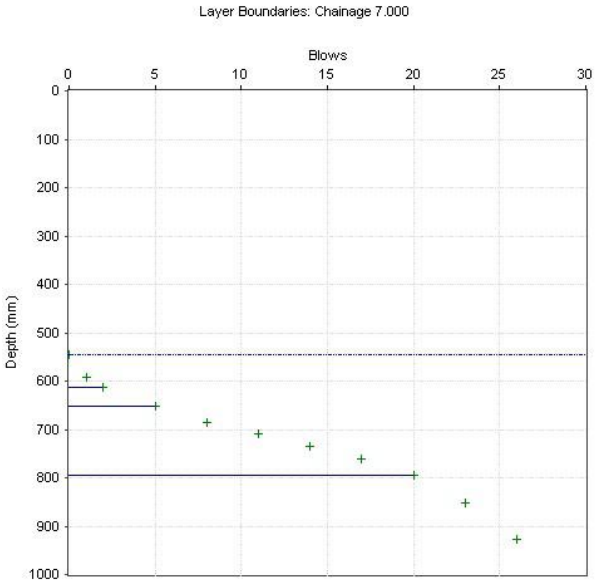
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

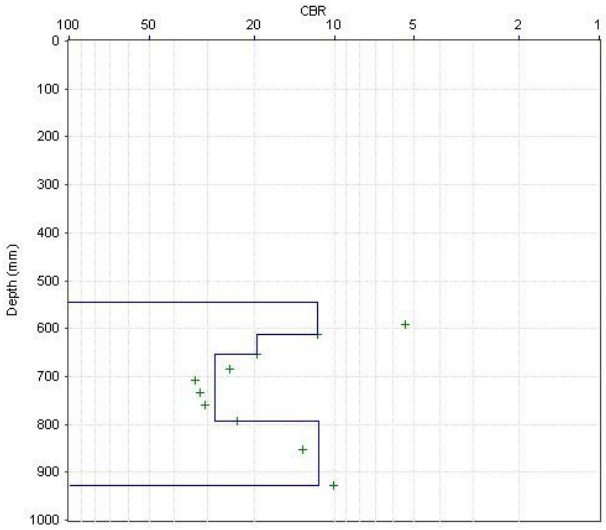
DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	7.000	Surface Type:	Other
Direction:		Thickness (mm):	350
Location/Offset:	Lay-by / other	Strength Coeff.:	0.10
Cone Angle:	60 degrees	Base Type:	Coarse granular
Zero Error (mm):	23	Thickness (mm):	196
Test Date:	08/06/2022	Strength Coeff.:	0.10



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	22.00	12	67	613
2	13.33	20	40	653
3	9.40	28	141	794
4	22.17	11	133	927

CBR Relationship:

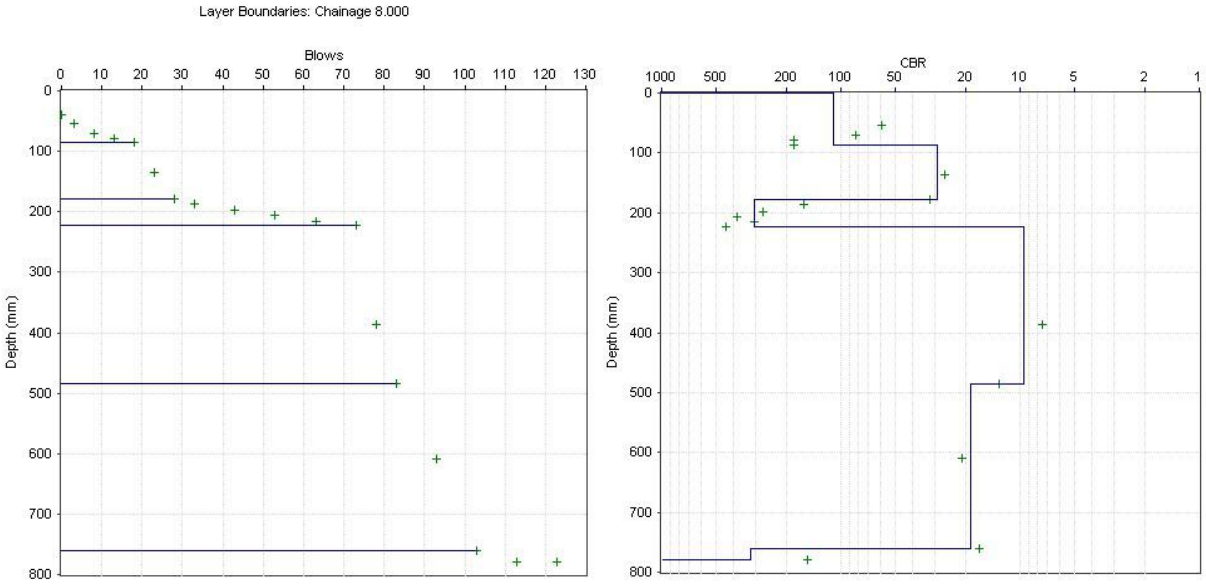
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	8.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart

CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	2.61	110	86	86
2	9.20	29	92	178
3	1.00	302	45	223
4	26.20	10	262	485
5	13.80	19	276	761
6	0.95	319	19	780

CBR Relationship:

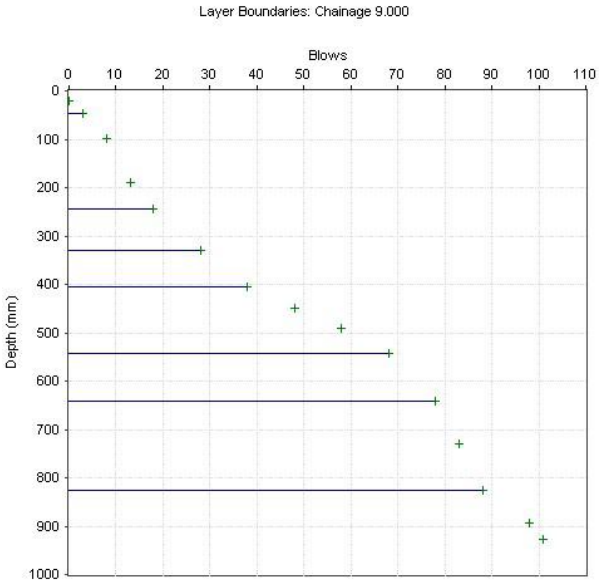
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

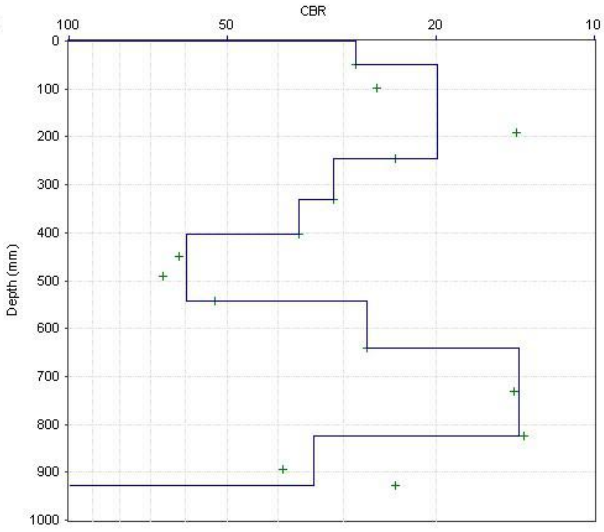
DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	9.000	Surface Type:	Unpaved
Direction:		Thickness (mm):	0
Location/Offset:	Lay-by / other	Base Type:	
Cone Angle:	60 degrees	Thickness (mm):	
Zero Error (mm):	23	Surface Moisture:	Unknown
Test Date:	08/06/2022	Moisture adjustment factor:	Not adjusted



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	9.33	28	48	48
2	13.13	20	197	245
3	8.50	31	85	330
4	7.40	36	74	404
5	4.63	60	139	543
6	9.80	27	98	641
7	18.40	14	184	825
8	7.85	34	102	927

CBR Relationship:

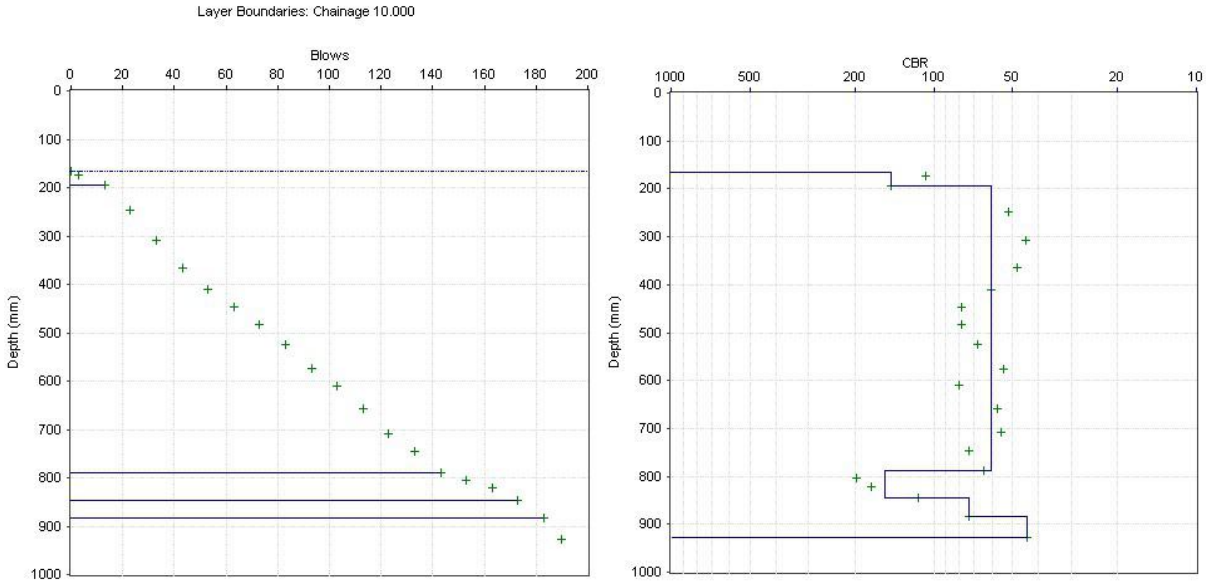
TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

DCP Layer Strength Analysis Report

Project Name: 20227_DCP

Chainage (km):	10.000	Surface Type:	Other
Direction:		Thickness (mm):	166
Location/Offset:	Lay-by / other	Strength Coeff.:	0.10
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	23	Thickness (mm):	
Test Date:	08/06/2022	Strength Coeff.:	



Layer Boundaries Chart

CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	2.00	145	28	194
2	4.58	61	595	789
3	1.90	153	57	846
4	3.80	74	38	884
5	6.14	44	43	927

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....

Appendix C.2 Geotechnical Laboratory Report

Laboratory Report

UKAS TESTING 2788

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES A PHENNA GROUP COMPANY

Contract Number: 59984

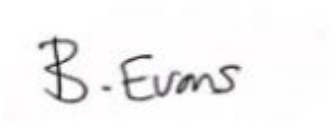
Client Ref: **20227**
Client PO: **20227/SB**

Client: **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Contract Title: **CTC Hayes**
For the attention of: **Sam Bevins**

Date Received: **15-06-2022**
Date Completed: **07-07-2022**
Report Date: **07-07-2022**

This report has been checked and approved by:



Brendan Evans
Office Administrator

Test Description	Qty
Moisture Content of Soil BS1377 : Part 2 : Clause 3.2 : 1990 - * UKAS	5
1 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.4 & 5.3 - * UKAS	5
PSD Wet & Dry Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	4
Quick Undrained Triaxial Compression test - single specimen at one confining pressure (100mm or 38mm diameter) BS 1377:1990 - Part 7 : 8 - * UKAS	3
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Brendan Evans (Office Administrator) - Emma Sharp (Business Support Manager) - Paul Evans (Director)
Richard John (Quality/Technical Manager) - Shaun Jones (Laboratory manager) - Shaun Thomas (Site Manager)
Wayne Honey (Health and Safety Coordinator/ Quality Assistant)

GEO Site & Testing Services Ltd
Units 3-4, Heol Aur, Dafen, Llanelli, Carmarthenshire, Wales SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

Summary of Soil Descriptions

Contract Number	59984
Site Name	CTC Hayes
Client Reference	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Descriptions
BHA		B	1.50	-	2.00	Brown fine to coarse sandy silty/ clayey fine to coarse GRAVEL
BHA		D	5.50	-		Brown fine to medium gravelly CLAY
BHA		D	10.00	-		Brown fine to medium gravelly CLAY
BHA		D	21.50	-		Brown CLAY
BHA		U	30.00	-	30.45	Grey silty CLAY
BHB		B	2.50	-	3.00	Brown fine to coarse sandy fine to coarse GRAVEL
BHB		D	6.50	-		Brown fine to medium gravelly CLAY
BHB		U	10.50	-	10.95	Brown/ grey silty CLAY
BHB		D	12.50	-		Brown CLAY
BHB		U	19.50	-	19.95	Grey silty CLAY
WS01		D	3.30	-		Brown slightly silty/ clayey fine to coarse sandy fine to coarse GRAVEL
WS02		D	1.40	-		Brown silty/ clayey fine to coarse sandy fine to coarse GRAVEL
				-		
				-		
				-		
				-		
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GSTL
GEOTECHNICAL SITE & TESTING LABORATORIES

NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
(BS 1377:1990 - Part 2 : 4.4 & 5.3)

Contract Number	59984
Project Location	CTC Hayes
Date Tested	27/06/2022

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing 0.425mm %	Remarks
BHA		D	5.50	-		31	65	23	42	96	CH High Plasticity
BHA		D	10.00	-		27	60	22	38	96	CH High Plasticity
BHA		D	21.50	-		27	63	22	41	100	CH High Plasticity
BHB		D	6.50	-		30	66	23	43	96	CH High Plasticity
BHB		D	12.50	-		23	79	20	59	100	CV Very High Plasticity
				-							
				-							
				-							
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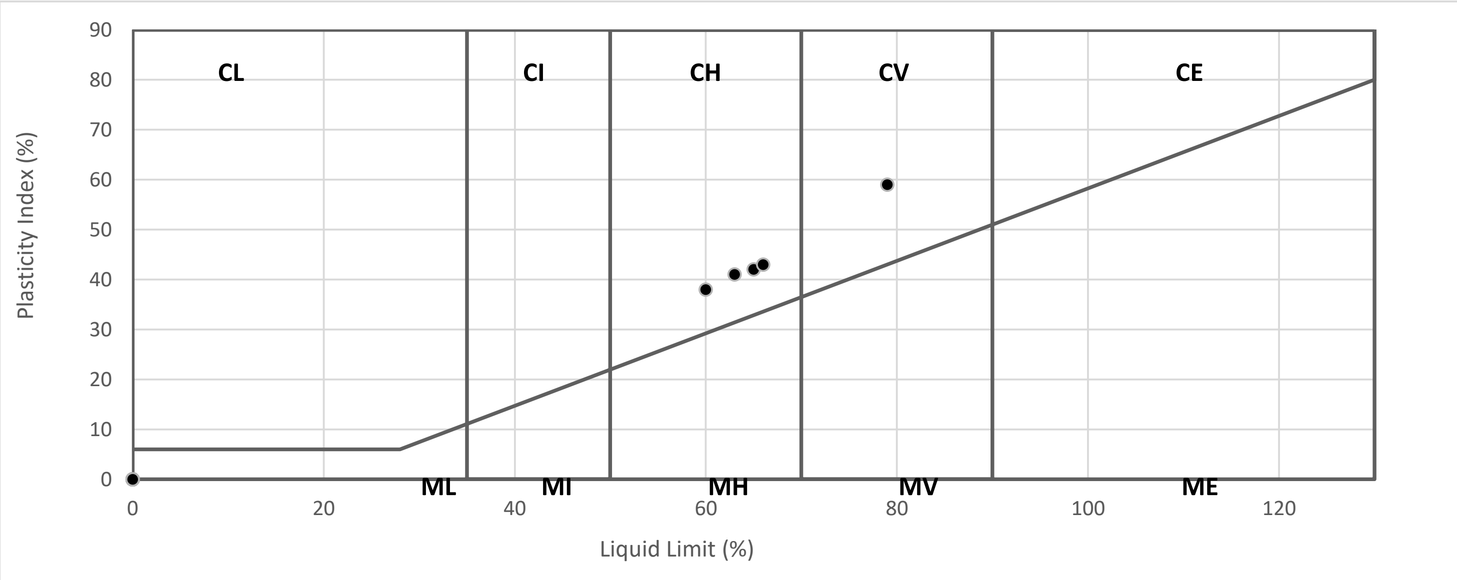
Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

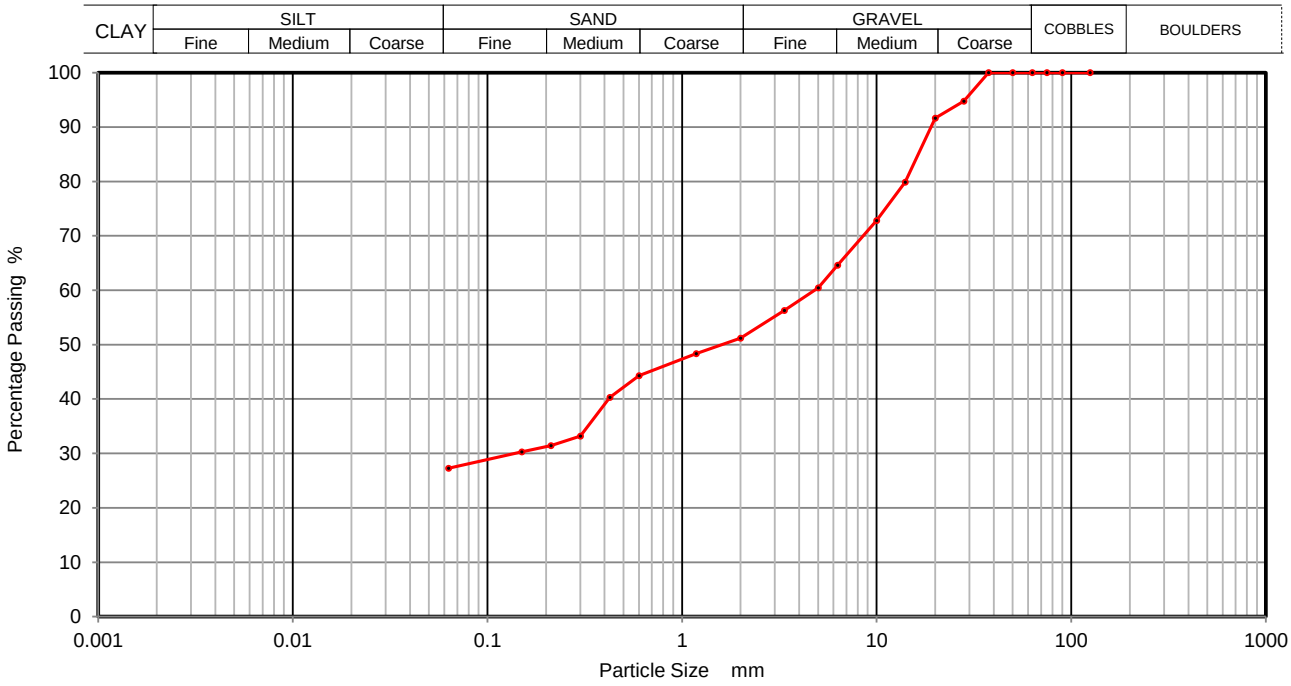
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators			
Owain Davies			

UKAS TESTING 2788

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	**PARTICLE SIZE DISTRIBUTION** **BS 1377 Part 2:1990** **Wet Sieve, Clause 9.2**	Contract Number	59984
		Borehole/Pit No.	BHA
Site Name	CTC Hayes	Sample No.	
Soil Description	*See sample description sheet	Depth Top	1.50
		Depth Base	2.00
Date Tested	29/06/2022	Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	95		
20	92		
14	80		
10	73		
6.3	65		
5	60		
3.35	56		
2	51		
1.18	48		
0.6	44		
0.425	40		
0.3	33		
0.212	31		
0.15	30		
0.063	27		

Sample Proportions	% dry mass
Cobbles	0
Gravel	49
Sand	24
Silt and Clay	27

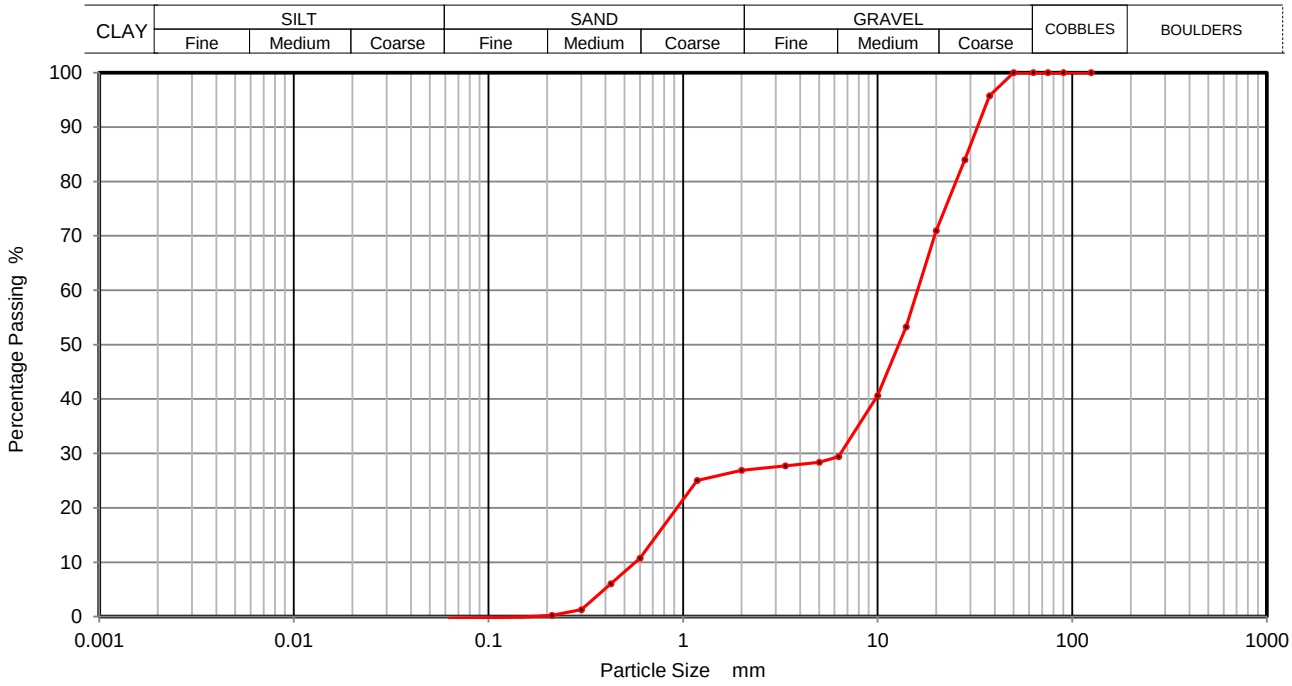
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator				
David Edwards				

UKAS TESTING
2788

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	**PARTICLE SIZE DISTRIBUTION** **BS 1377 Part 2:1990** **Wet Sieve, Clause 9.2**	Contract Number	59984
		Borehole/Pit No.	BHB
Site Name	CTC Hayes	Sample No.	
Soil Description	*See sample description sheet	Depth Top	2.50
		Depth Base	3.00
Date Tested	29/06/2022	Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	96		
28	84		
20	71		
14	53		
10	41		
6.3	29		
5	28		
3.35	28		
2	27		
1.18	25		
0.6	11		
0.425	6		
0.3	1		
0.212	0		
0.15	0		
0.063	0		

Sample Proportions	% dry mass
Cobbles	0
Gravel	73
Sand	27
Silt and Clay	0

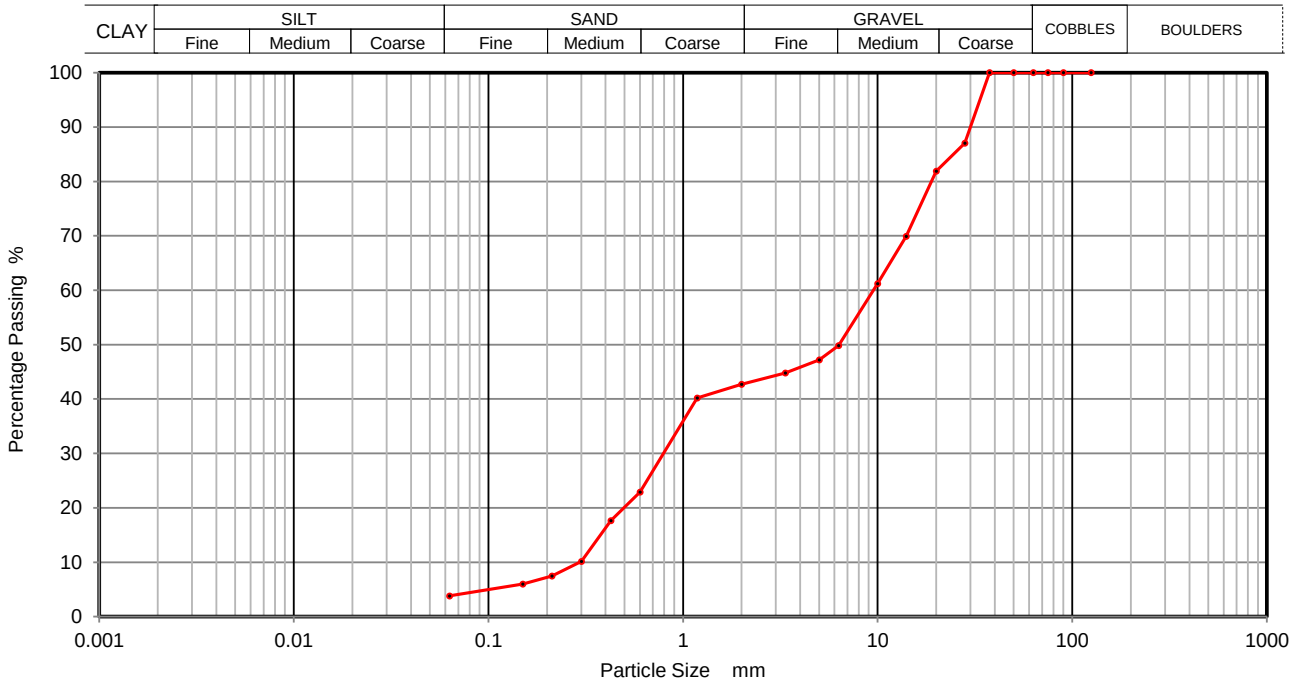
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator				
David Edwards				

UKAS TESTING
2788

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	**PARTICLE SIZE DISTRIBUTION** **BS 1377 Part 2:1990** **Wet Sieve, Clause 9.2**	Contract Number	59984
		Borehole/Pit No.	WS01
Site Name	CTC Hayes	Sample No.	
Soil Description	*See sample description sheet	Depth Top	3.30
		Depth Base	
Date Tested	29/06/2022	Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	87		
20	82		
14	70		
10	61		
6.3	50		
5	47		
3.35	45		
2	43		
1.18	40		
0.6	23		
0.425	18		
0.3	10		
0.212	7		
0.15	6		
0.063	4		

Sample Proportions	% dry mass
Cobbles	0
Gravel	57
Sand	39
Silt and Clay	4

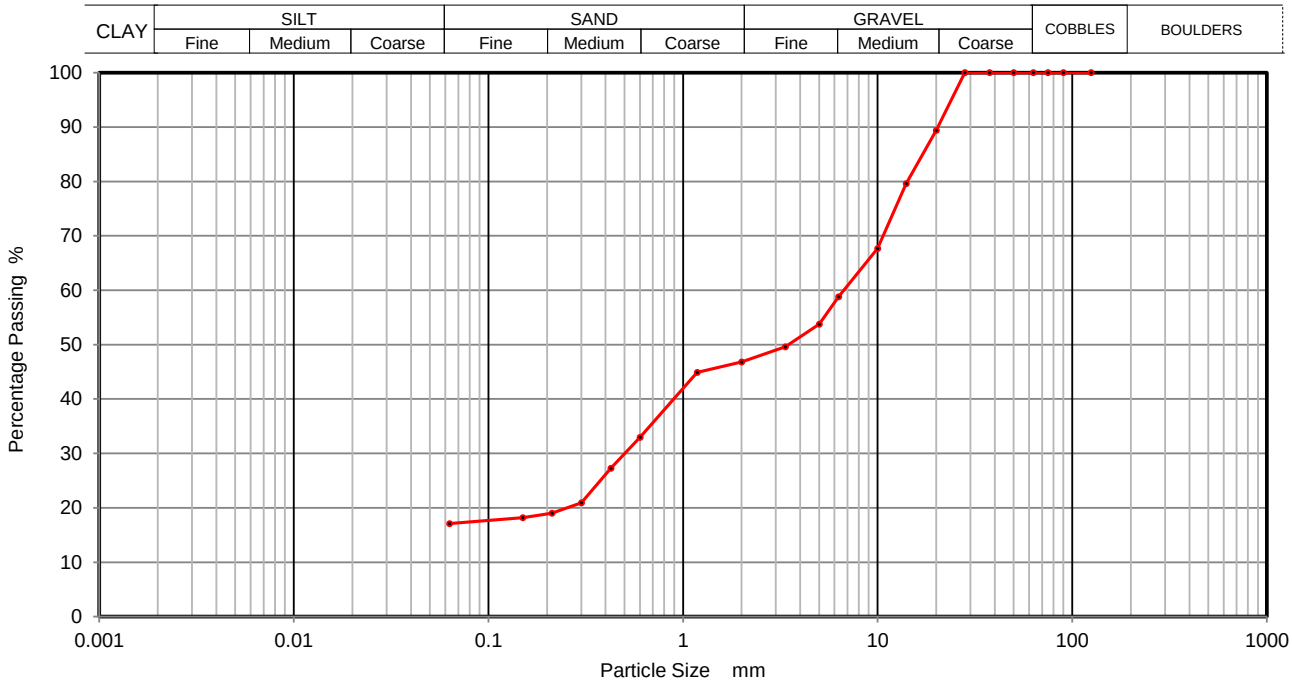
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator				
David Edwards				

UKAS TESTING
2788

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	**PARTICLE SIZE DISTRIBUTION** **BS 1377 Part 2:1990** **Wet Sieve, Clause 9.2**	Contract Number	59984
		Borehole/Pit No.	WS02
Site Name	CTC Hayes	Sample No.	
Soil Description	*See sample description sheet	Depth Top	1.40
		Depth Base	
Date Tested	29/06/2022	Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	89		
14	80		
10	68		
6.3	59		
5	54		
3.35	50		
2	47		
1.18	45		
0.6	33		
0.425	27		
0.3	21		
0.212	19		
0.15	18		
0.063	17		

Sample Proportions	% dry mass
Cobbles	0
Gravel	53
Sand	30
Silt and Clay	17

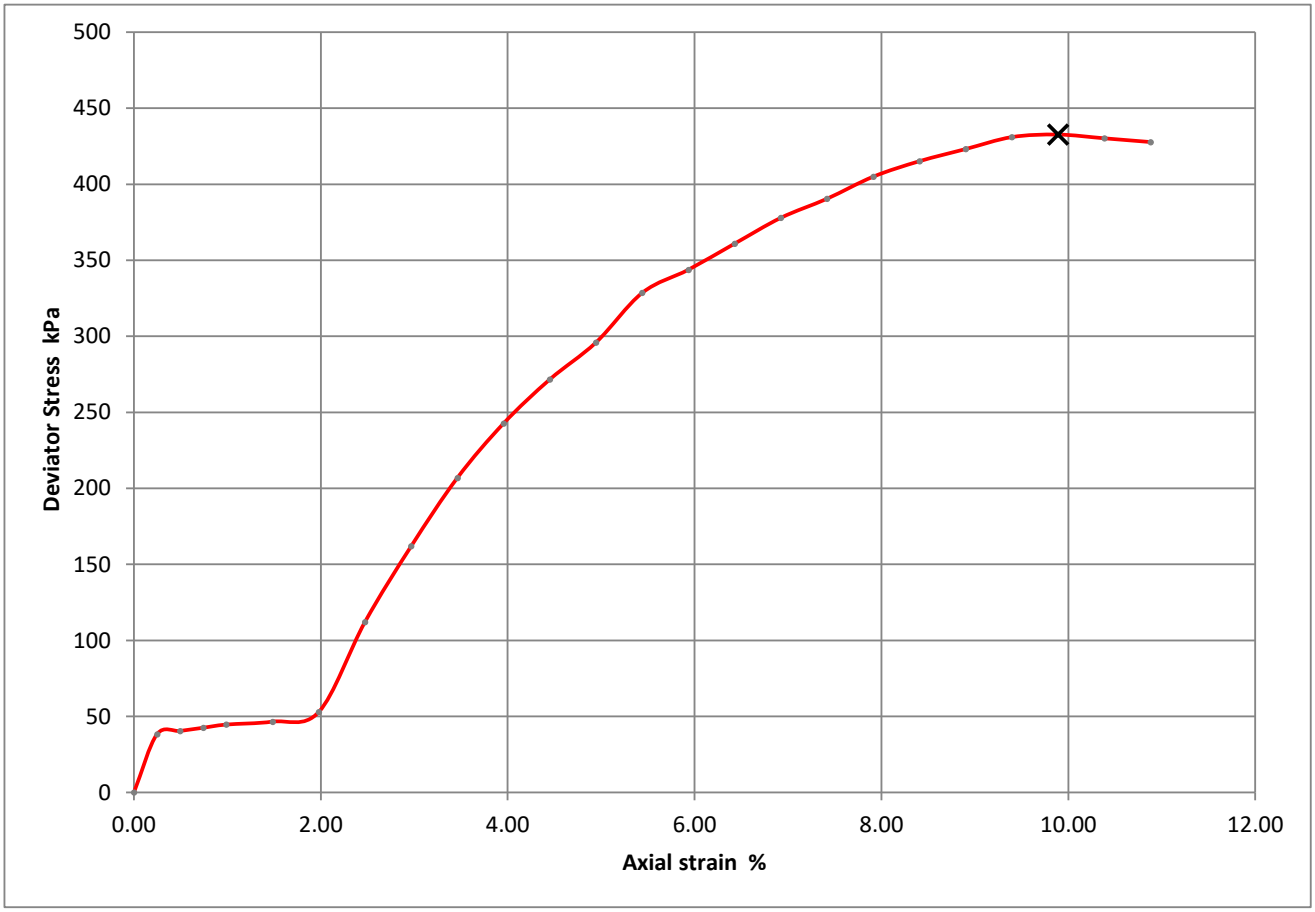
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator				
David Edwards				

UKAS TESTING 2788

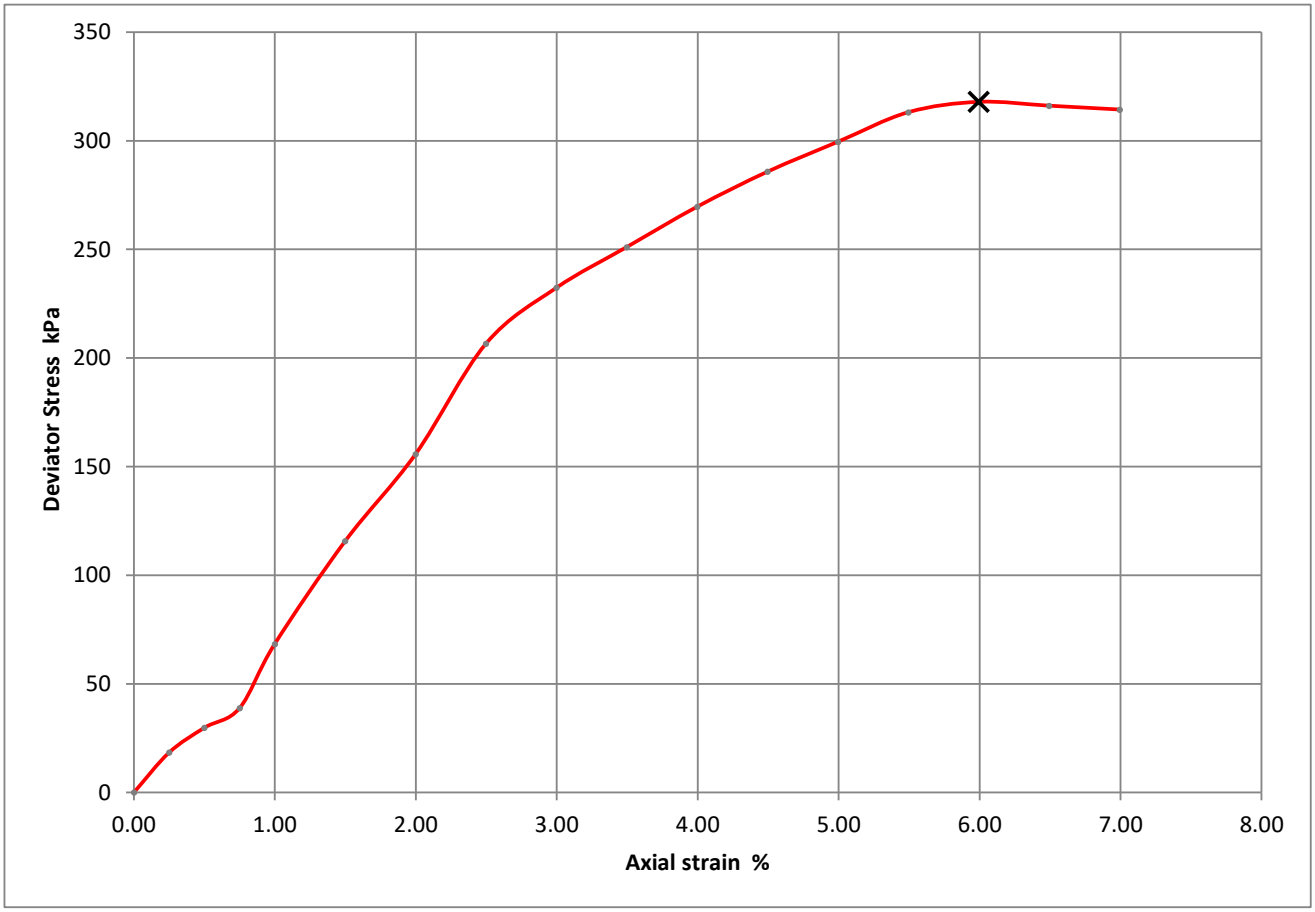
GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	**Single Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 8**	Contract Number	59984
		Borehole/Pit No.	BHA
Site Name	CTC Hayes	Sample No.	
Soil Description	*See Sample Description Sheet	Depth Top (m)	33.00
		Depth Base (m)	33.45
Date Tested	01/07/2022	Sample Type	U
		Technician	Jordan



Moisture Content (%)	21
Bulk Density (Mg/m^3)	2.12
Dry Density (Mg/m^3)	1.75
Specimen Length (mm)	202.2
Specimen Diamteter (mm)	101.1
Cell Pressure (kPa)	600
Deviator Stress (kPa)	433
Undrained Shear Strength (kPa)	216
Failure Strain (%)	10
Mode Of Failure	Compound
Membrane Used/Thickness	Rubber/0.3mm
Rate of Strain (%/min)	1.48

UKAS TESTING 2788

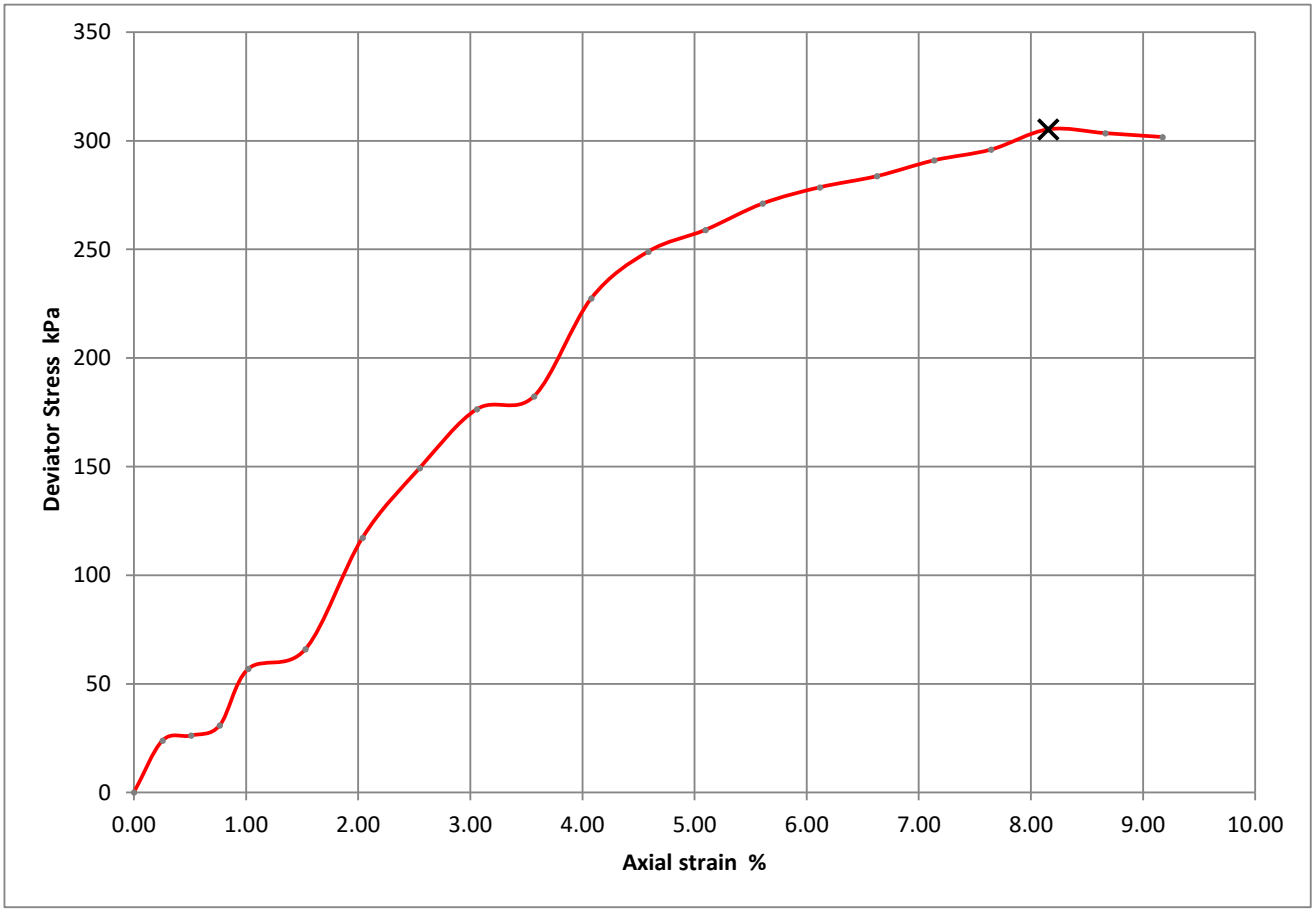
GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	**Single Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 8**	Contract Number	59984
		Borehole/Pit No.	BHB
Site Name	CTC Hayes	Sample No.	
Soil Description	*See Sample Description Sheet	Depth Top (m)	10.50
		Depth Base (m)	10.95
Date Tested	01/07/2022	Sample Type	U
		Technician	Jordan



Moisture Content (%)	25
Bulk Density (Mg/m^3)	2.16
Dry Density (Mg/m^3)	1.73
Specimen Length (mm)	200.2
Specimen Diamteter (mm)	100.1
Cell Pressure (kPa)	210
Deviator Stress (kPa)	318
Undrained Shear Strength (kPa)	159
Failure Strain (%)	6
Mode Of Failure	Brittle
Membrane Used/Thickness	Rubber/0.3mm
Rate of Strain (%/min)	1.50

UKAS TESTING
2788

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	**Single Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 8**	Contract Number	59984
		Borehole/Pit No.	BHB
Site Name	CTC Hayes	Sample No.	
Soil Description	*See Sample Description Sheet	Depth Top (m)	19.50
		Depth Base (m)	19.95
Date Tested	00/01/1900	Sample Type	U
		Technician	Jordan



Moisture Content (%)	24
Bulk Density (Mg/m^3)	2.21
Dry Density (Mg/m^3)	1.79
Specimen Length (mm)	196.2
Specimen Diamteter (mm)	98.12
Cell Pressure (kPa)	390
Deviator Stress (kPa)	305
Undrained Shear Strength (kPa)	153
Failure Strain (%)	8
Mode Of Failure	Compound
Membrane Used/Thickness	Rubber/0.3mm
Rate of Strain (%/min)	1.53

UKAS TESTING 2788

Sam Bevins
Soils Ltd
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Derwentside Environmental Testing Services Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 22-05121

Site Reference:	CTC Hayes
Project / Job Ref:	20227
Order No:	20227/SB
Sample Receipt Date:	13/06/2022
Sample Scheduled Date:	13/06/2022
Report Issue Number:	1
Reporting Date:	17/06/2022

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 22-05121	**Date Sampled**	30/05/22	31/05/22	01/06/22	02/06/22	06/06/22
Soils Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: CTC Hayes	**TP / BH No**	BHA	BHA	BHA	BHB	BHB
Project / Job Ref: 20227	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 20227/SB	**Depth (m)**	2.50 - 3.00	8.00	28.00	7.00	14.00
Reporting Date: 17/06/2022	**DETS Sample No**	600933	600934	600935	600936	600937

Determinand	Unit	RL	Accreditation	(n)				
pH	pH Units	N/a	MCERTS	7.6	7.8	8.6	8.0	8.6
Total Sulphate as SO_4	mg/kg	< 200	MCERTS	< 200	916	974	653	657
Total Sulphate as SO_4	%	< 0.02	MCERTS	< 0.02	0.09	0.10	0.07	0.07
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	21	266	260	205	184
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.02	0.27	0.26	0.20	0.18
Total Sulphur	%	< 0.02	NONE	< 0.02	0.33	0.89	0.32	0.37
Ammonium as NH_4	mg/kg	< 0.5	MCERTS	7.3	22.2	4	14.8	14.8
Ammonium as NH_4	mg/l	< 0.05	MCERTS	0.73	2.22	0.40	1.48	1.48
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	7	13	14	13	10
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	3.7	6.5	6.9	6.5	5.2
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Water Soluble Nitrate (2:1) as NO_3	mg/l	< 1.5	MCERTS	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
W/S Magnesium	mg/l	< 0.1	NONE	1.1	7.4	4.9	5.3	5.1

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion

Subcontracted analysis (S)

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 22-05121	
Soils Ltd	
Site Reference: CTC Hayes	
Project / Job Ref: 20227	
Order No: 20227/SB	
Reporting Date: 17/06/2022	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 600933	BHA	None Supplied	2.50 - 3.00	5	Brown sandy gravel
$ 600934	BHA	None Supplied	8.00	18.1	Brown clay
$ 600935	BHA	None Supplied	28.00	15.4	Brown clay
$ 600936	BHB	None Supplied	7.00	17.7	Brown clay
600937	BHB	None Supplied	14.00	17.7	Brown clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

$ samples exceeded recommended holding times

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 22-05121
Soils Ltd
Site Reference: CTC Hayes
Project / Job Ref: 20227
Order No: 20227/SB
Reporting Date: 17/06/2022

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - multiple specimens			Job Ref	32977
				Borehole/Pit No.	BH201A
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project No.	20709	Client	Soils Limited	Depth Top	8.50 m
Soil Description	High strength dark grey silty CLAY with rare fm pyrite nodules			Depth Base	- m
				Sample Type	U
				Date of test	14/02/2023
Test Method	BS1377:Part 7:1990, clause 8, multiple specimens				

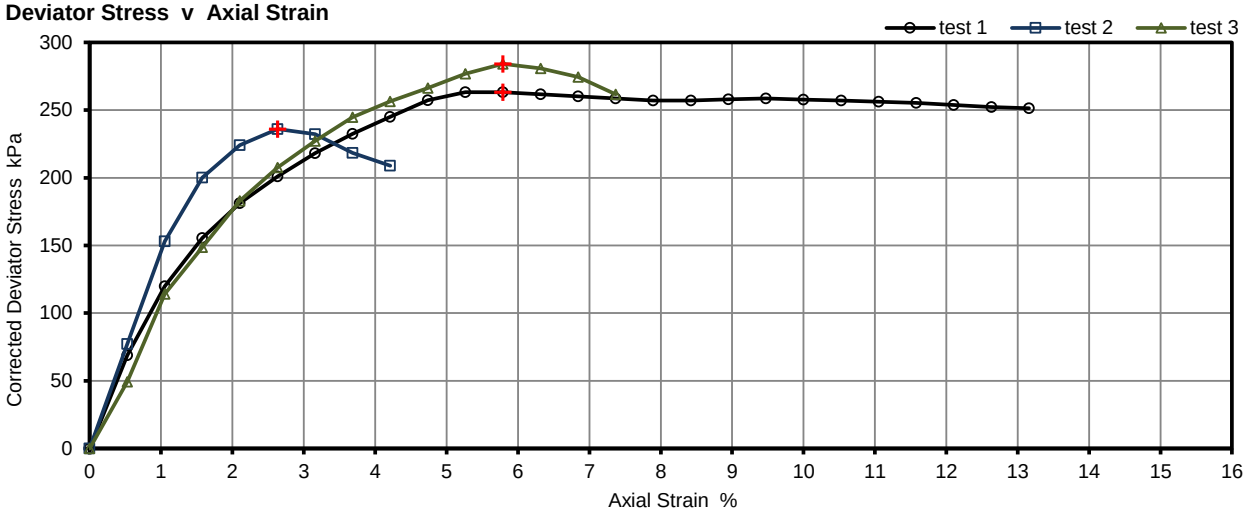
Remarks

Position within sample

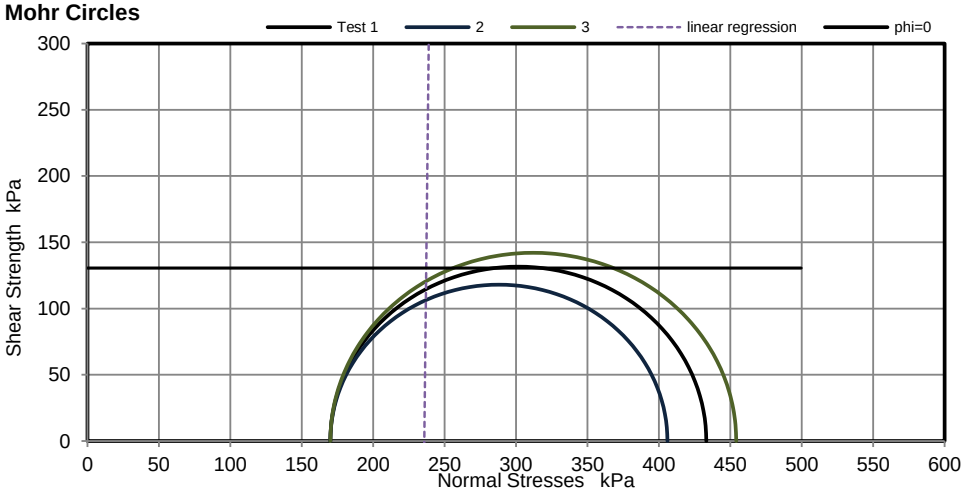
Test Number		1	2	3
Length	mm	76.0	76.0	76.0
Diameter	mm	38.0	38.0	38.0
Bulk Density	Mg/m3	1.97	1.99	2.00
Moisture Content	%	21	21	22
Dry Density	Mg/m3	1.63	1.65	1.64

Rate of Strain	%/min	2.0	2.0	2.0
Cell Pressure	kPa	170	170	170
Axial Strain	%	5.8	2.6	5.8
Deviator Stress	kPa	263	236	284
Shear strength	kPa	132	118	142
Mode of failure		Brittle	Brittle	Brittle

Deviator Stress v Axial Strain



Mohr Circles



ϕu = 0

Average cu 131 kPa

Linear Regression

ϕu 90.0 °

cu N/A kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

Test Report by K4 SOILS LABORATORY
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Checked and Approved
Initials: J.P
Date: 16/02/2023

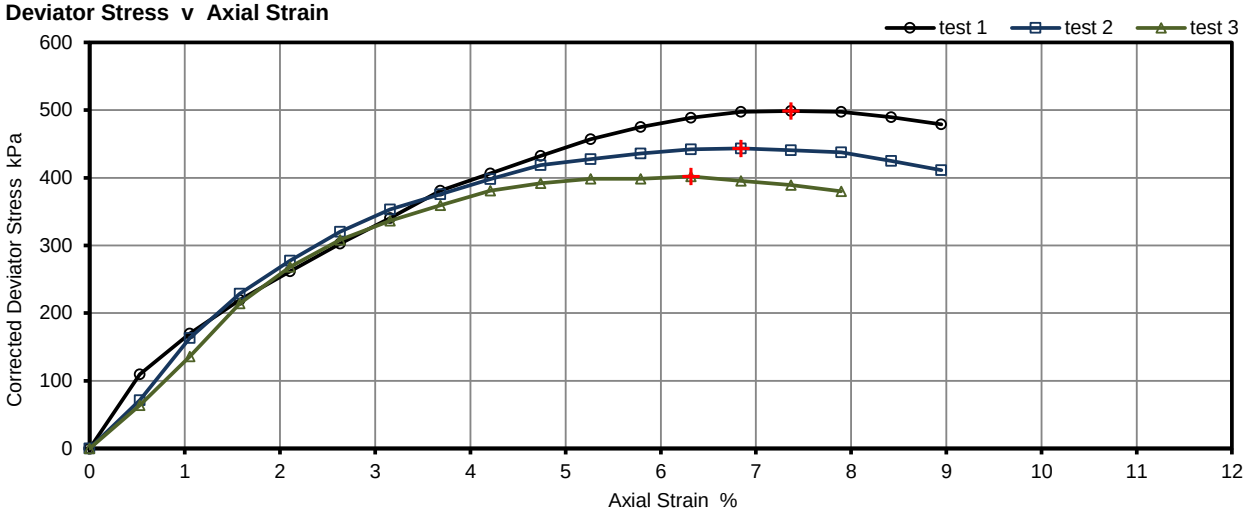
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - multiple specimens			Job Ref	32977
				Borehole/Pit No.	BH202
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project No.	20709	Client	Soils Limited	Depth Top	10.00 m
Soil Description	Very high strength dark grey silty CLAY with rare coarse claystone fragment			Depth Base	- m
				Sample Type	U
				Date of test	14/02/2023
Test Method	BS1377:Part 7:1990, clause 8, multiple specimens				

Remarks

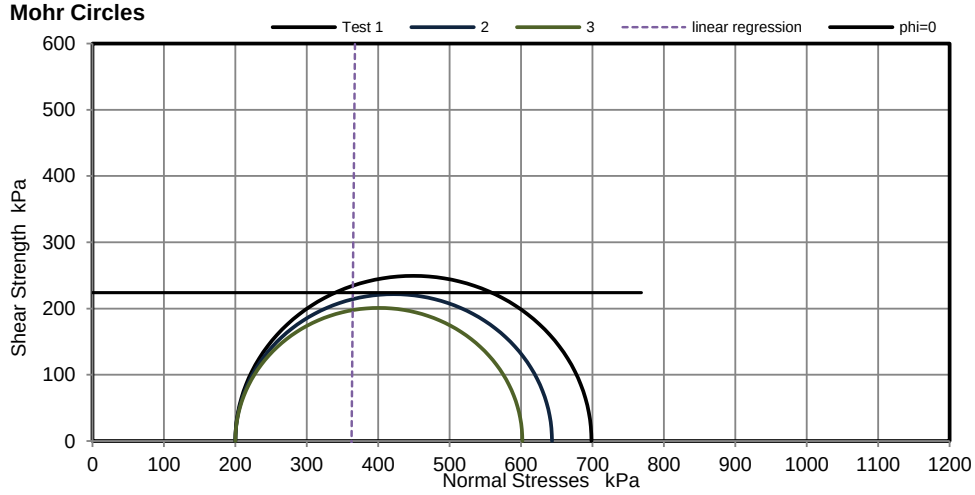
Position within sample

Test Number		1	2	3
Length	mm	76.0	76.0	76.0
Diameter	mm	38.0	38.0	38.0
Bulk Density	Mg/m3	2.00	1.96	1.95
Moisture Content	%	22	22	22
Dry Density	Mg/m3	1.64	1.61	1.59
Rate of Strain	%/min	2.0	2.0	2.0
Cell Pressure	kPa	200	200	200
Axial Strain	%	7.4	6.8	6.3
Deviator Stress	kPa	499	443	402
Shear strength	kPa	249	222	201
Mode of failure		Brittle	Brittle	Brittle

Deviator Stress v Axial Strain



Mohr Circles



ϕu = 0

Average cu 224 kPa

Linear Regression

ϕu 90.0 °

cu N/A kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

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Initials: J.P
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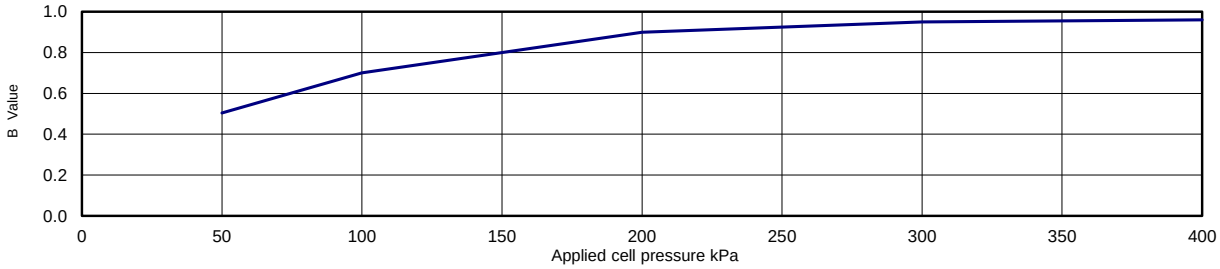
	Consolidated Undrained Triaxial Compression Test with measurement of pore pressure (Multistage test on a single specimen)			Job Ref	32977
				Borehole/Pit No.	BH201A
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project ID	20709	Client	Soils Limited	Depth m	5.50
Soil Description	Brown slightly sandy silty CLAY with occasional orangish brown silty sandy deposits			Sample Type	U
				Date Scheduled	09.02.2023
Test Method	Multistage test based on BS1377 : Part 8 : 1990, clauses 1 to 6 and 7			Date Started	14.02.2023

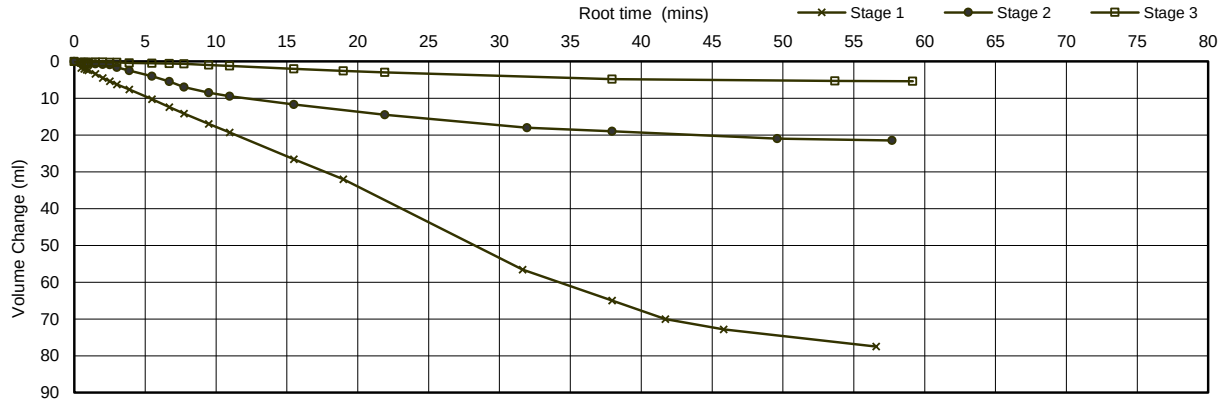
Specimen Type/Preparation	UNDISTURBED As BS 1377

Specimen Details		Initial	Final
Height	mm	210.0	
Diameter	mm	102.0	
Bulk Density	Mg/m³	2.02	1.91
Water Content	%	31	31
Dry density	Mg/m³	1.54	1.46

Saturation Details	Method of Saturation	
	Increments of cell and back pressure	
Cell pressure increments	100	kPa
Differential Pressure	10	kPa
Final Cell Pressure	400	kPa
Final pore water pressure	290	kPa
Final B Value	0.96	



	Drainage Conditions		from one end and radial boundary			
	Stage No.		1	2	3	
Consolidation Details	Cell Pressure applied		410	460	510	kPa
	Back Pressure applied		300	300	300	kPa
	Effective Pressure		110	160	210	kPa
	Pore pressure at start of consolidation		399	372	364	kPa
	Pore pressure at end of consolidation		296	300	303	kPa
	Pore pressure dissipation at end of consolidation		104	99	95	%
Consolidation parameters (see note to BS1377 : pt 8, clause 6.3.4)	Coefficient of Consolidation	Cvi	0.58	0.56	0.56	m2/year
	Coefficient of Compressibility	Mvi	0.393	0.165	0.048	m2/MN
	Coefficient of Permeability (calculated)	kvi	7.1E-11	2.9E-11	8.4E-12	m/s



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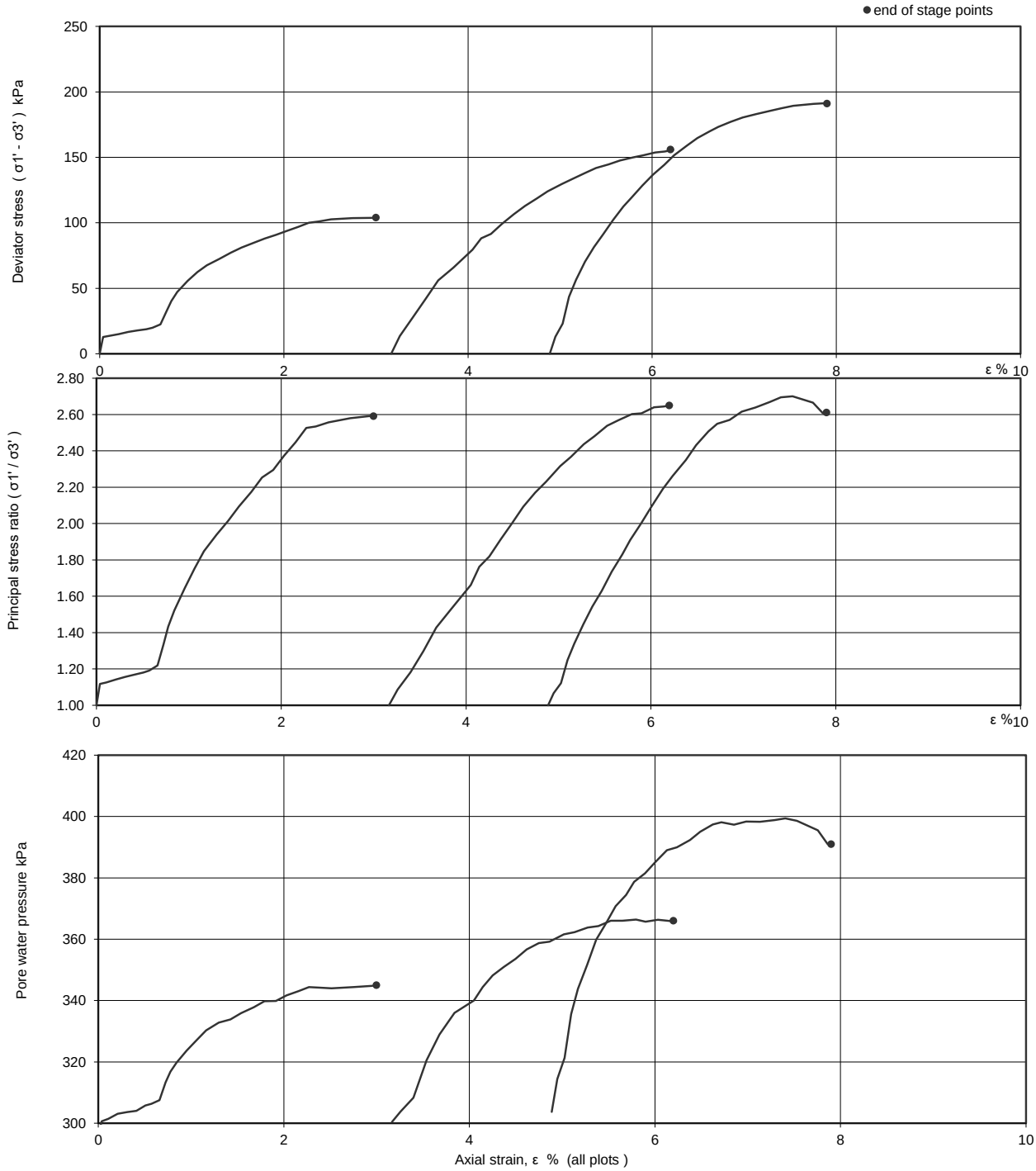
Date 07/03/2023

2519 *Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)*

	Consolidated Undrained Triaxial Compression Test with measurement of pore pressure (Multistage test on a single specimen)			Job Ref	32977
				Borehole/Pit No.	BH201A
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project ID	20709	Client	Soils Limited	Depth m	5.50
Compression stages - graphical data				Sample Type	U
				Date Started	20/02/223



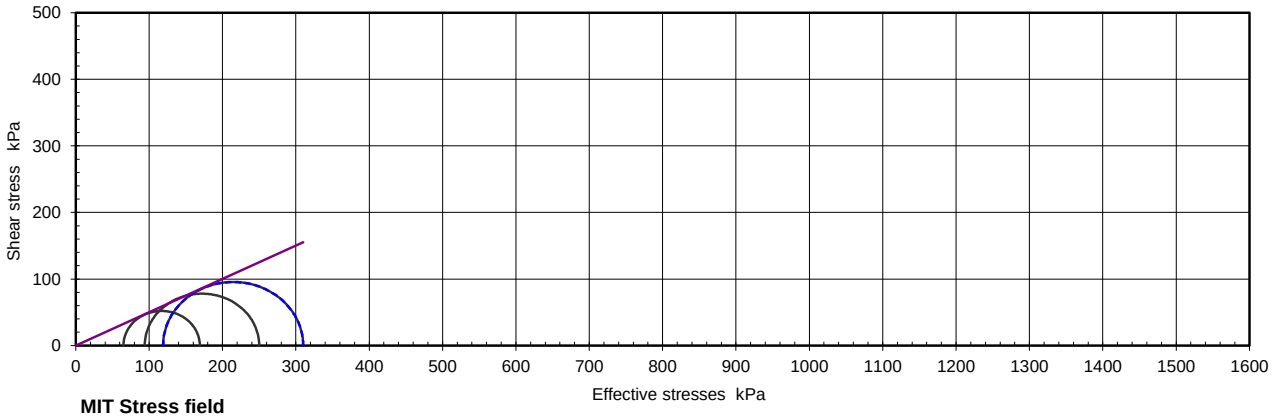
	Consolidated Undrained Triaxial Compression Test with measurement of pore pressure (Multistage test on a single specimen)			Job Ref	32977
				Borehole/Pit No.	BH201A
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project ID	20709	Client	Soils Limited	Depth m	5.50
Compression stages - table of results and interpretation				Sample Type	U
				Date Started	20.02.2023

End of stage criterion : Maximum effective principal stress ratio

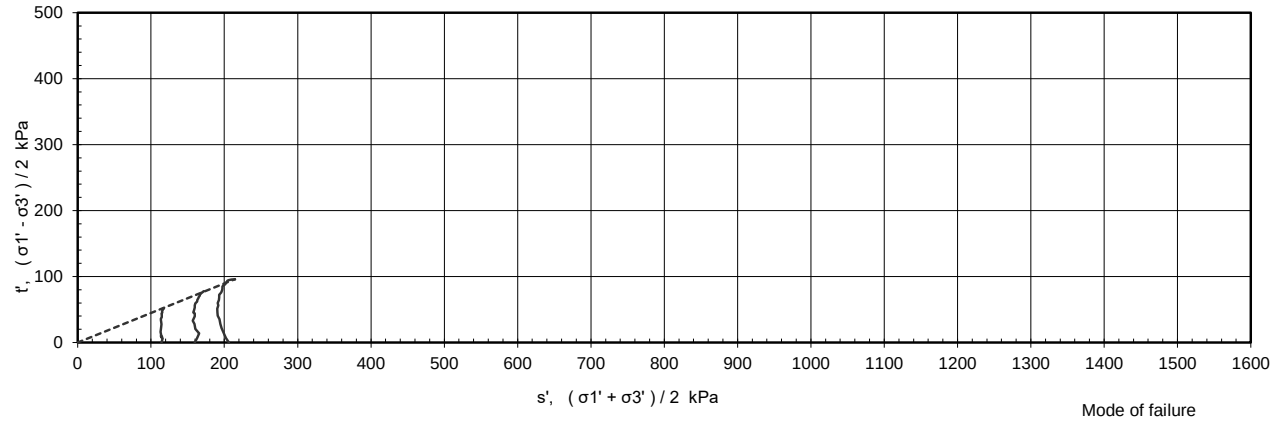
Stage	Cell pressure kPa	Initial pwp kPa	Initial σ3' kPa	Rate of strain %/hr	Axial strain, εf %	(σ1' / σ3') f	(σ1' - σ3') f kPa	uf kPa	σ3' f kPa	σ1' f kPa	Af
1	410	300	110	2.00	3.0	2.59	104	345	65	169	0.43
2	460	300	160	2.00	6.2	2.65	156	366	94	250	0.42
3	510	300	210	2.00	7.9	2.61	191	391	119	310	0.48
Conditions at Maximum Deviator Stress					7.9	2.61	191	391	119	310	0.48

Mohr Circles

_____ peak stress ratio _ _ _ _ peak deviator stress (final stage)

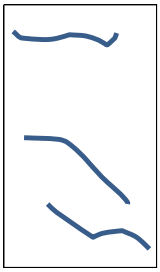


MIT Stress field



Shear Strength Parameters			Linear regression	Manual re-assessment
at peak stress ratio	c '	kPa	0.1	-
	Ø '	degrees	26.6	-

Mode of failure



Remarks

General	Deviator stresses corrected for area change, vertical side drains and 0.25 mm thick rubber membrane/
Stage 1	
Stage 2	
Stage 3	

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UKAS TESTING 2519

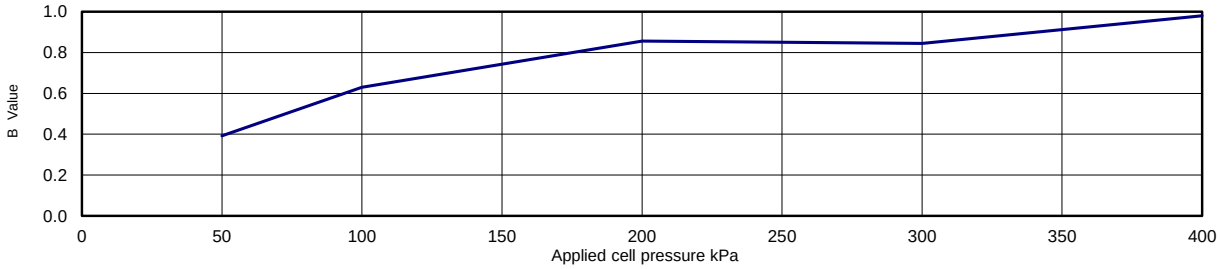
Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

	Consolidated Undrained Triaxial Compression Test with measurement of pore pressure (Multistage test on a single specimen)			Job Ref	32977
				Borehole/Pit No.	BH202
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project ID	20709	Client	Soils Limited	Depth m	7.00
Soil Description	Greyish brown slightly gravelly silty CLAY (gravel is fmc)			Sample Type	U
				Date Scheduled	09.02.2023
Test Method	Multistage test based on BS1377 : Part 8 : 1990, clauses 1 to 6 and 7			Date Started	14.02.2023

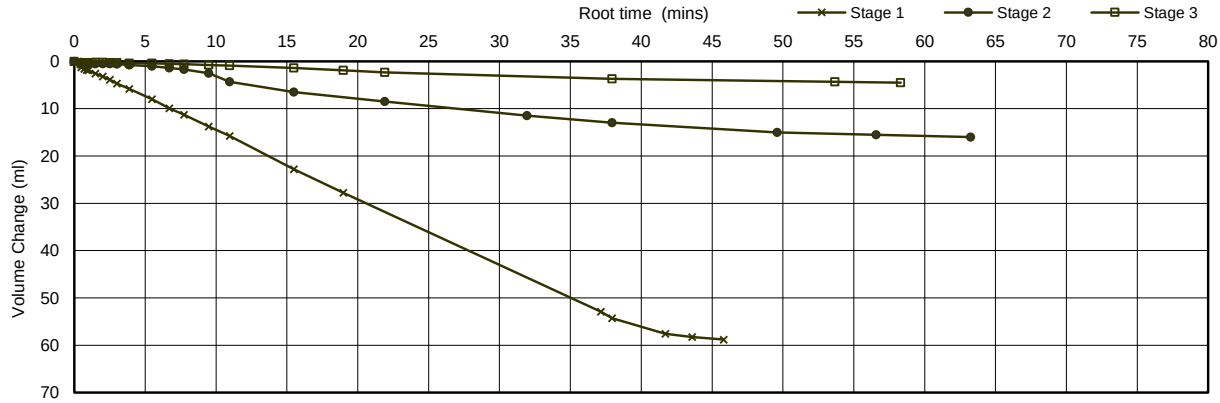
Specimen Type/Preparation	UNDISTURBED As BS 1377

Specimen Details		Initial	Final
Height	mm	210.0	
Diameter	mm	102.0	
Bulk Density	Mg/m³	2.05	1.95
Water Content	%	29	28
Dry density	Mg/m³	1.59	1.52

Saturation Details	Method of Saturation	
	Increments of cell and back pressure	
Cell pressure increments	100	kPa
Differential Pressure	10	kPa
Final Cell Pressure	40	kPa
Final pore water pressure	290	kPa
Final B Value	0.98	



	Drainage Conditions		from one end and radial boundary			
	Stage No.		1	2	3	
Consolidation Details	Cell Pressure applied		440	490	540	kPa
	Back Pressure applied		300	300	300	kPa
	Effective Pressure		140	190	240	kPa
	Pore pressure at start of consolidation		424	368	364	kPa
	Pore pressure at end of consolidation		291	298	300	kPa
	Pore pressure dissipation at end of consolidation		107	103	100	%
Consolidation parameters (see note to BS1377 : pt 8, clause 6.3.4)	Coefficient of Consolidation	Cvi	0.57	0.56	0.56	m2/year
	Coefficient of Compressibility	Mvi	0.236	0.126	0.039	m2/MN
	Coefficient of Permeability (calculated)	kvi	4.2E-11	2.2E-11	6.7E-12	m/s



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UKAS TESTING 2519

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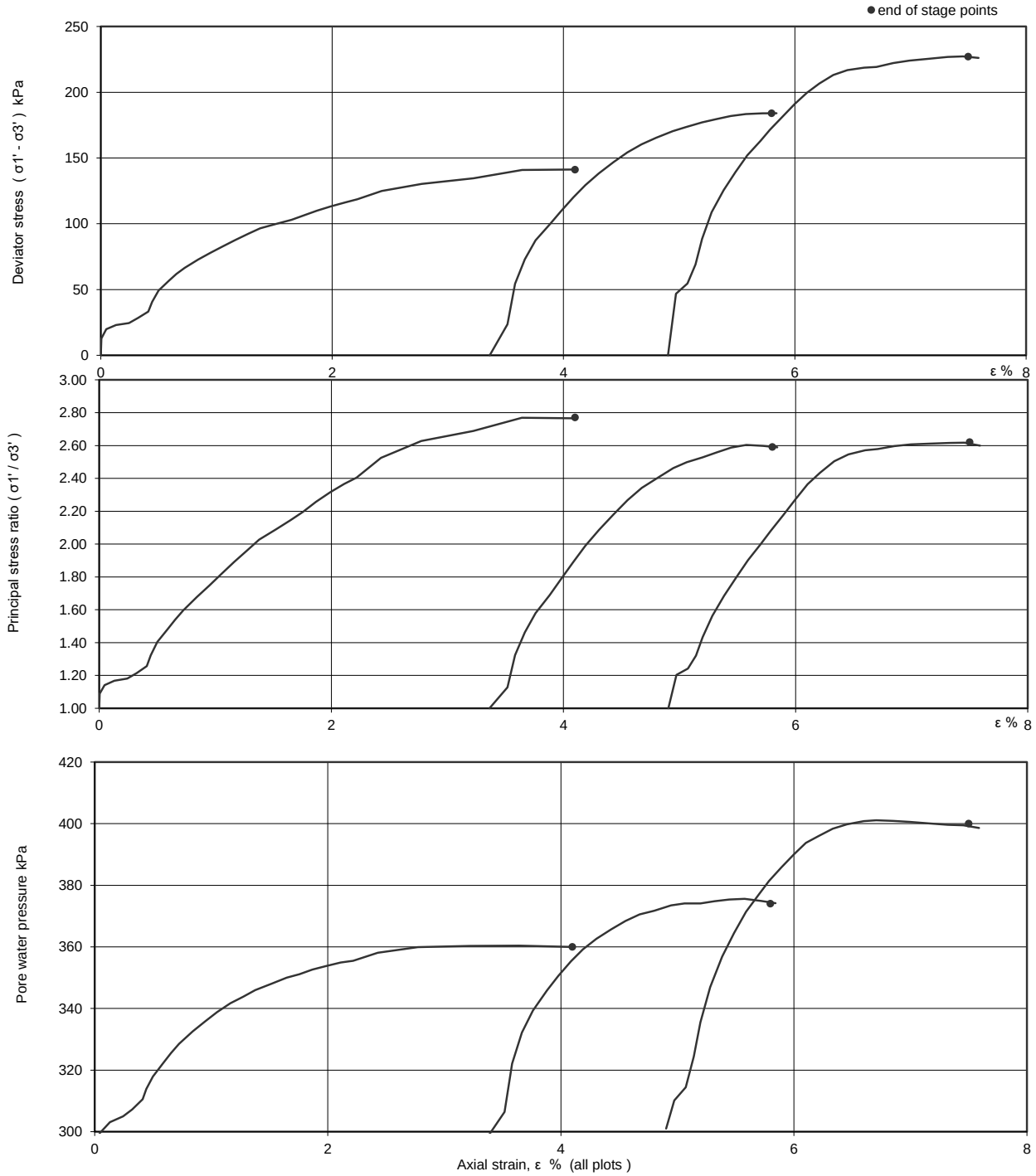
	Consolidated Undrained Triaxial Compression Test with measurement of pore pressure (Multistage test on a single specimen)			Job Ref	32977
				Borehole/Pit No.	BH202
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project ID	20709	Client	Soils Limited	Depth m	7.00
Compression stages - graphical data				Sample Type	U
				Date Started	20.02.2023



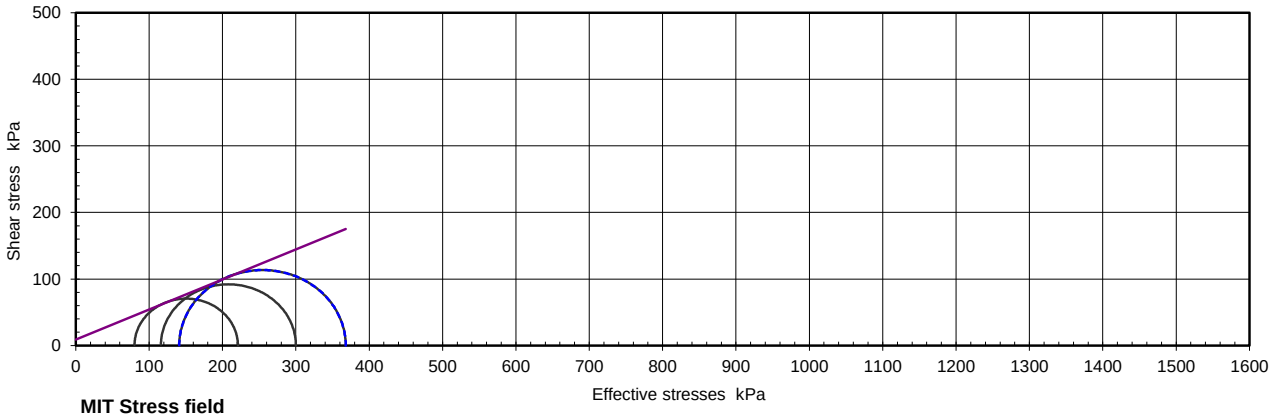
	Consolidated Undrained Triaxial Compression Test with measurement of pore pressure (Multistage test on a single specimen)			Job Ref	32977
				Borehole/Pit No.	BH202
Site Name	CTC Hayes - Canal Wall			Sample No.	-
Project ID	20709	Client	Soils Limited	Depth m	7.00
Compression stages - table of results and interpretation				Sample Type	U
				Date Started	20.02.2023

End of stage criterion : Maximum effective principal stress ratio

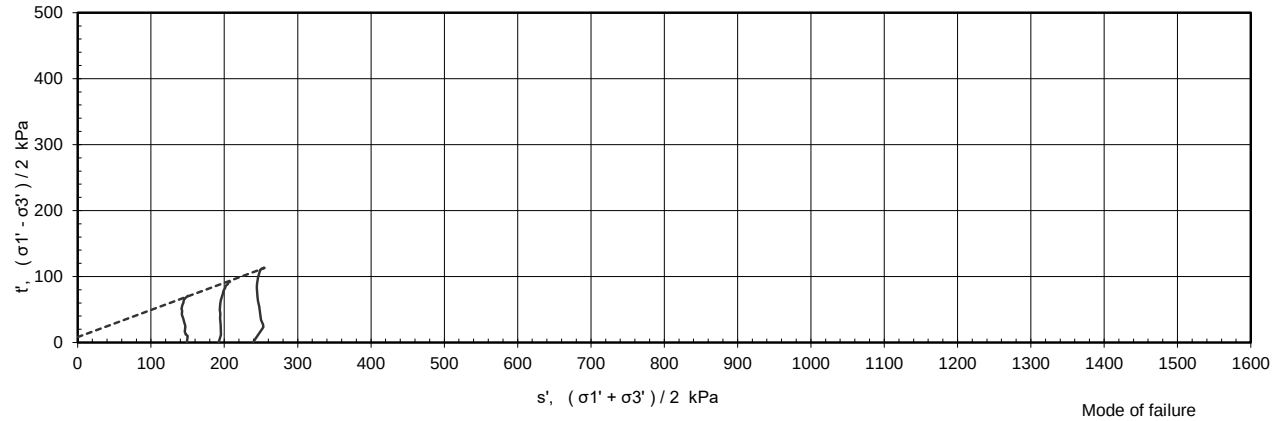
Stage	Cell pressure kPa	Initial pwp kPa	Initial σ3' kPa	Rate of strain %/hr	Axial strain, εf %	(σ1' / σ3') f	(σ1' - σ3') f kPa	uf kPa	σ3' f kPa	σ1' f kPa	Af
1	440	300	140	2.00	4.1	2.77	141	360	80	221	0.42
2	490	300	190	2.00	5.8	2.59	184	374	116	300	0.40
3	540	300	240	2.00	7.5	2.62	227	400	141	368	0.44
Conditions at Maximum Deviator Stress					7.5	2.62	227	400	141	368	0.44

Mohr Circles

_____ peak stress ratio _ _ _ _ peak deviator stress (final stage)

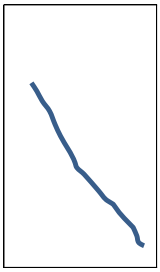


MIT Stress field



Shear Strength Parameters			Linear regression	Manual re-assessment
at peak stress ratio	c '	kPa	8.6	-
	Ø '	degrees	24.3	-

Mode of failure



Remarks

General	Deviator stresses corrected for area change, vertical side drains and 0.25 mm thick rubber membrane/
Stage 1	
Stage 2	
Stage 3	

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APPENDIX B

Existing Mass Concrete Wall Checks (Greta)

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.50000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.50000
1	0.68000	0.00000
2	1.71000	0.00000
3	1.71000	-3.50000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-6.00000
1	0.00000	-3.50000
2	1.71000	-3.50000
3	1.71000	-6.00000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
BS EN 1997-1:2011 DA1-2	0.000000/ 1.300000	1.000000/ 1.000000	1.000000	1.250000	1.400000	1.250000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	110.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	39.28571

Bearing Capacity

Foundation uses material parameters from "User-defined" material
Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation

Cohesion of material [kPa]	110.00000
Angle of internal fricton [deg]	25.00000

The unit weight is taken as the unsaturated density of material -1 and is 20.00[kN/m³]

Note: Use reduced passive pressures when modeling an SLS case.

Factors of Safety

Bearing	1.00000
Sliding	1.00000
Overturning	1.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Behind	0.10000	7.00000	0.00000	-

-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors	
						Overall	Bearing
Bending							
Surcharge	-	-	10.00000	0.00000	Variable	Unfavourable	Unfavourable
Unfavourable							

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-0.03562	0.00000	0.00000
3	-0.05749	0.00000	0.00000
4	-0.14177	3.48326	0.00000
5	-2.00000	15.72527	0.00000
6	-2.00000	11.85967	0.00000
7	-2.70000	14.71987	0.00000
8	-5.50000	19.80467	28.00000
9	-5.50000	23.04467	28.00000
10	-6.00000	24.79967	33.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	20.89200	8.00000
2	-6.00000	106.89200	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-21.74681	-64.12374
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	17.06935	0.00000	29.18859
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-45.65791	0.00000	0.00000
Soil pressure on virtual back	0.00000	-65.84516	-146.49260
Soil pressure on virtual front	0.00000	159.73000	154.87084
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	133.28315	72.13803	129.28924

Sliding Check

Sliding resistance [kN]	58.14016
Sum of disturbing forces [kN]	-142.04197
Sum of restoring forces [kN]	272.32016
Sliding factor of safety	1.91718

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]

Overturning Check

Sum of disturbing moments [kNm/m]	-318.75899
Sum of restoring moments [kNm/m]	448.04823
Overturning factor of safety	1.40560

SOIL AND WATER PRESSURES FOR BEARING CAPACITY CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.03562	0.00000	0.00000
3	-0.05749	0.00000	0.00000
4	-0.14177	3.48326	0.00000
5	-2.00000	15.72527	0.00000
6	-2.00000	11.85967	0.00000
7	-2.70000	14.71987	0.00000
8	-5.50000	19.80467	28.00000
9	-5.50000	23.04467	28.00000
10	-6.00000	24.79967	33.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	8.79553	8.00000
2	-6.00000	45.00153	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-21.74681	-64.12374
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	17.06935	0.00000	29.18859
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-26.98058	0.00000	0.00000
Soil pressure on virtual back	0.00000	-65.84516	-146.49260
Soil pressure on virtual front	0.00000	67.24633	65.20062
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	151.96048	-20.34564	39.61902

Bearing Check

Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation
Foundation undrained cohesion = 110.000 [kPa]
Total overburden q = 58.000 [kPa]
Effective width B' = 0.521 [m]

	Surcharge	Density	Cohesion
Bearing capacity factors (N_q, N_g, N_c)	-	-	-
Base inclination factors (b_q, b_g, b_c)	-	-	1.00000
Shape factors (s_q, s_g, s_c)	-	-	1.00000
Depth factors (d_q, d_g, d_c)	-	-	-

	Surcharge	Density	Cohesion
Load inclination factors (i_q, i_g, i_c)	-	-	0.85475
Ground inclination factors (g_q, g_g, g_c)	-	-	-

Ultimate bearing capacity of soil [kPa]	403.30574
Average vertical soil stress [kPa]	291.42551
Minimum FOS bearing	1.00000
Calculated FOS for average bearing pressure	1.38391
Bearing Capacity of soil is adequate	
Peak vertical bearing stress in the soil [kPa]	388.56734
Calculated FOS for peak bearing pressure	1.03793

WARNING: Midpoint for base reaction is outside middle third of base.

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.50000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.50000
1	0.68000	0.00000
2	1.71000	0.00000
3	1.71000	-3.50000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-6.00000
1	0.00000	-3.50000
2	1.71000	-3.50000
3	1.71000	-6.00000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
SLS	1.000000/ 1.000000	1.000000/ 1.000000	1.000000	1.000000	1.000000	1.000000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	110.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	55.00000

Bearing Capacity

Foundation uses material parameters from "User-defined" material
Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation

Cohesion of material [kPa]	110.00000
Angle of internal fricton [deg]	25.00000

The unit weight is taken as the unsaturated density of material -1 and is 20.00[kN/m³]

Note: Use reduced passive pressures when modeling an SLS case.

Factors of Safety

Bearing	1.00000
Sliding	1.00000
Overturning	1.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Behind	0.10000	7.00000	0.00000	-

-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors	
						Overall	Bearing
Bending							
Surcharge	-	-	10.00000	0.00000	Variable	Unfavourable	Unfavourable
Unfavourable							

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-0.04452	0.00000	0.00000
3	-0.07928	0.00000	0.00000
4	-0.15399	2.42813	0.00000
5	-2.00000	14.58967	0.00000
6	-2.00000	11.00867	0.00000
7	-2.70000	13.86887	0.00000
8	-5.50000	18.95367	28.00000
9	-5.50000	20.80267	28.00000
10	-6.00000	22.55767	33.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	26.11500	8.00000
2	-6.00000	112.11500	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-16.66122	-48.93147
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	19.80528	0.00000	33.86703
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-60.37814	0.00000	0.00000
Soil pressure on virtual back	0.00000	-64.63578	-143.79928
Soil pressure on virtual front	0.00000	172.78750	171.19271
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	121.29886	91.49050	168.17514

Sliding Check

Sliding resistance [kN]	35.59019
Sum of disturbing forces [kN]	-135.74700
Sum of restoring forces [kN]	262.82769
Sliding factor of safety	1.93616

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]

Overturning Check

Sum of disturbing moments [kNm/m] -300.87341
Sum of restoring moments [kNm/m] 469.04855
Overturning factor of safety 1.55896

WARNING: Midpoint for base reaction is outside middle third of base. 1.55896

SOIL AND WATER PRESSURES FOR BEARING CAPACITY CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.04452	0.00000	0.00000
3	-0.07928	0.00000	0.00000
4	-0.15399	2.42813	0.00000
5	-2.00000	14.58967	0.00000
6	-2.00000	11.00867	0.00000
7	-2.70000	13.86887	0.00000
8	-5.50000	18.95367	28.00000
9	-5.50000	20.80267	28.00000
10	-6.00000	22.55767	33.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	7.36443	8.00000
2	-6.00000	31.61643	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-16.66122	-48.93147
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	19.80528	0.00000	33.86703
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-29.05313	0.00000	0.00000
Soil pressure on virtual back	0.00000	-64.63578	-143.79928
Soil pressure on virtual front	0.00000	48.72608	48.27634
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	152.62386	-32.57093	45.25878

Bearing Check

Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation
Foundation undrained cohesion = 110.000 [kPa]
Total overburden q = 58.000 [kPa]
Effective width B' = 0.593 [m]

	Surcharge	Density	Cohesion
Bearing capacity factors (N_q, N_g, N_c)	-	-	-
Base inclination factors (b_q, b_g, b_c)	-	-	1.00000
Shape factors (s_q, s_g, s_c)	-	-	1.00000

	Surcharge	Density	Cohesion
Depth factors (d_q, d_g, d_c)	-	-	-
Load inclination factors (i_q, i_g, i_c)	-	-	0.85381
Ground inclination factors (g_q, g_g, g_c)	-	-	-

Ultimate bearing capacity of soil [kPa]	540.89646
Average vertical soil stress [kPa]	257.34280
Minimum FOS bearing	1.00000
Calculated FOS for average bearing pressure	2.10185

Bearing Capacity of soil is adequate

Peak vertical bearing stress in the soil [kPa]	343.12376
Calculated FOS for peak bearing pressure	1.57639

WARNING: Midpoint for base reaction is outside middle third of base.

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.50000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.50000
1	0.68000	0.00000
2	1.71000	0.00000
3	1.71000	-3.50000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-6.00000
1	0.00000	-3.50000
2	1.71000	-3.50000
3	1.71000	-6.00000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
BS EN 1997-1:2011 DA1-2	0.000000/ 1.300000	1.000000/ 1.000000	1.000000	1.250000	1.400000	1.250000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	110.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	39.28571

Bearing Capacity

Foundation uses material parameters from "User-defined" material
Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation

Cohesion of material [kPa]	110.00000
Angle of internal fricton [deg]	25.00000

The unit weight is taken as the unsaturated density of material -1 and is 20.00[kN/m³]

Note: Use reduced passive pressures when modeling an SLS case.

Factors of Safety

Bearing	1.00000
Sliding	1.00000
Overturning	1.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Behind	0.10000	1.90000	0.00000	-

-
Surcharge 2 Strip Behind 2.00000 5.00000 0.00000 -
-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors	
						Overall	Bearing
Bending Surcharge Unfavourable	-	-	5.00000	0.00000	Permanent	Unfavourable	Unfavourable
Surcharge 2 Unfavourable	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-0.03562	0.00000	0.00000
3	-0.07742	0.00000	0.00000
4	-0.14177	1.39151	0.00000
5	-0.71237	5.15058	0.00000
6	-2.00000	16.72572	0.00000
7	-2.00000	12.86012	0.00000
8	-2.70000	17.40134	0.00000
9	-3.01575	18.73302	3.15753
10	-5.24139	22.77478	25.41393
11	-5.24139	21.17887	25.41393
12	-5.50000	21.64850	28.00000
13	-5.50000	24.88850	28.00000
14	-6.00000	26.64350	33.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	20.89200	8.00000
2	-6.00000	106.89200	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-31.05811	-75.70421
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	19.59712	0.00000	33.51107
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-45.65791	0.00000	0.00000
Soil pressure on virtual back	0.00000	-65.84516	-146.49260
Soil pressure on virtual front	0.00000	159.73000	154.87084
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Resultant	135.81092	62.82673	122.03126

Sliding Check

Sliding resistance [kN]	63.75774
Sum of disturbing forces [kN]	-151.35327
Sum of restoring forces [kN]	277.93774
Sliding factor of safety	1.83635

Overturning Check

Sum of disturbing moments [kNm/m]	-330.33946
Sum of restoring moments [kNm/m]	452.37072
Overturning factor of safety	1.36941

SOIL AND WATER PRESSURES FOR BEARING CAPACITY CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.03562	0.00000	0.00000
3	-0.07742	0.00000	0.00000
4	-0.14177	1.39151	0.00000
5	-0.71237	5.15058	0.00000
6	-2.00000	16.72572	0.00000
7	-2.00000	12.86012	0.00000
8	-2.70000	17.40134	0.00000
9	-3.01575	18.73302	3.15753
10	-5.24139	22.77478	25.41393
11	-5.24139	21.17887	25.41393
12	-5.50000	21.64850	28.00000
13	-5.50000	24.88850	28.00000
14	-6.00000	26.64350	33.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	9.94459	8.00000
2	-6.00000	50.88059	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-31.05811	-75.70421
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	19.59712	0.00000	33.51107
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-28.75477	0.00000	0.00000
Soil pressure on virtual back	0.00000	-65.84516	-146.49260
Soil pressure on virtual front	0.00000	76.03148	73.71852
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	152.71407	-20.87179	40.87894

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]

Bearing Check

Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation
Foundation undrained cohesion = 110.000 [kPa]
Total overburden q = 58.000 [kPa]
Effective width B' = 0.535 [m]

	Surcharge	Density	Cohesion
Bearing capacity factors (N_q, N_g, N_c)	-	-	-
Base inclination factors (b_q, b_g, b_c)	-	-	1.00000
Shape factors (s_q, s_g, s_c)	-	-	1.00000
Depth factors (d_q, d_g, d_c)	-	-	-
Load inclination factors (i_q, i_g, i_c)	-	-	0.85490
Ground inclination factors (g_q, g_g, g_c)	-	-	-

Ultimate bearing capacity of soil [kPa]	403.36418
Average vertical soil stress [kPa]	285.25180
Minimum FOS bearing	1.00000
Calculated FOS for average bearing pressure	1.41406

Bearing Capacity of soil is adequate

Peak vertical bearing stress in the soil [kPa]	380.33577
Calculated FOS for peak bearing pressure	1.06055

WARNING: Midpoint for base reaction is outside middle third of base.

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.50000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.50000
1	0.68000	0.00000
2	1.71000	0.00000
3	1.71000	-3.50000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-6.00000
1	0.00000	-3.50000
2	1.71000	-3.50000
3	1.71000	-6.00000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
SLS	1.000000/ 1.000000	1.000000/ 1.000000	1.000000	1.000000	1.000000	1.000000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	110.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	55.00000

Bearing Capacity

Foundation uses material parameters from "User-defined" material
Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation

Cohesion of material [kPa]	110.00000
Angle of internal fricton [deg]	25.00000

The unit weight is taken as the unsaturated density of material -1 and is 20.00[kN/m³]

Note: Use reduced passive pressures when modeling an SLS case.

Factors of Safety

Bearing	1.00000
Sliding	1.00000
Overturning	1.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Pressure Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Behind	0.10000	1.90000	0.00000	-

-
Surcharge 2 Strip Behind 2.00000 5.00000 0.00000 -
-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors	
						Overall	Bearing
Bending							
Surcharge	-	-	5.00000	0.00000	Variable	Unfavourable	Unfavourable
Unfavourable							
Surcharge 2	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable
Unfavourable							

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-0.04452	0.00000	0.00000
3	-0.09900	0.00000	0.00000
4	-0.15399	1.14018	0.00000
5	-0.89046	5.99205	0.00000
6	-2.00000	15.21364	0.00000
7	-2.00000	11.63264	0.00000
8	-2.70000	15.69905	0.00000
9	-3.35976	18.03405	6.59761
10	-5.25464	21.47514	25.54637
11	-5.25464	19.92642	25.54637
12	-5.50000	20.37200	28.00000
13	-5.50000	22.22100	28.00000
14	-6.00000	23.97600	33.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	26.11500	8.00000
2	-6.00000	112.11500	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-24.40582	-59.16922
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	22.42795	0.00000	38.35179
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-60.37814	0.00000	0.00000
Soil pressure on virtual back	0.00000	-64.63578	-143.79928
Soil pressure on virtual front	0.00000	172.78750	171.19271
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Resultant	123.92153	83.74590	162.42216

Sliding Check

Sliding resistance [kN]	43.92459
Sum of disturbing forces [kN]	-143.49160
Sum of restoring forces [kN]	271.16209
Sliding factor of safety	1.88974

Overturning Check

Sum of disturbing moments [kNm/m]	-311.11116
Sum of restoring moments [kNm/m]	473.53331
Overturning factor of safety	1.52207

WARNING: Midpoint for base reaction is outside middle third of base. 1.52207

SOIL AND WATER PRESSURES FOR BEARING CAPACITY CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.04452	0.00000	0.00000
3	-0.09900	0.00000	0.00000
4	-0.15399	1.14018	0.00000
5	-0.89046	5.99205	0.00000
6	-2.00000	15.21364	0.00000
7	-2.00000	11.63264	0.00000
8	-2.70000	15.69905	0.00000
9	-3.35976	18.03405	6.59761
10	-5.25464	21.47514	25.54637
11	-5.25464	19.92642	25.54637
12	-5.50000	20.37200	28.00000
13	-5.50000	22.22100	28.00000
14	-6.00000	23.97600	33.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	8.43515	8.00000
2	-6.00000	36.21315	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-24.40582	-59.16922
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	22.42795	0.00000	38.35179
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-30.84189	0.00000	0.00000
Soil pressure on virtual back	0.00000	-64.63578	-143.79928
Soil pressure on virtual front	0.00000	55.81036	55.29525
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	153.45778	-33.23124	46.52469

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]

Bearing Check

Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation
Foundation undrained cohesion = 110.000 [kPa]
Total overburden q = 58.000 [kPa]
Effective width B' = 0.606 [m]

	Surcharge	Density	Cohesion
Bearing capacity factors (N_q, N_g, N_c)	-	-	-
Base inclination factors (b_q, b_g, b_c)	-	-	1.00000
Shape factors (s_q, s_g, s_c)	-	-	1.00000
Depth factors (d_q, d_g, d_c)	-	-	-
Load inclination factors (i_q, i_g, i_c)	-	-	0.85418
Ground inclination factors (g_q, g_g, g_c)	-	-	-

Ultimate bearing capacity of soil [kPa]	541.10239
Average vertical soil stress [kPa]	253.08377
Minimum FOS bearing	1.00000
Calculated FOS for average bearing pressure	2.13804

Bearing Capacity of soil is adequate

Peak vertical bearing stress in the soil [kPa]	337.44503
Calculated FOS for peak bearing pressure	1.60353

WARNING: Midpoint for base reaction is outside middle third of base.

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.50000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.50000
1	0.68000	0.00000
2	1.71000	0.00000
3	1.71000	-3.50000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-6.00000
1	0.00000	-3.50000
2	1.71000	-3.50000
3	1.71000	-6.00000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
BS EN 1997-1:2011 DA1-2	0.000000/ 1.300000	1.000000/ 1.000000	1.000000	1.250000	1.400000	1.250000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	110.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	39.28571

Bearing Capacity

Foundation uses material parameters from "User-defined" material
Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation

Cohesion of material [kPa]	110.00000
Angle of internal fricton [deg]	25.00000

The unit weight is taken as the unsaturated density of material -1 and is 20.00[kN/m³]

Note: Use reduced passive pressures when modeling an SLS case.

Factors of Safety

Bearing	1.00000
Sliding	1.00000
Overturning	1.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]

[m]

Surcharge	Strip	Behind	0.10000	7.00000	0.00000	-

-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors	
						Overall	Bearing
Bending							
Surcharge	-	-	10.00000	0.00000	Variable	Unfavourable	Unfavourable
Unfavourable							

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-0.03562	0.00000	0.00000
3	-0.05749	0.00000	0.00000
4	-0.14177	3.48326	0.00000
5	-2.00000	15.72527	0.00000
6	-2.00000	11.85967	0.00000
7	-2.70000	14.71987	0.00000
8	-5.50000	19.80467	28.00000
9	-5.50000	23.04467	28.00000
10	-6.00000	24.79967	33.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	0.00000	8.00000
2	-5.50000	106.88000	28.00000
3	-5.50000	75.93200	28.00000
4	-6.00000	93.13200	33.00000

Component forces

Component	Normal Force	Parallel Force	Moment
	[kN/m]	[kN/m]	[kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-21.74681	-64.12374
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	17.06935	0.00000	29.18859
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-49.71016	0.00000	0.00000
Soil pressure on virtual back	0.00000	-65.84516	-146.49260
Soil pressure on virtual front	0.00000	149.14600	134.90150
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	129.23090	61.55403	109.31990

Sliding Check

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Sliding resistance [kN]	66.46569		
Sum of disturbing forces [kN]	-142.04197		
Sum of restoring forces [kN]	270.06168		
Sliding factor of safety	1.90128		

Overturning Check

Sum of disturbing moments [kNm/m]	-318.75899
Sum of restoring moments [kNm/m]	428.07889
Overturning factor of safety	1.34295

SOIL AND WATER PRESSURES FOR BEARING CAPACITY CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.03562	0.00000	0.00000
3	-0.05749	0.00000	0.00000
4	-0.14177	3.48326	0.00000
5	-2.00000	15.72527	0.00000
6	-2.00000	11.85967	0.00000
7	-2.70000	14.71987	0.00000
8	-5.50000	19.80467	28.00000
9	-5.50000	23.04467	28.00000
10	-6.00000	24.79967	33.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	0.00000	8.00000
2	-5.50000	49.48544	28.00000
3	-5.50000	35.15652	28.00000
4	-6.00000	43.12012	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-21.74681	-64.12374
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	17.06935	0.00000	29.18859
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-24.45496	0.00000	0.00000
Soil pressure on virtual back	0.00000	-65.84516	-146.49260
Soil pressure on virtual front	0.00000	69.05460	62.45939
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	154.48610	-18.53738	36.87780

Bearing Check

Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation
Foundation undrained cohesion = 110.000 [kPa]
Total overburden q = 54.000 [kPa]
Effective width B' = 0.477 [m]

	Surcharge	Density	Cohesion
Bearing capacity factors (N_q, N_g, N_c)	-	-	-
Base inclination factors (b_q, b_g, b_c)	-	-	1.00000
Shape factors (s_q, s_g, s_c)	-	-	1.00000
Depth factors (d_q, d_g, d_c)	-	-	-
Load inclination factors (i_q, i_g, i_c)	-	-	0.85561
Ground inclination factors (g_q, g_g, g_c)	-	-	-

Ultimate bearing capacity of soil [kPa]	399.65046
Average vertical soil stress [kPa]	323.58163
Minimum FOS bearing	1.00000
Calculated FOS for average bearing pressure	1.23508

Bearing Capacity of soil is adequate

Peak vertical bearing stress in the soil [kPa]	431.44218
Calculated FOS for peak bearing pressure	0.92631

WARNING: Midpoint for base reaction is outside middle third of base.

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.50000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.50000
1	0.68000	0.00000
2	1.71000	0.00000
3	1.71000	-3.50000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-6.00000
1	0.00000	-3.50000
2	1.71000	-3.50000
3	1.71000	-6.00000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
SLS	1.000000/ 1.000000	1.000000/ 1.000000	1.000000	1.000000	1.000000	1.000000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	110.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	55.00000

Bearing Capacity

Foundation uses material parameters from "User-defined" material
Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation

Cohesion of material [kPa]	110.00000
Angle of internal fricton [deg]	25.00000

The unit weight is taken as the unsaturated density of material -1 and is 20.00[kN/m³]

Note: Use reduced passive pressures when modeling an SLS case.

Factors of Safety

Bearing	1.00000
Sliding	1.00000
Overturning	1.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]

[m]
Surcharge Strip Behind 0.10000 7.00000 0.00000 -
-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors Overall	Bearing
Bending							
Surcharge	-	-	10.00000	0.00000	Variable	Unfavourable	Unfavourable
Unfavourable							

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.04452	0.00000	0.00000
3	-0.07928	0.00000	0.00000
4	-0.15399	2.42813	0.00000
5	-2.00000	14.58967	0.00000
6	-2.00000	11.00867	0.00000
7	-2.70000	13.86887	0.00000
8	-5.50000	18.95367	28.00000
9	-5.50000	20.80267	28.00000
10	-6.00000	22.55767	33.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	0.00000	8.00000
2	-5.50000	106.88000	28.00000
3	-5.50000	81.15500	28.00000
4	-6.00000	98.35500	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-16.66122	-48.93147
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	19.80528	0.00000	33.86703
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-61.54348	0.00000	0.00000
Soil pressure on virtual back	0.00000	-64.63578	-143.79928
Soil pressure on virtual front	0.00000	151.75750	135.55437
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	120.13352	70.46049	132.53681

Sliding Check

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Sliding resistance [kN]	66.74296		
Sum of disturbing forces [kN]	-135.74700		
Sum of restoring forces [kN]	272.95045		
Sliding factor of safety	2.01073		

Overturning Check

Sum of disturbing moments [kNm/m]	-300.87341
Sum of restoring moments [kNm/m]	433.41021
Overturning factor of safety	1.44051

SOIL AND WATER PRESSURES FOR BEARING CAPACITY CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.04452	0.00000	0.00000
3	-0.07928	0.00000	0.00000
4	-0.15399	2.42813	0.00000
5	-2.00000	14.58967	0.00000
6	-2.00000	11.00867	0.00000
7	-2.70000	13.86887	0.00000
8	-5.50000	18.95367	28.00000
9	-5.50000	20.80267	28.00000
10	-6.00000	22.55767	33.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	0.00000	8.00000
2	-5.50000	36.33920	28.00000
3	-5.50000	27.59270	28.00000
4	-6.00000	33.44070	33.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	217.68000	0.00000	204.06160
Weight of soil	0.00000	0.00000	0.00000
Weight of water	0.62171	0.00000	0.03221
Load on wall	0.00000	0.00000	0.00000
Load behind wall	0.00000	-16.66122	-48.93147
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	19.80528	0.00000	33.86703
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-23.13578	0.00000	0.00000
Soil pressure on virtual back	0.00000	-64.63578	-143.79928
Soil pressure on virtual front	0.00000	51.59755	46.08849
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-54.45000	-59.89500
Water pressure on front	0.00000	54.45000	59.89500
Water pressure under base	-56.43000	0.00000	-48.24765
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	158.54121	-29.69946	43.07092

Bearing Check

Foundation material is "Undrained"
EC7 Annex D - D3 used for calculation
Foundation undrained cohesion = 110.000 [kPa]
Total overburden q = 54.000 [kPa]
Effective width B' = 0.543 [m]

	Surcharge	Density	Cohesion
Bearing capacity factors (N_q, N_g, N_c)	-	-	-
Base inclination factors (b_q, b_g, b_c)	-	-	1.00000
Shape factors (s_q, s_g, s_c)	-	-	1.00000
Depth factors (d_q, d_g, d_c)	-	-	-
Load inclination factors (i_q, i_g, i_c)	-	-	0.85464
Ground inclination factors (g_q, g_g, g_c)	-	-	-

Ultimate bearing capacity of soil [kPa]	537.36415
Average vertical soil stress [kPa]	291.78989
Minimum FOS bearing	1.00000
Calculated FOS for average bearing pressure	1.84161

Bearing Capacity of soil is adequate

Peak vertical bearing stress in the soil [kPa]	389.05316
Calculated FOS for peak bearing pressure	1.38121

WARNING: Midpoint for base reaction is outside middle third of base.

APPENDIX C

Existing Mass Concrete Wall Checks (Slide2)

Slide2 Analysis Information

Existing Wall Check

Project Summary

File Name:	Existing Wall Check.slmd
Slide2 Modeler Version:	9.027
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	16/03/2023, 10:33:11

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
ULS2 - Surcharge Scenario 1	Master Scenario	Bishop Simplified: 1.341280	00h:00m:00.963s
SLS - Surcharge Scenario 1	Master Scenario	Bishop Simplified: 2.094410	00h:00m:00.725s
ULS2 - Surcharge Scenario 2	Master Scenario	Bishop Simplified: 1.081930	00h:00m:00.876s
SLS - Surcharge Scenario 2	Master Scenario	Bishop Simplified: 2.037300	00h:00m:00.775s
ULS2 - Sensitivity Check	Master Scenario	Bishop Simplified: 1.341280	00h:00m:01.16s
SLS - Sensitivity Check	Master Scenario	Bishop Simplified: 1.905860	00h:00m:00.775s

General Settings

Units of Measurement:	Metric Units
Time Units:	days
Permeability Units:	meters/second
Data Output:	Standard
Failure Direction:	Right to Left

Design Standard

ULS2 - Surcharge Scenario 1

Selected Type:	Eurocode 7 - Design Approach 1, Combination 2
Type	**Partial Factor**
Permanent Actions: Unfavourable	1
Permanent Actions: Favourable	1
Variable Actions: Unfavourable	1.3
Variable Actions: Favourable	0
Effective cohesion	1.25
Coefficient of shearing resistance	1.25
Undrained strength	1.4
Weight density	1
Shear strength (other models)	1.25
Earth resistance	1
Tensile and plate strength	1.1
Shear strength	1.1
Compressive strength	1.1
Bond strength	1.1
Seismic Coefficient	1

ULS2 - Surcharge Scenario 2

Selected Type:	Eurocode 7 - Design Approach 1, Combination 2
Type	**Partial Factor**
Permanent Actions: Unfavourable	1
Permanent Actions: Favourable	1
Variable Actions: Unfavourable	1.3
Variable Actions: Favourable	0
Effective cohesion	1.25
Coefficient of shearing resistance	1.25
Undrained strength	1.4
Weight density	1
Shear strength (other models)	1.25
Earth resistance	1
Tensile and plate strength	1.1
Shear strength	1.1
Compressive strength	1.1
Bond strength	1.1
Seismic Coefficient	1

ULS2 - Sensitivity Check

Selected Type:	Eurocode 7 - Design Approach 1, Combination 2
Type	**Partial Factor**
Permanent Actions: Unfavourable	1
Permanent Actions: Favourable	1
Variable Actions: Unfavourable	1.3
Variable Actions: Favourable	0
Effective cohesion	1.25
Coefficient of shearing resistance	1.25
Undrained strength	1.4
Weight density	1
Shear strength (other models)	1.25
Earth resistance	1
Tensile and plate strength	1.1
Shear strength	1.1
Compressive strength	1.1
Bond strength	1.1
Seismic Coefficient	1

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [kN/m3]:	9.81
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [kPa]:	0
Advanced Groundwater Method:	None

Random Numbers

All Open Scenarios

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

All Open Scenarios

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

All Open Scenarios

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

ULS2 - Surcharge Scenario 1

Distribution:	Constant
Magnitude [kPa]:	10
Orientation:	Vertical
Load Action:	Variable

SLS - Surcharge Scenario 1

Distribution:	Constant
Magnitude [kPa]:	10
Orientation:	Vertical

ULS2 - Surcharge Scenario 2

Distribution:	Constant
Magnitude [kPa]:	5
Orientation:	Vertical
Load Action:	Variable

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical
Load Action:	Variable

SLS - Surcharge Scenario 2

Distribution:	Constant
Magnitude [kPa]:	5
Orientation:	Vertical

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical

ULS2 - Sensitivity Check

Distribution:	Constant
Magnitude [kPa]:	10
Orientation:	Vertical
Load Action:	Variable

SLS - Sensitivity Check

Distribution:	Constant
Magnitude [kPa]:	10
Orientation:	Vertical

Materials

Made Ground Cohesive	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	18
Cohesion [kPa]	1
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Hu Value	1
Made Ground Granular	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	18
Cohesion [kPa]	0
Friction Angle [deg]	35
Water Surface	Assigned per scenario
Hu Value	1
London Clay Cohesive	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	20
Cohesion [kPa]	5
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Hu Value	1
Concrete	
Color	
Strength Type	Infinite strength
Unit Weight [kN/m3]	24
Allow Sliding Along Boundary	Yes
Water Surface	Assigned per scenario
Hu Value	0
Ru Value	0

Materials In Use

Material	ULS2 - Surcharge Scenario 1	SLS - Surcharge Scenario 1	ULS2 - Surcharge Scenario 2	SLS - Surcharge Scenario 2	ULS2 - Sensitivity Check	SLS - Sensitivity Check
Made Ground Cohesive	✓	✓	✓	✓	✓	✓
Made Ground Granular	✓	✓	✓	✓	✓	✓
London Clay Cohesive	✓	✓	✓	✓	✓	✓
Concrete	✓	✓	✓	✓	✓	✓

Global Minimums

ULS2 - Surcharge Scenario 1

Method: bishop simplified

FS	1.341280
Center:	13.299, 15.063
Radius:	0.139
Left Slip Surface Endpoint:	13.175, 15.000
Right Slip Surface Endpoint:	13.423, 15.000
Resisting Moment:	0.13413 kN-m
Driving Moment:	0.100002 kN-m
Total Slice Area:	0.0134613 m2
Surface Horizontal Width:	0.248072 m
Surface Average Height:	0.0542639 m

SLS - Surcharge Scenario 1

Method: bishop simplified

FS	2.094410
Center:	7.785, 15.979
Radius:	7.467
Left Slip Surface Endpoint:	1.810, 11.500
Right Slip Surface Endpoint:	15.188, 15.000
Left Slope Intercept:	1.810 12.300
Right Slope Intercept:	15.188 15.000
Resisting Moment:	3275.98 kN-m
Driving Moment:	1564.15 kN-m
Total Slice Area:	49.651 m2
Surface Horizontal Width:	13.3774 m
Surface Average Height:	3.71155 m

ULS2 - Surcharge Scenario 2

Method: bishop simplified

FS	1.081930
Center:	12.311, 15.077
Radius:	0.132
Left Slip Surface Endpoint:	12.204, 15.000
Right Slip Surface Endpoint:	12.417, 15.000
Resisting Moment:	0.108556 kN-m
Driving Moment:	0.100336 kN-m
Total Slice Area:	0.00807217 m2
Surface Horizontal Width:	0.212794 m
Surface Average Height:	0.0379342 m

SLS - Surcharge Scenario 2

Method: bishop simplified

FS	2.037300
Center:	7.928, 17.273
Radius:	8.604
Left Slip Surface Endpoint:	1.548, 11.500
Right Slip Surface Endpoint:	16.227, 15.000
Left Slope Intercept:	1.548 12.300
Right Slope Intercept:	16.227 15.000
Resisting Moment:	4084.02 kN-m
Driving Moment:	2004.62 kN-m
Total Slice Area:	52.7252 m2
Surface Horizontal Width:	14.679 m
Surface Average Height:	3.59187 m

ULS2 - Sensitivity Check

Method: bishop simplified

FS	1.341280
Center:	13.299, 15.063
Radius:	0.139
Left Slip Surface Endpoint:	13.175, 15.000
Right Slip Surface Endpoint:	13.423, 15.000
Resisting Moment:	0.13413 kN-m
Driving Moment:	0.100002 kN-m
Total Slice Area:	0.0134613 m2
Surface Horizontal Width:	0.248072 m
Surface Average Height:	0.0542639 m

SLS - Sensitivity Check

Method: bishop simplified

FS	1.905860
Center:	8.039, 15.958
Radius:	7.336
Left Slip Surface Endpoint:	2.212, 11.500
Right Slip Surface Endpoint:	15.312, 15.000
Left Slope Intercept:	2.212 12.300
Right Slope Intercept:	15.312 15.000
Resisting Moment:	2982.13 kN-m
Driving Moment:	1564.71 kN-m
Total Slice Area:	48.2068 m2
Surface Horizontal Width:	13.0999 m
Surface Average Height:	3.67993 m

Global Minimum Support Data

All Open Scenarios

No Supports Present

APPENDIX D

Proposed Replacement RC Wall Checks (Greta)

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.60000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.20000
1	0.00000	0.30000
2	0.30000	0.30000
3	0.30000	-3.20000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-3.60000
1	0.00000	-3.20000
2	3.90000	-3.20000
3	3.90000	-3.60000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
BS EN 1997-1:2011 DA1-2	0.000000/ 1.300000	1.000000/ 1.000000	1.000000	1.250000	1.400000	1.250000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	35.00000
Delta/phi ratio	0.67000
Factored friction angle between the foundation and soil	19.60156
Allowable sub-grade cohesion (unfactored) [kN/m²]	0.00000
Cw/C ratio	0.67000
Factored adhesion between the foundation and soil [kN/m²]	0.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Over	0.10000	7.00000	0.00000	-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors Overall Bending	Partial Factors Bearing
Surcharge	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

Name	Shape	Location	Offset	Width	Level	Perpendicular Segment Length
			[m]	[m]	[m]	Length [m]

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-0.17280	0.00000	0.00000
3	-2.00000	12.03760	0.00000
4	-2.00000	8.17200	0.00000
5	-2.70000	11.03220	0.00000
6	-3.60000	12.66660	9.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	0.00000	8.00000
2	-3.60000	5.34400	9.00000

Component forces

Component	Normal Force	Parallel Force	Moment
	[kN/m]	[kN/m]	[kNm/m]
Weight of wall	62.64000	0.00000	76.78800
Weight of soil	207.36000	0.00000	435.45600
Weight of water	0.00000	0.00000	0.00000
Load on wall	136.50000	0.00000	532.35000
Load behind wall	0.00000	0.00000	0.00000
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	1.75257	0.00000	6.83502
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-0.09515	0.00000	0.00000
Soil pressure on virtual back	0.00000	-28.38349	-37.26807
Soil pressure on virtual front	0.00000	0.26720	0.00891
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-4.05000	-1.21500
Water pressure on front	0.00000	4.05000	1.21500
Water pressure under base	-35.10000	0.00000	-68.44500
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	373.05742	-28.11629	945.72486

Sliding Check

Sliding resistance [kN]	132.85125
Sum of disturbing forces [kN]	-32.43349
Sum of restoring forces [kN]	137.16845
Sliding factor of safety	4.22922

Overturning Check

Sum of disturbing moments [kNm/m]	-106.92807
Sum of restoring moments [kNm/m]	1052.65293
Overturning factor of safety	9.84450

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.60000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.20000
1	0.00000	0.30000
2	0.30000	0.30000
3	0.30000	-3.20000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-3.60000
1	0.00000	-3.20000
2	3.90000	-3.20000
3	3.90000	-3.60000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
SLS	1.000000/ 1.000000	1.000000/ 1.000000	1.000000	1.000000	1.000000	1.000000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	0.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.62000
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-2.0	Made Ground - Cohesive
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	35.00000
Delta/phi ratio	0.67000
Factored friction angle between the foundation and soil	23.45000
Allowable sub-grade cohesion (unfactored) [kN/m²]	0.00000
Cw/C ratio	0.67000
Factored adhesion between the foundation and soil [kN/m²]	0.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Over	0.10000	7.00000	0.00000	-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors Overall	Partial Factors Bearing	Partial Factors Bending
Surcharge	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable	Unfavourable

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Length [m]	Segment Length

RESULTS

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-0.21600	0.00000	0.00000
3	-2.00000	11.75300	0.00000
4	-2.00000	8.17200	0.00000
5	-2.70000	11.03220	0.00000
6	-3.60000	12.66660	9.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	0.00000	8.00000
2	-3.60000	5.34400	9.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	62.64000	0.00000	76.78800
Weight of soil	207.36000	0.00000	435.45600
Weight of water	0.00000	0.00000	0.00000
Load on wall	105.00000	0.00000	409.50000
Load behind wall	0.00000	0.00000	0.00000
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	2.13476	0.00000	8.32558
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-0.11590	0.00000	0.00000
Soil pressure on virtual back	0.00000	-27.86961	-35.98192
Soil pressure on virtual front	0.00000	0.26720	0.00891
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-4.05000	-1.21500
Water pressure on front	0.00000	4.05000	1.21500
Water pressure under base	-35.10000	0.00000	-68.44500
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	341.91886	-27.60241	825.65156

Sliding Check

Sliding resistance [kN]	148.31589
Sum of disturbing forces [kN]	-31.91961
Sum of restoring forces [kN]	152.63309
Sliding factor of safety	4.78180

Overturning Check

Sum of disturbing moments [kNm/m]	-105.64192
Sum of restoring moments [kNm/m]	931.29348
Overturning factor of safety	8.81557

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.60000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.20000
1	0.00000	0.30000
2	0.30000	0.30000
3	0.30000	-3.20000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-3.60000
1	0.00000	-3.20000
2	3.90000	-3.20000
3	3.90000	-3.60000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
BS EN 1997-1:2011 DA1-2	0.000000/ 1.300000	1.000000/ 1.000000	1.000000	1.250000	1.400000	1.250000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Backfill	User Specified	Drained	20.	20.	30.00000	0.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	35.
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Backfill	0.00000	0.0	0.67000	0.67	0.28300	0.00000	4.70100	0.00000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Backfill	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-3.6	Backfill
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	35.00000
Delta/phi ratio	0.67000
Factored friction angle between the foundation and soil	19.60156
Allowable sub-grade cohesion (unfactored) [kN/m²]	0.00000
Cw/C ratio	0.67000
Factored adhesion between the foundation and soil [kN/m²]	0.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Over	0.10000	7.00000	0.00000	-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors Overall	Partial Factors Bearing	Partial Factors Bending
Surcharge	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable	Unfavourable

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

Name	Shape	Location	Offset	Width	Level	Perpendicular Length	Segment Length
			[m]	[m]	[m]	[m]	

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-2.70000	15.28200	0.00000
3	-3.60000	17.82900	9.00000
4	-3.60000	14.30100	9.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	0.00000	8.00000
2	-3.60000	5.34400	9.00000

Component forces

Component	Normal Force	Parallel Force	Moment
	[kN/m]	[kN/m]	[kNm/m]
Weight of wall	62.64000	0.00000	76.78800
Weight of soil	230.40000	0.00000	483.84000
Weight of water	0.00000	0.00000	0.00000
Load on wall	136.50000	0.00000	532.35000
Load behind wall	0.00000	0.00000	0.00000
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	2.05986	0.00000	8.03347
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-1.97115	0.00000	0.00000
Soil pressure on virtual back	0.00000	-35.53065	-43.66831
Soil pressure on virtual front	0.00000	0.26720	0.00891
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-4.05000	-1.21500
Water pressure on front	0.00000	4.05000	1.21500
Water pressure under base	-35.10000	0.00000	-68.44500
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	394.52871	-35.26345	988.90707

Sliding Check

Sliding resistance [kN]	140.49750
Sum of disturbing forces [kN]	-39.58065
Sum of restoring forces [kN]	144.81470
Sliding factor of safety	3.65872

Overturning Check

Sum of disturbing moments [kNm/m]	-113.32831
Sum of restoring moments [kNm/m]	1102.23538
Overturning factor of safety	9.72604

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.60000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.20000
1	0.00000	0.30000
2	0.30000	0.30000
3	0.30000	-3.20000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-3.60000
1	0.00000	-3.20000
2	3.90000	-3.20000
3	3.90000	-3.60000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
SLS	1.000000/ 1.000000	1.000000/ 1.000000	1.000000	1.000000	1.000000	1.000000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Backfill	User Specified	Drained	20.	20.	30.00000	0.0
2	Made Ground - Granular	User Specified	Drained	18.	18.	35.00000	35.
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Backfill	0.00000	0.0	0.67000	0.67	0.28300	0.00000	4.70100	0.00000
2	Made Ground - Granular	0.00000	0.0	0.67000	0.67	0.22700	0.00000	6.68000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Backfill	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
2	Made Ground - Granular	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-3.6	Backfill
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Granular
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	35.00000
Delta/phi ratio	0.67000
Factored friction angle between the foundation and soil	23.45000
Allowable sub-grade cohesion (unfactored) [kN/m²]	0.00000
Cw/C ratio	0.67000
Factored adhesion between the foundation and soil [kN/m²]	0.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Over	0.10000	7.00000	0.00000	-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors Overall	Partial Factors Bearing Bending
Surcharge	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable Unfavourable

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

Name	Shape	Location	Offset	Width	Level	Perpendicular Segment Length
			[m]	[m]	[m]	Length [m]

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	0.00000	0.00000	0.00000
2	-2.70000	15.28200	0.00000
3	-3.60000	17.82900	9.00000
4	-3.60000	14.30100	9.00000

Pressures on virtual front surface

Interface	Level	Soil Effective Pressure	Water Pressure
	[mOD]	[kN/m²]	[kN/m²]
1	-3.50000	0.00000	8.00000
2	-3.60000	5.34400	9.00000

Component forces

Component	Normal Force	Parallel Force	Moment
	[kN/m]	[kN/m]	[kNm/m]
Weight of wall	62.64000	0.00000	76.78800
Weight of soil	230.40000	0.00000	483.84000
Weight of water	0.00000	0.00000	0.00000
Load on wall	105.00000	0.00000	409.50000
Load behind wall	0.00000	0.00000	0.00000
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	2.52695	0.00000	9.85509
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-2.46090	0.00000	0.00000
Soil pressure on virtual back	0.00000	-35.53065	-43.66831
Soil pressure on virtual front	0.00000	0.26720	0.00891
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-4.05000	-1.21500
Water pressure on front	0.00000	4.05000	1.21500
Water pressure under base	-35.10000	0.00000	-68.44500
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	363.00604	-35.26345	867.87869

Sliding Check

Sliding resistance [kN]	157.46298
Sum of disturbing forces [kN]	-39.58065
Sum of restoring forces [kN]	161.78018
Sliding factor of safety	4.08736

Overturning Check

Sum of disturbing moments [kNm/m]	-113.32831
Sum of restoring moments [kNm/m]	981.20700
Overturning factor of safety	8.65809

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.60000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.20000
1	0.00000	0.30000
2	0.30000	0.30000
3	0.30000	-3.20000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-3.60000
1	0.00000	-3.20000
2	3.90000	-3.20000
3	3.90000	-3.60000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
BS EN 1997-1:2011 DA1-2	0.000000/ 1.300000	1.000000/ 1.000000	1.000000	1.250000	1.400000	1.250000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Backfill	User Specified	Drained	20.	20.	30.00000	0.0
2	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Backfill	0.00000	0.0	0.67000	0.67	0.28300	0.00000	4.70100	0.00000
2	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Backfill	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
2	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-3.6	Backfill
2	-5.5	Made Ground - Cohesive
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Cohesive
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	50.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	17.85714

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Over	0.10000	7.00000	0.00000	-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors Overall	Partial Factors Bearing Bending
Surcharge	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable Unfavourable

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Length [m]	Segment Length

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-2.70000	15.28200	0.00000
3	-3.60000	17.82900	9.00000
4	-3.60000	21.91960	9.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	4.03200	8.00000
2	-3.60000	6.62720	9.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	62.64000	0.00000	76.78800
Weight of soil	230.40000	0.00000	483.84000
Weight of water	0.00000	0.00000	0.00000
Load on wall	136.50000	0.00000	532.35000
Load behind wall	0.00000	0.00000	0.00000
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	2.05986	0.00000	8.03346
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-0.17797	0.00000	0.00000
Soil pressure on virtual back	0.00000	-35.53065	-43.66831
Soil pressure on virtual front	0.00000	0.53296	0.02449
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-4.05000	-1.21500
Water pressure on front	0.00000	4.05000	1.21500
Water pressure under base	-35.10000	0.00000	-68.44500
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	396.32189	-34.99769	988.92264

Sliding Check

Sliding resistance [kN]	50.16960
Sum of disturbing forces [kN]	-39.58065
Sum of restoring forces [kN]	54.75256
Sliding factor of safety	1.38332

Overturning Check

Sum of disturbing moments [kNm/m]	-113.32831
Sum of restoring moments [kNm/m]	1102.25095
Overturning factor of safety	9.72617

WALL GEOMETRY

Ground level

Level behind wall[mOD]	0.00000
Ground inclination at the back of wall[deg]	0.00000
Ground inclination at the front of wall[deg]	0.00000
Average ground level across toe width[mOD]	-3.60000
Level in front of wall at the toe[mOD]	-3.50000

Wall stem

Point	X [m]	Y [m]
0	0.00000	-3.20000
1	0.00000	0.30000
2	0.30000	0.30000
3	0.30000	-3.20000

Wall Base

Point	X [m]	Y [m]
0	0.00000	-3.60000
1	0.00000	-3.20000
2	3.90000	-3.20000
3	3.90000	-3.60000

Wall material

Unit weight of wall[kN/m³]	24.00000

PARTIAL FACTORS

Partial Factor Set	Variable Load (Rest./Dist.)	Permanent Load (Rest./Dist.)	Unit Weight	Drained Cohesion	Undrained Cohesion	Shear Angle
SLS	1.000000/ 1.000000	1.000000/ 1.000000	1.000000	1.000000	1.000000	1.000000

MATERIAL PROPERTIES

General

No.	Description	Earth Pressures	Drained/ Undrained	Bulk Unit Weight Above GWL [kN/m³]	Bulk Unit Weight Below GWL [kN/m³]	Strength Parameters Phi' [°]	Strength Parameters c' [kN/m²]
1	Backfill	User Specified	Drained	20.	20.	30.00000	0.0
2	Made Ground - Cohesive	User Specified	Drained	18.	18.	24.00000	1.0
3	London Clay - Cohesive	User Specified	Drained	20.	20.	25.00000	5.0

Overall stability related

No.	Description	Virtual-Boundary Delta/Phi Ratio	Virtual-Boundary Cw/C Ratio	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka	Coeff. Kac	Passive Kp	Coeff. Kpc
1	Backfill	0.00000	0.0	0.67000	0.67	0.28300	0.00000	4.70100	0.00000
2	Made Ground - Cohesive	0.00000	0.0	0.67000	0.67	0.36600	1.42300	3.24400	5.04000
3	London Clay - Cohesive	0.00000	0.0	0.67000	0.67	0.35100	1.39100	3.44000	5.22300

Bending moment calculations related

No.	Description	Soil / Wall Delta/Phi Ratio	Soil / Wall Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0
1	Backfill	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.42600
2	Made Ground - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	0.00000
3	London Clay - Cohesive	0.00000	0.0	0.00000	0.00000	0.00000	0.00000	1.00000

MATERIAL LAYERS

No.	Description	Soil / Wall Delta/Phi Ratio	Cw/C Ratio	Active Ka(w)	Coeff. Kac(w)	Passive Kp(w)	Coeff. Kpc(w)	At rest Coeff. K0

At back of wall

No	Base Level [mOD]	Description
1	-3.6	Backfill
2	-5.5	Made Ground - Cohesive
3	-15.	London Clay - Cohesive

At front of wall

No	Base Level [mOD]	Description
2	-5.5	Made Ground - Cohesive
3	-15.	London Clay - Cohesive

FOUNDATION PROPERTIES

Allowable sub-grade friction (unfactored) [deg]	0.00000
Delta/phi ratio	0.50000
Factored friction angle between the foundation and soil	0.00000
Allowable sub-grade cohesion (unfactored) [kN/m²]	50.00000
Cw/C ratio	0.50000
Factored adhesion between the foundation and soil [kN/m²]	25.00000

GROUNDWATER DATA

Back

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

Front

Unit weight of water [kN/m³] = 10.00

Level [mOD]	Pressure Overall Stability [kN/m²]	Bending Moment Calculations [kN/m²]
-2.7	0.0	0.0

SURFACE LOADING

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Segment Length [m]
Surcharge	Strip	Over	0.10000	7.00000	0.00000	-

Name	Vertical Load [kN/m]	Horizontal Load [kN/m]	Vertical Pressure [kPa]	Horizontal Pressure [kPa]	Load Type	Partial Factors Overall	Partial Factors Bearing	Partial Factors Bending
Surcharge	-	-	15.00000	0.00000	Variable	Unfavourable	Unfavourable	Unfavourable

ANALYSIS OPTIONS

Derivation of Bending Moment Calculations NOT included

RESULTS

Name	Shape	Location	Offset [m]	Width [m]	Level [m]	Perpendicular Length [m]	Segment Length

SOIL AND WATER PRESSURES FOR SLIDING/OVERTURNING CHECK

Pressures on virtual back surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	0.00000	0.00000	0.00000
2	-2.70000	15.28200	0.00000
3	-3.60000	17.82900	9.00000
4	-3.60000	21.63500	9.00000

Pressures on virtual front surface

Interface	Level [mOD]	Soil Effective Pressure [kN/m²]	Water Pressure [kN/m²]
1	-3.50000	5.04000	8.00000
2	-3.60000	7.63520	9.00000

Component forces

Component	Normal Force [kN/m]	Parallel Force [kN/m]	Moment [kNm/m]
Weight of wall	62.64000	0.00000	76.78800
Weight of soil	230.40000	0.00000	483.84000
Weight of water	0.00000	0.00000	0.00000
Load on wall	105.00000	0.00000	409.50000
Load behind wall	0.00000	0.00000	0.00000
Load in front of wall	0.00000	0.00000	0.00000
Shear on virtual back (excluding base)	0.00000	0.00000	0.00000
Shear on back of base	2.52694	0.00000	9.85508
Shear on virtual front (excluding base)	0.00000	0.00000	0.00000
Shear on front of base	-0.24969	0.00000	0.00000
Soil pressure on virtual back	0.00000	-35.53065	-43.66831
Soil pressure on virtual front	0.00000	0.63376	0.02953
Horizontal surchage on back	0.00000	0.00000	0.00000
Water pressure on back	0.00000	-4.05000	-1.21500
Water pressure on front	0.00000	4.05000	1.21500
Water pressure under base	-35.10000	0.00000	-68.44500
Anchor forces on wall	0.00000	0.00000	0.00000
Resultant	365.21726	-34.89689	867.89930

Sliding Check

Sliding resistance [kN]	76.18041
Sum of disturbing forces [kN]	-39.58065
Sum of restoring forces [kN]	80.86417
Sliding factor of safety	2.04302

Overturning Check

Sum of disturbing moments [kNm/m]	-113.32831
Sum of restoring moments [kNm/m]	981.22761
Overturning factor of safety	8.65827

APPENDIX E

Proposed Replacement RC Wall Checks (Slide2)

Project Summary

File Name:	Proposed Wall Check.slmd
Slide2 Modeler Version:	9.027
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	16/03/2023, 10:33:11

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
ULS2 - Backfill 1	Master Scenario	Bishop Simplified: 1.145270	00h:00m:00.824s
SLS - Backfill 1	Master Scenario	Bishop Simplified: 1.519300	00h:00m:00.734s
ULS2 - Backfill 2	Master Scenario	Bishop Simplified: 1.204970	00h:00m:00.850s
SLS - Backill 2	Master Scenario	Bishop Simplified: 1.548020	00h:00m:00.848s
ULS2 - Sensitivity Check	Master Scenario	Bishop Simplified: 1.014920	00h:00m:00.788s
SLS - Sensitivity Check	Master Scenario	Bishop Simplified: 1.325470	00h:00m:00.851s

General Settings

Units of Measurement:	Metric Units
Time Units:	days
Permeability Units:	meters/second
Data Output:	Standard
Failure Direction:	Right to Left

Design Standard

ULS2 - Backfill 1

Selected Type:	Eurocode 7 - Design Approach 1, Combination 2
Type	**Partial Factor**
Permanent Actions: Unfavourable	1
Permanent Actions: Favourable	1
Variable Actions: Unfavourable	1.3
Variable Actions: Favourable	0
Effective cohesion	1.25
Coefficient of shearing resistance	1.25
Undrained strength	1.4
Weight density	1
Shear strength (other models)	1.25
Earth resistance	1
Tensile and plate strength	1.1
Shear strength	1.1
Compressive strength	1.1
Bond strength	1.1
Seismic Coefficient	1

ULS2 - Backfill 2

Selected Type:	Eurocode 7 - Design Approach 1, Combination 2
Type	**Partial Factor**
Permanent Actions: Unfavourable	1
Permanent Actions: Favourable	1
Variable Actions: Unfavourable	1.3
Variable Actions: Favourable	0
Effective cohesion	1.25
Coefficient of shearing resistance	1.25
Undrained strength	1.4
Weight density	1
Shear strength (other models)	1.25
Earth resistance	1
Tensile and plate strength	1.1
Shear strength	1.1
Compressive strength	1.1
Bond strength	1.1
Seismic Coefficient	1

ULS2 - Sensitivity Check

Selected Type: Eurocode 7 - Design Approach 1, Combination 2

Type	Partial Factor
Permanent Actions: Unfavourable	1
Permanent Actions: Favourable	1
Variable Actions: Unfavourable	1.3
Variable Actions: Favourable	0
Effective cohesion	1.25
Coefficient of shearing resistance	1.25
Undrained strength	1.4
Weight density	1
Shear strength (other models)	1.25
Earth resistance	1
Tensile and plate strength	1.1
Shear strength	1.1
Compressive strength	1.1
Bond strength	1.1
Seismic Coefficient	1

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [kN/m3]:	9.81
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [kPa]:	0
Advanced Groundwater Method:	None

Random Numbers

All Open Scenarios

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

All Open Scenarios

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

All Open Scenarios

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

ULS2 - Backfill 1

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical
Load Action:	Variable

SLS - Backfill 1

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical

ULS2 - Backfill 2

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical
Load Action:	Variable

SLS - Backill 2

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical

ULS2 - Sensitivity Check

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical
Load Action:	Variable

SLS - Sensitivity Check

Distribution:	Constant
Magnitude [kPa]:	15
Orientation:	Vertical

Materials

Made Ground - Cohesive	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	18
Cohesion [kPa]	1
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Hu Value	1
Made Ground Granular	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	18
Cohesion [kPa]	0
Friction Angle [deg]	35
Water Surface	Assigned per scenario
Hu Value	1
London Clay Cohesive	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	20
Cohesion [kPa]	5
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Hu Value	1
Concrete	
Color	
Strength Type	Infinite strength
Unit Weight [kN/m3]	24
Allow Sliding Along Boundary	Yes
Water Surface	Assigned per scenario
Hu Value	0
Ru Value	0
Backfill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	20
Cohesion [kPa]	0
Friction Angle [deg]	30
Water Surface	Assigned per scenario
Hu Value	1
Made Ground - Cohesive (Subgrade check)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [kN/m3]	18
Cohesion [kPa]	1
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Hu Value	1

Materials In Use

Material	ULS2 - Backfill 1	SLS - Backfill 1	ULS2 - Backfill 2	SLS - Backill 2	ULS2 - Sensitivity Check	SLS - Sensitivity Check
Made Ground - Cohesive	✓	✓	✗	✗	✗	✗
Made Ground Granular	✓	✓	✓	✓	✗	✗
London Clay Cohesive	✓	✓	✓	✓	✓	✓
Concrete	✓	✓	✓	✓	✓	✓
Backfill	✗	✗	✓	✓	✓	✓
Made Ground - Cohesive (Subgrade check)	✗	✗	✗	✗	✓	✓

Global Minimums

ULS2 - Backfill 1

Method: bishop simplified

FS	1.145270
Center:	9.800, 8.182
Radius:	0.114
Left Slip Surface Endpoint:	9.699, 8.130
Right Slip Surface Endpoint:	9.901, 8.130
Resisting Moment:	0.114583 kN-m
Driving Moment:	0.100049 kN-m
Total Slice Area:	0.00897845 m2
Surface Horizontal Width:	0.202597 m
Surface Average Height:	0.0443167 m

SLS - Backfill 1

Method: bishop simplified

FS	1.519300
Center:	9.254, 8.477
Radius:	0.896
Left Slip Surface Endpoint:	8.691, 7.780
Right Slip Surface Endpoint:	10.081, 8.130
Left Slope Intercept:	8.691 7.860
Right Slope Intercept:	10.081 8.130
Resisting Moment:	10.0639 kN-m
Driving Moment:	6.62404 kN-m
Total Slice Area:	0.443724 m2
Surface Horizontal Width:	1.3902 m
Surface Average Height:	0.31918 m

ULS2 - Backfill 2

Method: bishop simplified

FS	1.204970
Center:	9.952, 8.204
Radius:	0.125
Left Slip Surface Endpoint:	9.850, 8.130
Right Slip Surface Endpoint:	10.053, 8.130
Resisting Moment:	0.120516 kN-m
Driving Moment:	0.100016 kN-m
Total Slice Area:	0.00731466 m2
Surface Horizontal Width:	0.202564 m
Surface Average Height:	0.0361104 m

SLS - Backill 2

Method: bishop simplified

FS	1.548020
Center:	9.251, 8.478
Radius:	0.899
Left Slip Surface Endpoint:	8.684, 7.780
Right Slip Surface Endpoint:	10.079, 8.130
Left Slope Intercept:	8.684 7.860
Right Slope Intercept:	10.079 8.130
Resisting Moment:	10.5779 kN-m
Driving Moment:	6.83317 kN-m
Total Slice Area:	0.445704 m2
Surface Horizontal Width:	1.39542 m
Surface Average Height:	0.319405 m

ULS2 - Sensitivity Check

Method: bishop simplified

FS	1.014920
Center:	9.286, 8.471
Radius:	0.885
Left Slip Surface Endpoint:	8.734, 7.780
Right Slip Surface Endpoint:	10.103, 8.130
Left Slope Intercept:	8.734 7.860
Right Slope Intercept:	10.103 8.130
Resisting Moment:	8.26143 kN-m
Driving Moment:	8.14001 kN-m
Total Slice Area:	0.440125 m2
Surface Horizontal Width:	1.36868 m
Surface Average Height:	0.321568 m

SLS - Sensitivity Check

Method: bishop simplified

FS	1.325470
Center:	9.279, 8.476
Radius:	0.895
Left Slip Surface Endpoint:	8.716, 7.780
Right Slip Surface Endpoint:	10.105, 8.130
Left Slope Intercept:	8.716 7.860
Right Slope Intercept:	10.105 8.130
Resisting Moment:	9.00789 kN-m
Driving Moment:	6.79602 kN-m
Total Slice Area:	0.449504 m2
Surface Horizontal Width:	1.38854 m
Surface Average Height:	0.323723 m

APPENDIX F

Bearing Capacity Checks

Bearing Capacity Check

Job Number	Job Name	Designer	Checked
CG/39507	Crown Trading Centre, Clayton Road, Hayes	IGO	JMS

Bearing Capacity Calculation

Subgrade type	*Soil Parameters*		*Footing Dimensions*	
Cohesive	Cu(kPa)	110	B(m)	1.7
	γ(kN/m3)	20	L(m)	1
			Depth(mbgl)	6

Factors

Nc	5.14	sc	1.34	*Inclination factors not applied, assumes loads vertical on a level piling mat.*
Nγ	0.00	sγ	0.49	
Nq	1.00	sq	1	

BEARING CAPACITY

qa(kPa)	**295**	*Allowable bearing capacity (factored)*
FoS	**3**	*Factor of Safety*

LOADING

qf	295	*Average bearing stress at underside of existing wall (kPa)*

CHECK Acceptable

Bearing Capacity Check

Job Number	Job Name	Designer	Checked
CG/39507	Crown Trading Centre, Clayton Road, Hayes	IGO	JMS

Bearing Capacity Calculation

Subgrade type	*Soil Parameters*		*Footing Dimensions*	
Cohesive	Cu(kPa)	110	B(m)	1.7
	γ(kN/m3)	20	L(m)	1
			Depth(mbgl)	6

Factors

Nc	5.14	sc	1.34	*Inclination factors not applied, assumes loads vertical on a level piling mat.*
Nγ	0.00	sγ	0.49	
Nq	1.00	sq	1	

BEARING CAPACITY

qa(kPa)	**399**	*Allowable bearing capacity (factored)*
FoS	**2**	*Factor of Safety*

LOADING

qf	390	*Peak bearing stress at underside of existing wall (kPa)*

CHECK Acceptable

Bearing Capacity Check

Job Number	Job Name	Designer	Checked
CG/39507	Crown Trading Centre, Clayton Road, Hayes	IGO	JMS

Bearing Capacity Calculation

Subgrade type	*Soil Parameters*		*Footing Dimensions*	
Granular	c'(kPa)	0	B(m)	3.6
	γ(kN/m3)	10	L(m)	1
	ϕ	35	Depth(mbgl)	0.4

Factors

Nc	46.12	sc	3.12881093	*Inclination factors not applied, assumes loads vertical on a level piling mat.*
Nγ	45.23	sγ	-0.08	
Nq	33.30	sq	3.06487517	

BEARING CAPACITY

qa(kPa)	**114**	*Allowable bearing capacity (factored)*
FoS	**3**	*Factor of Safety*

LOADING

qf	40	*Net bearing stress at underside of existing wall (kPa)*

CHECK Acceptable

Bearing Capacity Check

Job Number	Job Name	Designer	Checked
CG/39507	Crown Trading Centre, Clayton Road, Hayes	IGO	JMS

Bearing Capacity Calculation

Subgrade type	*Soil Parameters*		*Footing Dimensions*	
Cohesive	Cu(kPa)	30	B(m)	3.6
	γ(kN/m3)	18	L(m)	1
			Depth(mbgl)	0.4

Factors

Nc	5.14	sc	1.72	*Inclination factors not applied, assumes loads vertical on a level piling mat.*
Nγ	0.00	sγ	-0.08	
Nq	1.00	sq	1	

BEARING CAPACITY

qa(kPa)	**91**	*Allowable bearing capacity (factored)*
FoS	**3**	*Factor of Safety*

LOADING

qf	40	*Net bearing stress at underside of existing wall (kPa)*

CHECK Acceptable