46 Avenue Road

Basement Impact Assessment

by **RKD Consultant Ltd.**
On Behalf of :

Edge Structures

Issued: Rev05: **02nd** July **2014**

4th floor
Wigham House
16-30 Wakering Road
Barking
IG11 8QN

Tel: 020- 8591 9747
Fax: 020- 8594 1331

46 Avenue Road

Basement Impact Assessment

Table of Contents

Issued at Rev05, 2rd July 2014: To address a new Planning Application for the same Engineering Proposals as previous but with updated understanding of current base conditions.

RKD Consultant Ltd. note that this report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

1. Purpose and Planning Policy Context

As part of the current Camden Local Development Framework (November 2010), there is an obligation on Developers to address the potential impacts of new basement designs with respect to (i) surface water flooding, (ii) subterranean groundwater flow and (iii) ground stability. A screening process is presented in the Camden Planning Guidance[1] that identifies whether further examination of these issues are required. Such examination is also required to address design mitigation of potential impacts and as may be required. This report articulates all this work in the form of a Basement Impact Assessment (BIA) that is specific to the design proposals and the Site.

This BIA report is the latest part in a sequence of work on the design proposals. The Proposals have been presented previously (in 2011, April 2014) and are re-presented here on account of some minor changes to the existing baseline condition such as single basement excavation and two additional light well area. The key alteration to the existing condition since 2011 is that there had been a swimming pool present in the Garden area up until recently and during the period of Site Investigation. The base and sides of this pool have been broken out and the whole backfilled. Consideration is given to this in this report. Note that the swimming pool appears in the base photograph in figure 2a and may be ignored. Figure 7 also shows its historic location in area D.

Prior to the presenting of this BIA report there has been a Desk Study including a draft conceptual ground model and scoping of intrusive Site Investigation (SI); and then SI work leading to a factual report. Relevant interpretation of the SI and revision of the conceptual model is made as part of this report.

The early Sections of this report, Sections 2 to 7, describe the existing site, the new design proposals and then the existing conditions in relation to water, groundwater and the ground. Screening flowchart as per CPG4 has been summarised in Tables 2, 3 & 4 in appendix A. **Sections 8, 9 and 10 provide the concluding Basement Impact Assessment with respect to the three requirements mentioned above.**

This report has been prepared by Adam Pellew MSc PhD CEng MICE on behalf of RKD Consultant Limited and on instruction from Edge Structures Limited and specifically as part of a preparatory process leading to planning submission and development of the Site of 46 Avenue Road and to the drawings identified here. It is not designed to be used for other purposes.

2. The Existing Site, Location and Property

The Site address is 46 Avenue Road, London, NW8 6HS – refer to Figure 1 and Figure 2. For the purpose of this report, the Site North is defined upwards just skewed left from the orientation of the main building as shown in Figure 1.

The Site is located in a residential area with neighbouring houses; No. 44 south-east of the Site and No. 48 north-west of the Site. The Site faces Norfolk Road directly opposite, with roads; Queen's

[1] Current published document: Camden Planning Guidance 4 – Basement and Lightwells, September 2013. Within the CLD Framework, DP27 on Basements and Lightwells is highlighted as being a principle document.

Grove, Elsworthy Road, Acacia Road and Radlett Place found within a 130m radius of the Site and off Avenue Road. Primrose Hill is behind the Site and Regents Park is approximately 600m away.

Currently, 46 Avenue Road is a four storey house comprising; a part basement, ground, first and second floors with a hard standing area for vehicles in front of the house. The rear garden of the property is extensively grassed over with a single storey summer house set back from the house.

Architectural plans that show the existing property are shown on BB Partnership Ltd drawing FFS-101.

3. Description of Proposed Development

The proposed development works involves new accommodation provided at the basement level. The basement is to be extended over the footprint of the house whilst retaining the existing part basement. See BB Partnership drawing FFS-104.

At the rear of the house, beneath the garden, a two storey basement is proposed that would accommodate a swimming pool, changing room facilities and pool plant equipment with access to the house. See BB Partnership drawing FFS-105.

The summer house at the far end of the garden is to be demolished and rebuilt with a spiral staircase providing access to the new basement. See BB Partnership drawings FFS-106 and FFS-107. The depth of the new single storey basement will be approximately 6.45m below ground level.

4. Topography

The Desk Study has revealed that the ground which the Site sits on appears to be near a junction where two downward slopes occur. This may be near the convergence of two old river valleys which was part of an old river tributary, the River Tyburn and as further described in Section 6 below. From the North-East down to the South-West across the Site, the ground level varies between 46.6m and 44.5m with a gradient of approximately 2.1% (1.2º). From North-West down to South East, the ground level varies from 44.5m and 42.8m with a gradient of approximately 1.8% (1.0º). Ground is therefore tending to slope slightly in both directions, although within the property itself the ground levels have been adjusted further and the garden exists at approximately 2 levels [43.4mOD (BH2) and 44.0mOD (BH3)] and a slope of around 5.1% (2.9º) from the entrance to the face of the building.

Further examination of the gradients has been specifically assessed visually and as far as practicable for a distance of a few 10s of metres away from the site and from the garden wall boundaries. There are no large gradients visible. The garden that backs onto the rear garden wall (north-east), appears to slope gently upwards away from the Site at the largest of the local gradients. Inspection of the publicly available ground contours together with the existing Site Survey plan would suggest that this slope is approximately 6.3% (3.6 º).

5. Geology & Ground Conditions

5.1. Setting

The Desk Study work examined 1:10 000 scale geological maps from the 1920s to present day[2]; Camden Geological, Hydrogeological & Hydrological study[3]; and nearby historic boreholes available through the BGS[4]. However, the nearest available historic boreholes were more than 400m away from the Site which limited their validity. The geological maps showed that the Site sits on the near-surface or out-cropping soil layer of London Clay formation and the thickness of this stratum locally may be between 70 and 100m deep.

The SI was designed with three boreholes to provide coverage across the length and width of the Site. The investigation revealed that the Clay was very close to the surface and so borehole cores obtained were taken back to the laboratory and logged by an engineering geologist and specifically with a view to looking for features of fabric in the Clay such as sand lenses that might indicate higher than usual permeability within the depth of the proposed basement.

It is noted also that all the boreholes terminated in the London Clay horizon and the local stratum thickness was unproven.

5.2. Site Investigation Observations

Boreholes BH2 and BH3 were carried out in the garden area where the proposed 2 level basement is located. BH2, at the level of the former swimming pool and proposed new basement ground finished level, showed the Clay to start at 0.95m depth with the bulk of the material above this being clayey Made Ground. BH3, at the raised garden level behind or north-east of the former swimming pool and approximately 0.6m higher, showed the London Clay to occur within 0.5m of ground level. These results confirm that the London Clay out-crops locally and the laboratory strength and index tests are all consistent with this observation.

The soil descriptions for BH2 & BH3 indicate some evidence of weathering of the London Clay but not heavily so. These boreholes showed the London Clay fabric to have occasional or rare pockets of silt, but neither any lenses nor partings of silt or sand or any extensive fissuring within the zone occupied by the proposed basement depth. This supports the view that there is no significant raised horizontal permeability (k) to the London Clay which would allow mobile groundwater and this is then supported by subsequent observations as described below.

Borehole BH1 was carried out at the front of the Site near Avenue Road itself and a 1.1m zone of Made Ground was indicated here over a 1.4m thickness of Clay that may be geologically re-worked[5] London Clay overlying the Stiff London Clay. Here the Stiff London Clay is described as closely fissured which contrasts with the other boreholes. However the fissures show some gleying

---

[2] Obtained through GroundSure Environmental Insight, [http://www.groundsure.com] and 1920's map scale at 1":1mile.

[3] London Borough of Camden, Camden Geological, Hydrogeological & Hydrological study, Guidance for subterranean development, Issue 01, November 2010.

[4] BGS – British Geological Survey, [http://www.bgs.ac.uk/geoindex/home.html]

[5] i.e. subject to some geological Mass Transport.

along old rootlet tracks and this is evidence of a currently non-aerobic environment[6]. Such an environment would not be consistent with present day groundwater moving at anything other than very slow velocities. The overlying re-worked London Clay does not appear to have fabric features that would indicate uncharacteristically high permeability and this supports the view that this layer is relatively widespread and inhibits surface water infiltration to the Stiff fissured Clay beneath. So again, the borehole observations for the London Clay are consistent with there being no mobile groundwater.

With respect to the Garden area of the Site (BH2 & BH3), it may be reasonably inferred that the ground level has been reduced historically and cut into the London Clay at least towards the north-east end of the proposed new basement area. Also, the London Clay fabric is not especially open or fractured or otherwise contains features that would lead to its permeability being higher than is generally characteristic for the London Clay. No unequivocally clear evidence for alluvial deposits was found in the investigation and the small amounts of gravel at the surface may very likely be associated with the existing swimming pool or summerhouse construction.

The evidence from the SI would tend to suggest that the historic tributary(s) of the Tyburn river that have been identified locally did not pass through the location of the proposed basement for the Site. Although Avenue Road itself may locally have been a palaeo-watercourse, the adjacent ground just within the Site would appear to have London Clay close to the surface with no distinct alluvial deposits.

6. Groundwater

6.1. Setting

From Camden's Geological Study[7] – Watercourses of lost rivers in London, see Figure 3, shows that two old tributaries part of the River Tyburn existed; one tributary passing near the Site and the other on the west side of the site, later the two tributaries converging together, flowing towards the Lake in Regent's Park and then southwards towards the Thames. The 1920s geological map, see Figure 4, also shows the existence of the River Tyburn with its two tributaries, passing closely to the Site. However, there is conflicting information between the two sources; the 1920s geological map shows the river to be passing near the Site, whereas the Barton's – lost rivers map shows the river to pass slightly further east away from the site.

While the historic Tyburn river tributary is close to the Site, the Site Investigation evidence would support the fact of the Site itself not being crossed by a historic watercourse, supporting Barton's interpretation.

The Camden Aquifer Designation Map shows that the Site sits on an area where an outer source protection zone 2 exists, see Figure 5. A deep aquifer lies beneath but should not affect the proposed works as the aquifer is sandwiched between London Clay and Chalk which is deeply confined and well below the level of the proposed works. In addition, a program of aquifer

[6] Allowing the iron reduction process from the previously weathered state: $Fe^{3+} + e^{-} => Fe^{2+}$

[7] London Borough of Camden, Camden Geological, Hydrogeological & Hydrological study, Guidance for subterranean development, Issue 01, November 2010.

dewatering was put in place to control the groundwater level and by 2000 it was considered that the on-going program has stabilised the groundwater levels[8].

6.2. Site Investigation Observations

Borehole BH1 & BH3, at the front of the Site and the rear raised garden level, were bored dry into the London Clay. In borehole BH2 at the lower garden level water was found in the inspection pit at 0.7m depth below ground and this then stabilised at 0.62m depth. This is 330mm depth of water on the Clay and above the bottom of the Made Ground. A layer of pea shingle just beneath the topsoil was found in this area and it seems likely that the lower garden area picks up the rainwater runoff from the raised garden area in addition to its own infiltration. Actual volumes of water that can be stored in the lower garden area are likely to be small as the clayey Made Ground is both thin and would not provide extensive pore space.

Three standpipes were installed, one in each of the boreholes and all to similar levels between +34mOD to +35.4mOD consistent with the deepest basement level. Response zones were formed to close to ground level with sufficient grout beneath the surface to inhibit rainwater ingress as far as possible. The completed BH1 had a local surface relatively impermeable to surface water whereas BH2 and BH3 had permeable grass surrounds to the standpipe installations. Given that the standpipes proved to be located in relatively impermeable London Clay, it is likely that the results from BH2 and BH3 were affected by surface infiltration. The weather was generally wet both before and after the SI fieldwork.

The BH1 standpipe remained near dry on first reading one week after installation and supporting the expected insignificant water ingress from the London Clay horizon and even from the bottom of the Made Ground. The water level then rose 790mm over a 14 day period to the second reading. It is not considered that the groundwater level could have equalised from these combined observations. The calculation provided in Appendix A indicates a permeability $k \approx 10^{-10}$ m/s from these observations and broadly consistent with the characteristic low permeability of the London Clay and without the presence of horizontal layers of silts or sands that provide mobile groundwater. This is consistent with the earlier described observations.

The BH2 standpipe was filled with water to 0.54m depth on first reading and this is consistent with the top of the response zone penetrating the water-bearing Made Ground level and top-filling the standpipe via surface infiltration. The second reading is similar.

The BH3 standpipe held water to a depth of 4.75m on first reading. This is intermediate between the standpipe tip and ground level. The second reading showed a substantial filling of the standpipe to a depth of 0.8m. Again and as described this is considered to be a feature of surface infiltration from the surrounding grass into the installation from high level.

[8] London Borough of Camden, Camden Geological, Hydrogeological & Hydrological study, Guidance for subterranean development, Issue 01, November 2010.

7. Conceptual Geotechnical Ground Model

Following the Site Investigation the Conceptual Geotechnical Ground Model key features are revised and summarised as follows:

- Made ground (with top soil) exists generally up to approximately 1m depth with variable depth across the site and reflecting re-profiling of the Site levels. Otherwise the London Clay extends up towards the surface and to sufficient depth for the purposes of the proposed new basement design;
- River Tyburn tributary(s) pass around the Site with no evidence found for crossing of the Site itself;
- Some weathering and geological reworking of the top of the London Clay but no evidence for higher than characteristic permeabilities for the London Clay from close inspection of the fabric or water observations;
- Groundwater levels are still probably high in the London Clay and the variation seen in the standpipes demonstrates the low permeability of the Clay rather than ambient and equalised pore pressures;

8. Surface Flow and Flooding: Evaluation & Recommendations

8.1. Flood Risk Assessment

Avenue Road is a street identified as a 'secondary' location with respect to surface water flooding and as given in "Camden Planning Guidance 4". As such it is a requirement to address Flood Risk Assessment in accordance with PPS25.

Following PPS25, the Site is within Zone 1 of the Environment Agency's flood risk categorisation which permits development in principle, though there remains a requirement to seek "to reduce the overall level of flood risk. Through the layout and form of the development, and the appropriate application of sustainable drainage techniques."

With respect to flood risk, the Environment Agency does not have any historic record of flooding of either the Site or Avenue Road. The Site is not in an area that benefits from flood defences.

The 1 in 200 year flood event for 6.5 hour rainfall duration has been simulated by JBA Consulting[9], using 5m topographical "cells" and this is re-produced here in Figure 6. In simulation, while Avenue Road itself floods and at depths of up to 1m maximum, most locations nearby and in front of the Site on Avenue road flood to less than 300mm, co-existent with significantly flowing water given the gradient in the road. The corresponding maximum flood level at the front Site boundary is estimated here at +43.2mOD and this is approximately 100mm higher than the existing minimum ground level across the entire Site and which occurs close to the front entrance off the pavement.

[9] Groundsure ltd have provided these simulations by Jeremy Benn Associates Ltd, 2008/2009. Strictly the requirement for flood risk protection for river flooding is a 1 in 100 year event for river flooding.

The areas with existing basement on the Site at present have ground levels higher than +43.2mOD and as a first step it is recommended that areas of proposed new basement continue to have ground level above this level. This is reflected in the current drawings as mentioned above.

The existing lower garden level, beneath which the new basement extension is proposed, has a level of approximately +43.4mOD and remains unflooded in simulation. The ground in this area has been characterised as Clay below a depth of 1m. This Clay has been shown to be demonstrably non-retentive of mobile water and therefore it is only the top 1m of the proposed basement development that would significantly influence any change in the local flood characteristics.

8.2. Surface Water Drainage

The new proposals do not increase the impermeable areas of the Site at surface level from the existing situation and given the poor infiltration characteristics of the London Clay, total quantities of surface runoff are not expected to change materially and attenuation characteristics should be moderately improved with the use of granular fill above the basement roof.

The proposed design incorporates a depth of approximately 800mm of granular fill beneath the restored topsoil which will assist in attenuating peak runoff rates. If the general groundwater level is at 0.62m depth as observed in the Site Investigation and following a wet period at that time, then this would leave a depth of approximately 350mm of 'dry' fill beneath the topsoil to attenuate surface water flow. Allowing for the void space in the fill, this might be equivalent to around 120mm of available free water depth that can be stored for the 411m^2 garden area that includes this design fill. This should be adequate attenuation for the design 1:100 year storm event and including for 30% climate change uplift.

The collected surface water from the granular fill will leave the rear garden area via pipework along the side of the house and then to the front drive area which is currently impermeable. Here additional granular fill provided beneath the granite setts of the drive will provide some relatively inefficient soakaway effect over the Clay and the residual collected water will leave the Site across this front boundary below surface level. Otherwise rainwater arriving on the surface of the granite setts will leave as at present over the surface of this boundary.

Certain existing impermeable Site surface areas and other relevant areas are given in table 1 below and these areas are illustrated in figure 7. Historically the Swimming Pool and adjacent paths and terrace (areas C and D) have been considered impermeable. These areas have now been broken out and the pool infilled such that the backfill material is relatively free-draining with respect to the intact London Clay. The effect of this has been to increase the available surface area of London Clay exposed to surface water runoff. Therefore the plan areas C and D are now considered to be permeable.

Table 1 is given to assist in assessing the change in the amount of available surface area of the top of the London Clay that occurs due to the new proposals and from the present baseline situation.

Area Reference	**Area Description**	**Area in m^2**
Existing Site Layout: Impermeable areas - A	Front Drive (gross to building frontage & boundaries)	205
B	Gardenside: Terrace (Veranda)	55
[C – now permeable]	Gardenside: Paths adjacent Pool & Terrace	[91]
[D – now permeable]	Gardenside: Swimming Pool	[41]
E	Gardenside: Summer House	35
F	Gardenside: Steps & Path adjacent Summer House	28
Proposed Site Layout: G	Gardenside: New Basement Plan (Net)	(480-34) 446
AA	Front Drive: Net area available for sub-surface drainage	173

Table 1: Existing impermeable Site areas and proposed key Site areas

The reduction in the London Clay surface area available to free water at or just below the ground surface and as a result of the proposals would then be equivalent to:

G - [B+E+F] - AA
= 446 – [55+26+37] – 173 = 155 m^2.

From this calculation it can be seen that the loss of the Clay surface from the new basement (G) is partly compensated for by the combined existing impermeable surfaces already in this area (B,E,F) and the contribution from the proposed free-draining layer in the front drive area (AA). As a result the final loss of Clay area is 155 m^2.

8.3. Design Requirements

It is recommended that the surface water drainage conditions may be suitably addressed, and in consideration of sustainable drainage techniques, by:

1) Ensure that the top 800m depth of new fill over the new basement roof consists of a free-draining fill overlain by topsoil to achieve the design levels. This will then preserve and potentially improve the existing surface water attenuation characteristics of the current layer of soil above the London Clay level. The perimeter of the basement will need to be either no higher than 800mm below ground level or detailed such as to prevent ponding in this zone;

2) Permit runoff to flow with the natural topography and in pipework at a high level from the garden side, and within the new free-draining layer, past the side of the structure and to the front drive side of the property;

3) Introduce a thin free-draining layer beneath the existing granite setts of the front drive to allow this extra water to drain further beneath the drive surface towards and beneath the adjacent Avenue Road pavement. The detail at the pavement boundary and with respect to the site services and the setts themselves within the property will need to be detailed appropriately;

4) The free-draining layer in the front drive will thereby provide replacement soakaway effect into the London Clay and in part mitigation for the lost new basement area in the garden, as demonstrated above. The soakaway effect is not expected to be efficient in either the existing or proposed states due to the low permeability of the London Clay;

5) All existing and new basement access points should be detailed with small upstands relative to local ground water level and to provide assurance against any potential transient water level rises, although good detailing generally should ensure that this does not occur. Such barriers will have a level of +43.55mOD minimum.

9. Subterranean Groundwater Flow: Evaluation

The investigation work detailed here demonstrates that the proposed new basement works extend into the London Clay that itself rises close to ground level. The Clay is shown to be substantially non-retentive of mobile groundwater and as such the proposed new basement works will not cause 'damming' action within this stratum.

The flow chart provided in "Camden Planning Guidance 4" is considered with respect to groundwater flow and it is noted that:

i) the Site is within 100m of an historic sub-surface watercourse;
ii) the groundwater regime has been examined through an SI that has included 3 exploratory holes;
iii) the Site is demonstrably on out-cropping London Clay;
iv) the London Clay has been examined to demonstrate its low permeability and lack of permeable horizons.

From these observations it may be concluded that 'no further hydrogeological assessment [is] required.'

10. Land Stability: Evaluation

The existing ground level gradients on and around the Site are not sufficiently large as to cause stability issues with the London Clay in either the short- or long-term and the proposed basement works do not alter these gradients. The most severe gradient away from the Site boundary occurs at the far north-eastern garden boundary and has been assessed at approximately 3.6° which is still comfortably less than geological residual slope angles for the London Clay.

There will be a need to retain the ground adequately during and after construction, for example using an embedded piled retaining wall and/or underpinning techniques. No new sloping ground surfaces are proposed as part of the proposed new works and except for the restoration of the existing very shallow sloping ground at the rear of the garden.

With respect to the effect of ground movements due to construction and on the neighbouring properties, a separate report has been prepared entitled "Ground Movement Assessment Report: New Basement Proposal" and this is included as part of this Basement Impact Assessment in Appendix B. This report specifically considers the adjoining properties of numbers 44 and 48 Avenue Road and the resulting Damage Categories arising in respect of these works are both given as (0) or 'negligible' together with the stated assumptions in the assessment.

The flow chart provided in "Camden Planning Guidance 4" is considered with respect to land stability issues and it is noted that:

i) the Site is within 100m of an historic sub-surface watercourse;
ii) the ground conditions have been examined through an SI that has included 3 exploratory holes;
iii) the Site is demonstrably on out-cropping London Clay;

The Site Investigation work undertaken and the examination provided here supports the view that the historic sub-surface watercourse identified passes away from the Site to the south and east. Land stability issues on the Site are not likely to be significant beyond what is usual for out-cropping London Clay.

In view of all the above, it may be concluded that 'no further assessment of land stability [is] required.'

46 Avenue Road,
London,
NW8 6HS

N
W
E
S

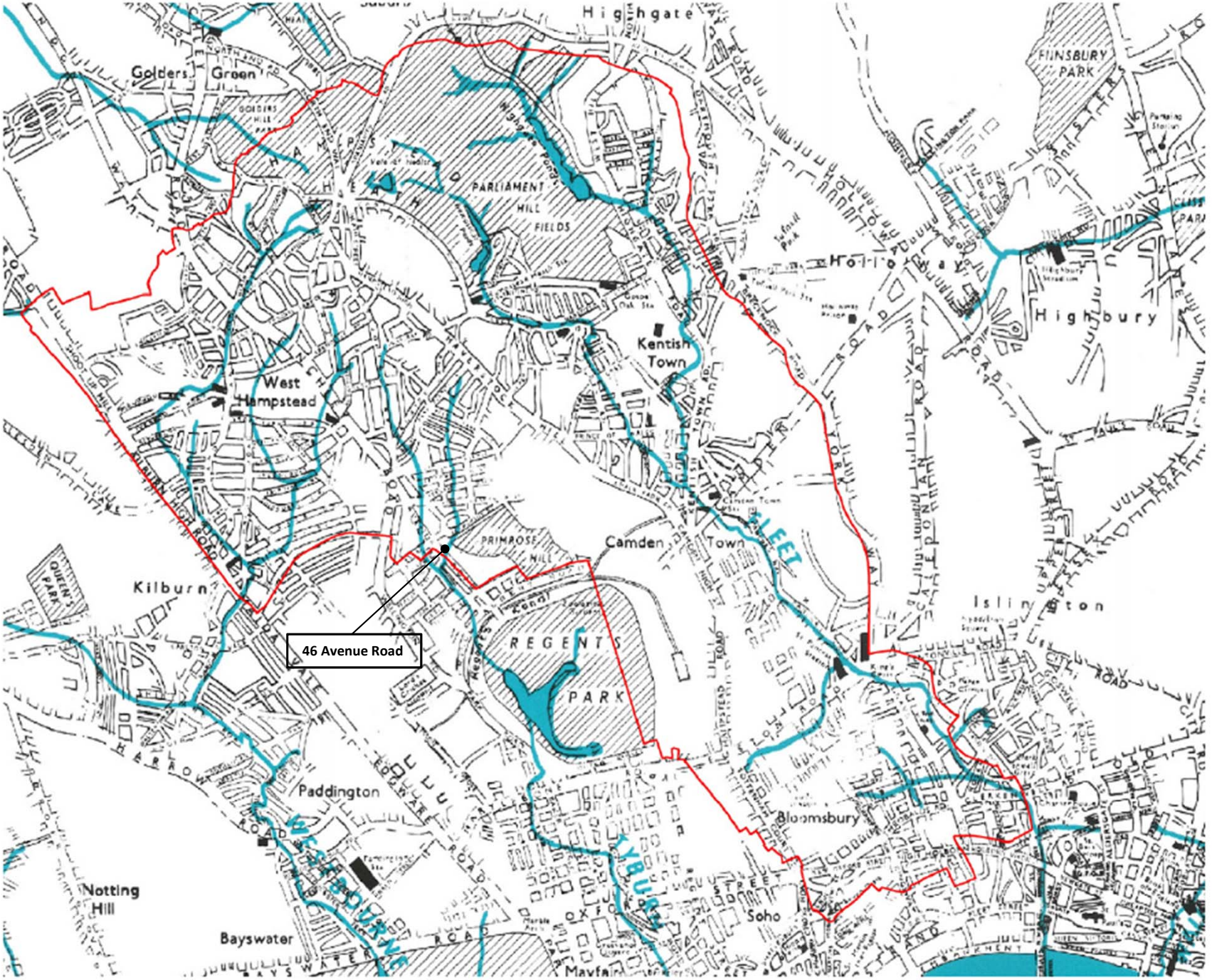
Figure 1

46 Avenue Road, London, NW8 6HS

Figure 2a. Aerial Photograph of Property: No. 46 Avenue Road

Figure 2b. Photograph of Front-view of No. 46 Avenue Road from Norfolk Road

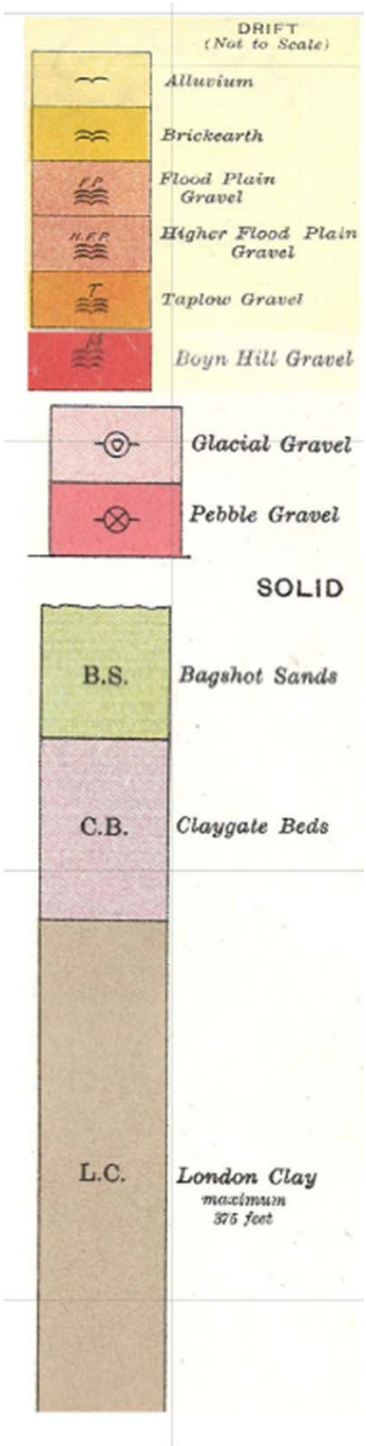
Figure 2

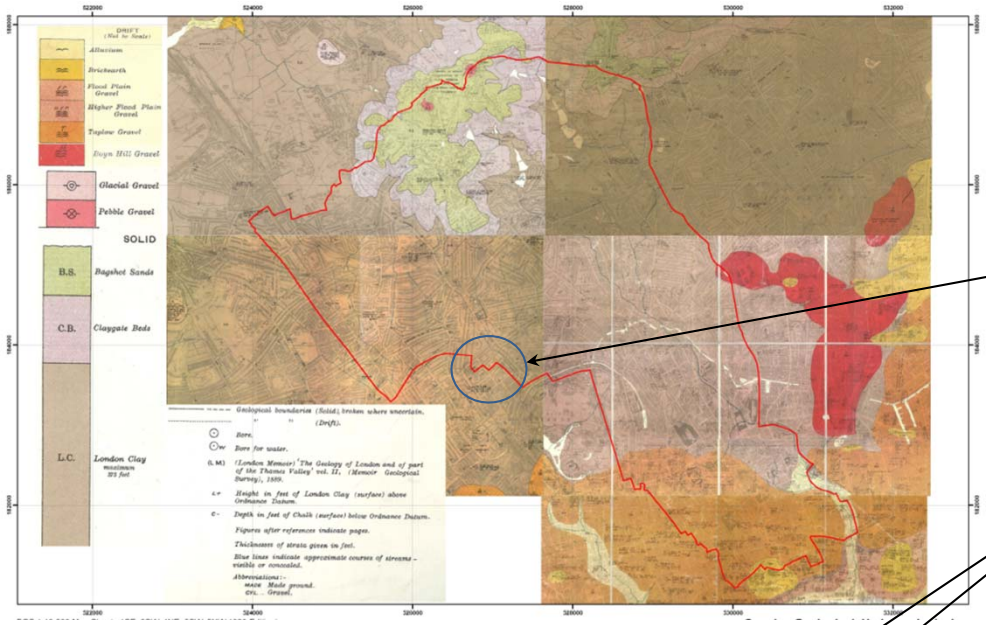


Watercourses

Source – Barton, Lost Rivers of London

Figure 3

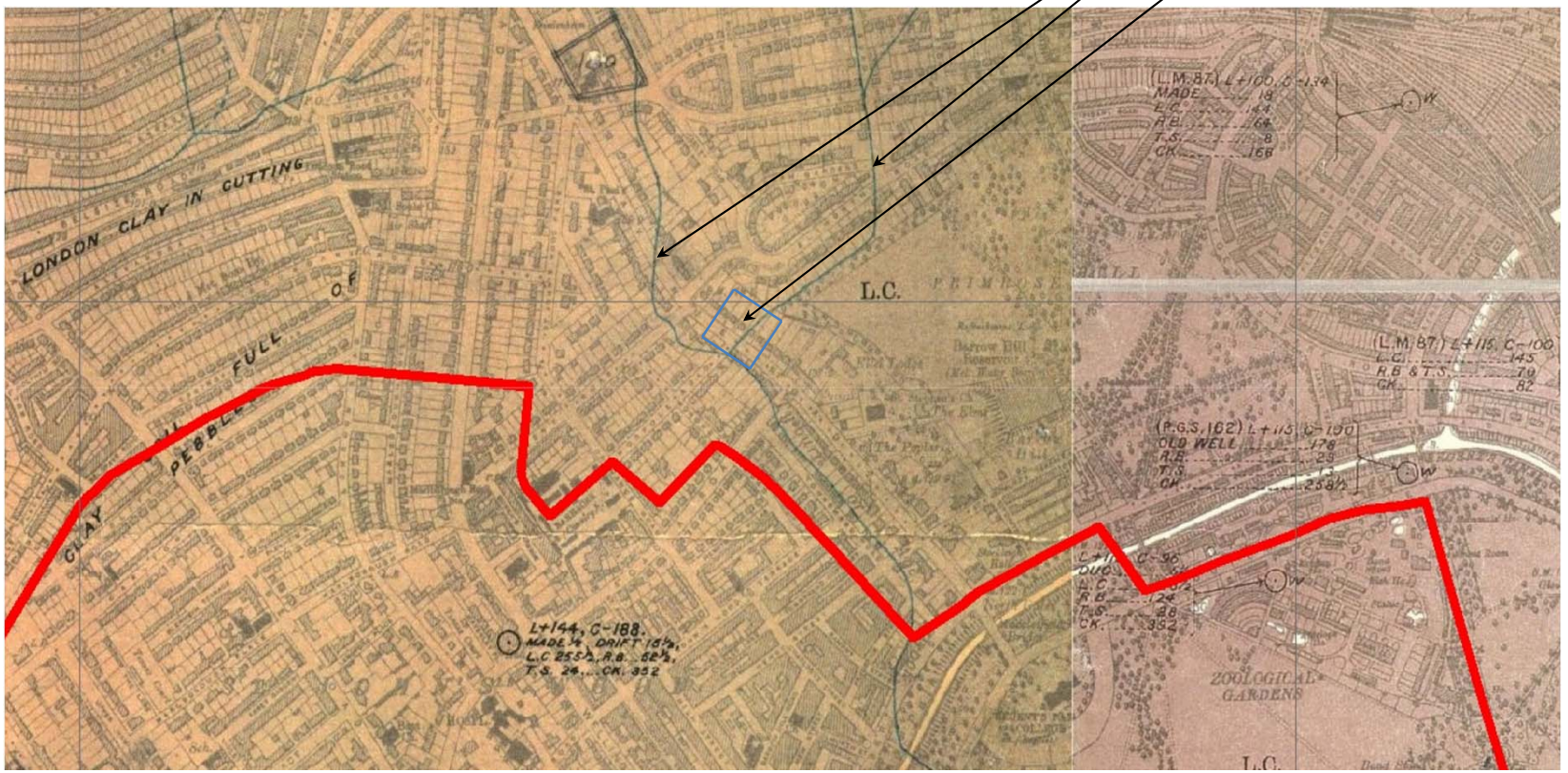




See enlarged image below

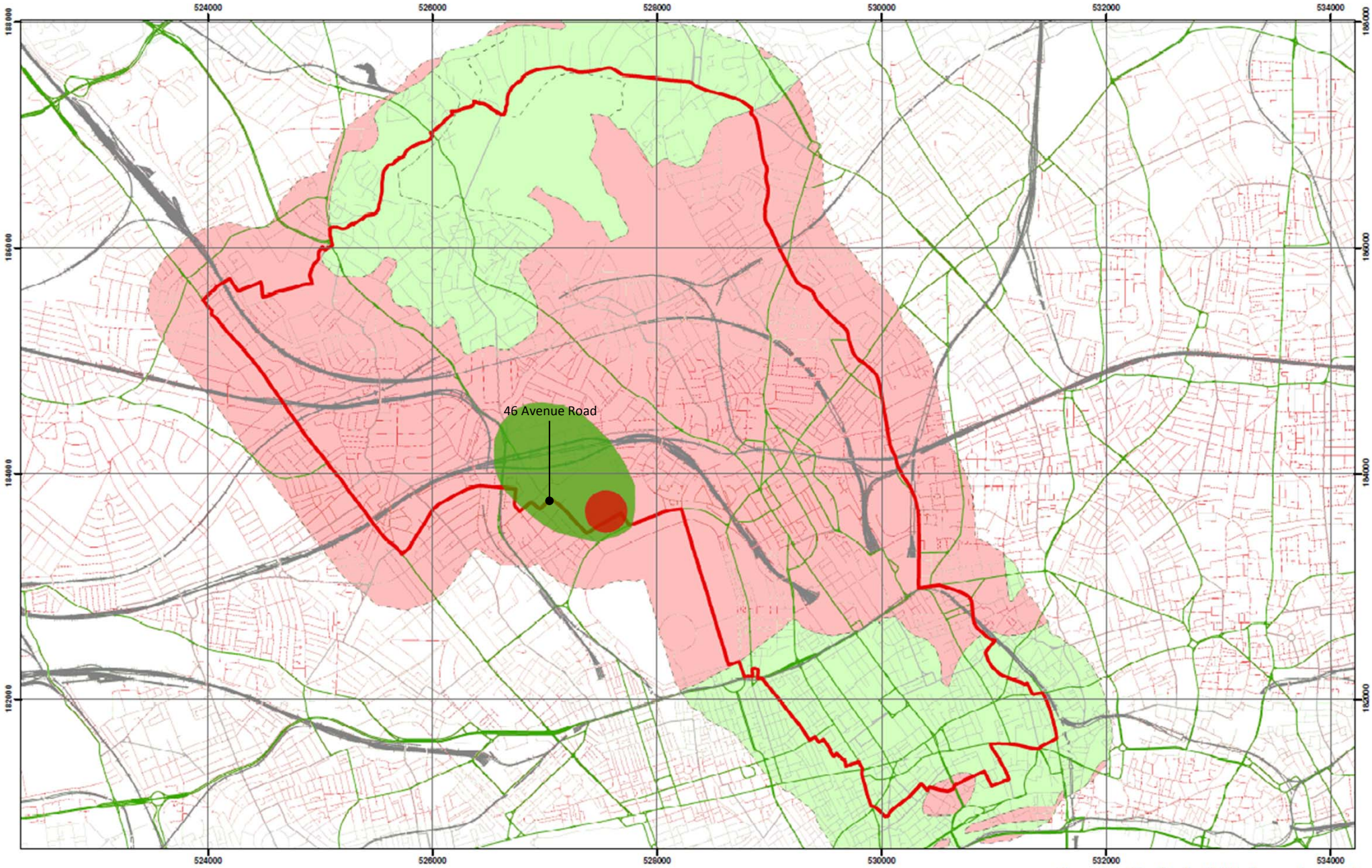
River Tyburn Tributaries

46 Avenue Road



1920s Geological Map

Figure 4



Environment Agency Aquifer Designation based on BGS Mapping

N

Scale at A3: 1:30,000

Coordinate System:
British National Grid
GCS_OSGB_1936

0 0.5 1 2 3
Kilometers

Legend

Borough of Camden
Railway Lines
A Roads

Aquifer Designation
Secondary A Aquifer
Unproductive Strata

Source Protection Zone
Outer Source Protection Zone
Inner Source Protection Zone

NB. Aquifer boundaries are indicative based on available geological mapping data

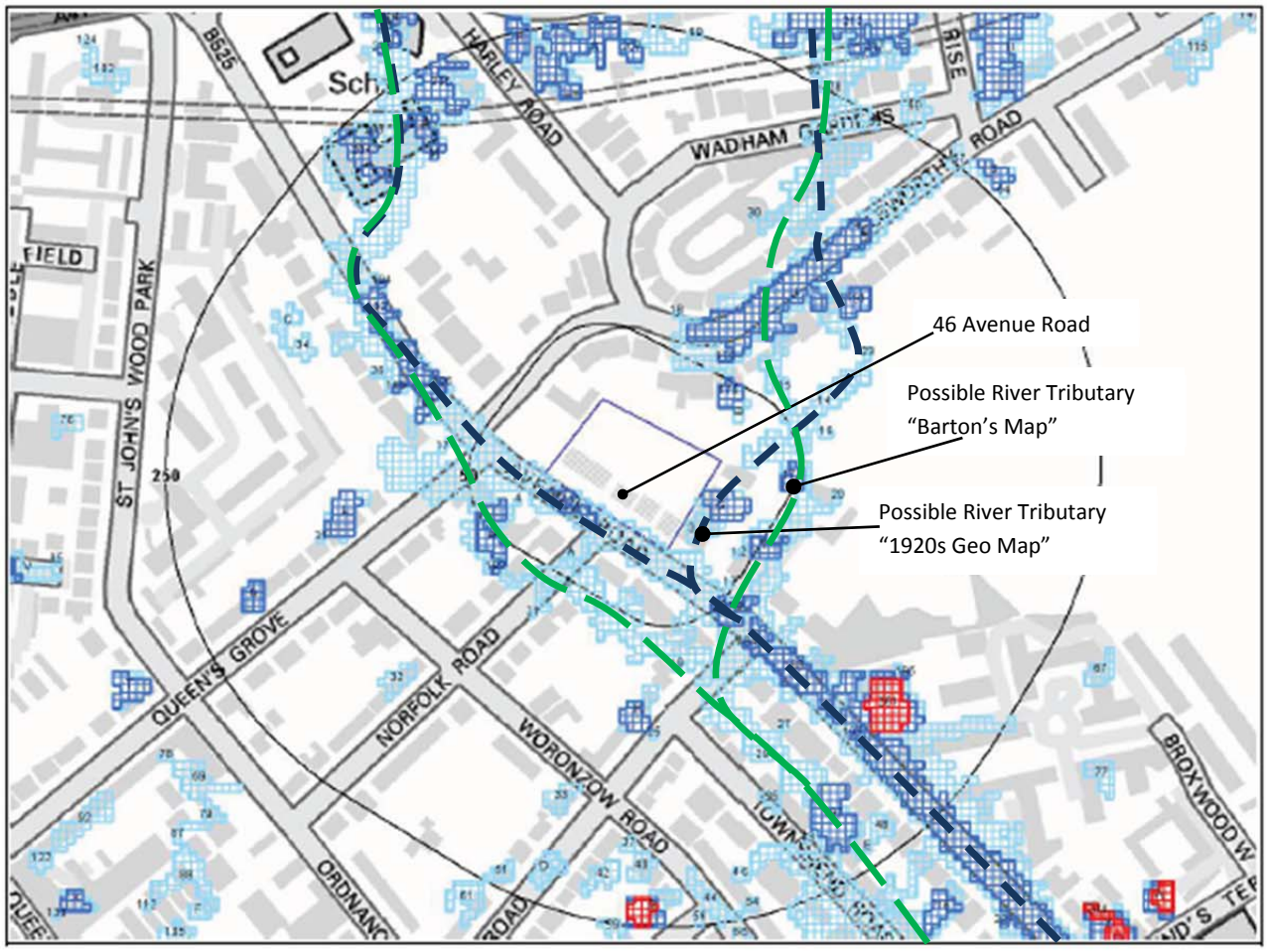
Camden Geological, Hydrogeological and Hydrological Study

Camden Aquifer Designation Map

213923

Figure 5

4. JBA Surface Water (Pluvial) Flood Map



Surface Water (Pluvial) Flood Legend

Enabled by Ordnance Survey

Crown Copyright. All Rights Reserved
Licence Number: 100035207

This data is provided by JBA Consulting, © Jeremy Benn Associates Limited 2008/2009

Site Outline

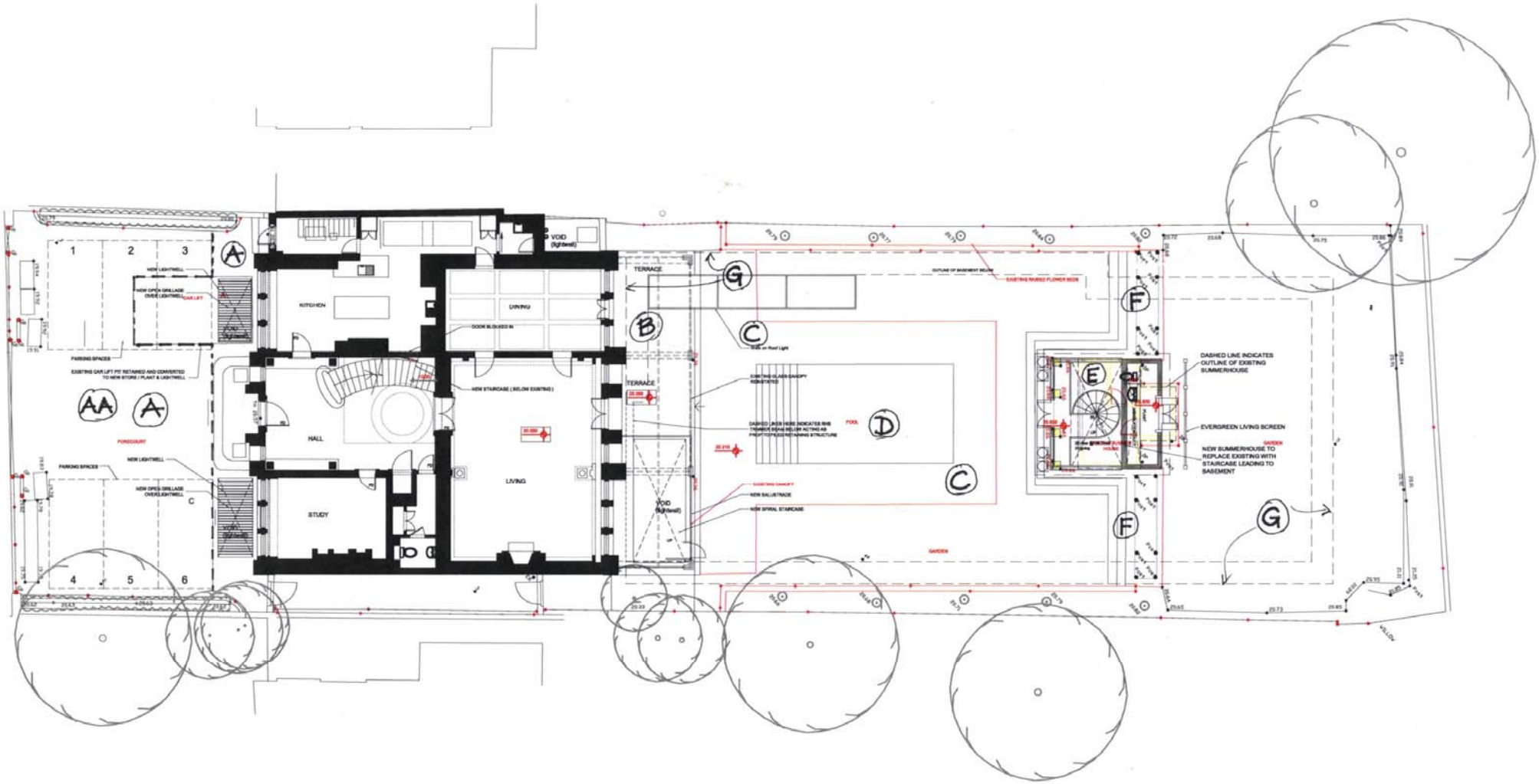
125
250
Search Buffers (m)

Flood depth greater than 1m

Flood depth between 0.3 and 1m

Flood depth between 0.1 and 0.3m

Figure 6



Site Plan showing existing impermeable surface areas in the garden and front drive gross and areas for drainage, see Table 1.

Figure 7

Appendix A

Surface flow and flooding screening flowchart

No	Screening Question	Impact	Source/Comment
1	Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site lies outside Hampstead Heath defined surface water catchment areas as defined in the "Camden Geological Study" (Figure 14)
2	As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	Yes	Refer to section 8.2 in this report.
3	Will the proposed basement development result in change in the proportion of hard surfaced / paved external areas?	Yes	There is a very small increase in the hard-surfaced/paved area in the rear garden. Refer to section 8.
4	Will the proposed basement result in change to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	Yes	There is a very small reduction in the natural drainage and infiltration in the rear garden and this is balanced by a very small increase in front car park. Natural infiltration on the site is weak at present due to London clay being close to surface.
5	Will the proposed basement result in change to the quality of surface water being received by adjacent properties or downstream watercourses?	No	There is no change to the quality of the surface water that will result from the proposed scheme.
6	Is the site in an area known to be at risk from surface water flooding, or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?	Yes	CPG4 shows the property is within the list of streets at risk of surface water flooding. Geotechnical Desk Study Report examines this and also see section 8 on this report.

Table 2: Screening Chart 1

Subterranean (groundwater) flow screening chart

No	Screening Question	Impact	Source/Comment
1a	Is the site located directly above an aquifer?	No	See section 9 in this report.
1b	Will the proposed basement extend beneath the water table surface?	Yes	Water table has been determined slightly above the London clay.
2	Is the site within 100m of a watercourse, well (open/disused) or potential spring line?	Yes	Refer to section 9 in this report.
3	Is the site within the catchment of the pond chains on Hampstead Health?	No	The site lies outside the Hampstead Heath defined surface water catchment area as shown in "The Camden Geological Study" (Figure 14).
4	Will the proposed basement development result in change in the proportion of hard-surfaced/paved areas?	Yes	There is a very small increase in the hard-surfaced/paved area in the rear garden.
5	As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soak-away and/or SUDS)?	No	No additional water will be discharged to the ground and a very small reduction in the rear garden area is proposed.
6	Is the lowest point of the excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath) or spring line?	No	There are no local ponds. The Geotechnical Desk Study demonstrates this.

Table 3: Screening Chart 2

Slope stability screening flowchart

No	Screening Question	Impact	Source/Comment
1	Does the existing site include slopes, natural or manmade, greater than 7°? (approximately 1 in 8)	No	Local slopes have been measured and the slopes which are present on sites are less than 7°. The Geotechnical Desk Study & Interpretive Reports examine this. Refer to section 4 and 10 on this report.
2	Will the proposed re-profiling of landscaping at site change slopes at the property boundary to more than 7°? (approximately 1 in 8)	No	No significant alteration of existing ground levels and no new slopes proposed.
3	Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°? (approximately 1 in 8)	No	The development is located within residential area and there are no nearby cuttings or slopes greater than 7°. See section 4 of this report.
4	Is the site within a wider hillside setting in which the general slope is greater than 7°? (approximately 1 in 8)	No	Examination of nearby roads and levels show the general slopes are less than 7°.
5	Is the London clay the shallowest stratum at the site?	Yes	There is a very small zone of made ground above the London clay.
6	Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained? (Note that the consent is required from LB Camden to undertake work to any tree/s protected by a Tree Protection Order or to tree/s in a conservation Area if the tree is over certain dimensions).	No	No large trees within the property, so no felling. A neighbouring large tree has been identified but the proposed works are outside zones requiring root protection.
7	Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	No	There is a very small zone of made ground above the stiff London clay and the neighbouring structures and properties on the Site do not show any evidence of seasonal shrink-swell damage.
8	Is the site within 100m of water course or potential spring line?	Yes	Refer to section 10 in this report.
9	Is the site within an area of previously worked ground?	No	See section 8.2.
10	Is the site within an aquifer? If so, will proposed basement extend beneath the water table such that dewatering may be required during construction?	No	De-watering measures are not required.

11	Is the site within 50m of the Hampstead Heath ponds?	No	The nearest Hampstead Heath pond is about 600m away from the Site.
12	Is the site within 5m of a highway or pedestrian right of way?	Yes	Avenue Road is a highway at the front of the property.
13	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The foundations for neighbouring properties will become relatively higher in relation to the proposed basement and its foundation action. Refer to appendix B
14	Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	The Geotechnical Desk Study has examined this.

Table 4: Screening Chart 3

Appendix B

46 Avenue Road

Ground Movement Assessment Report: New Basement Proposal

46 Avenue Road

Ground Movement Assessment Report: New Basement Proposal

Table of Contents

[Issue: 02nd July 2014]

RKD Consultant Ltd. note that this report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

1 Introduction

As part of the Planning Application process, an assessment is required for the Damage Category status of the adjacent structures adjoining number 46 Avenue Road and in consequence of the proposed new basement works. This report has been prepared by RKD Consultant ltd to address this and is to be read together with the other parts of the Basement Impact Assessment (Rev05 of 02nd July 2014).

While this report does not represent a 'design' of the new basement, the following processes are required to be carried out in order to assess the Damage Category for adjacent structures:

(i) Preliminary analysis or assessment of basement excavation, including the retaining walls and both their installation and method of retention;

(ii) Evaluation of the consequent implied ground movements outside of the excavation and leading to a 'contour map' of these movements;

(iii) Evaluation of the adjacent structures, how they lie on the proposed movement contours and the implications of distortion for these structures given their essential geometry. This process finally leads to an implied Damage Category due to the works.

These analytical processes are reported here, addressing both the proposed single storey basement within the Garden of number 46 Avenue Road and the proposed single storey excavation beneath the southern half of the existing property itself. The process concludes with Damage Category Assessments for the two immediately adjacent properties of number 44 Avenue Road and number 48 Avenue Road.

2 Assumptions of the Damage Category Assessment

2.1 General Assumptions

The scheme described in all the information included and referenced in the Basement Impact Assessment (Rev05 of 02nd July 2014) is assumed for the work in this report.

The general approach adopted here for the movement of structures adjacent to ground works is that commonly used[1] and it assumes that the ground is not stiffened by the actual structures on or close to the ground surface. This is termed a 'greenfield' movement assessment as it should apply accurately in such an instance. The presence of the existing structure on the Site will tend to modify and 'even out' the gradients of the greenfield ground movement and similarly any adjacent neighbouring structures will see more even movements than implied by this interpretation. Since in this project the adjacent structures continue into areas in which the greenfield ground movements are trivially small this means that the implied actual differential and total movements will be markedly smaller than interpreted. Furthermore, if these adjacent structures themselves contain basements then, in this case, this will also further reduce the actual experienced building movements.
The ground and groundwater conditions have been examined in both a Desk Study and Site Investigation. It has been found that London Clay exists up to a point very close to the ground surface, leaving little space for free water above the Clay and within the ground profile.

[1] e.g. Assessments of most structures carried out by Crossrail follow the principles of this method.

2.2 Nature and Design of the retaining walls

Piled walls are contiguous reinforced concrete bored piled walls and following the Proposed Work Sequence given on Edge Structures drawings 1147/014 to ../020. These drawings indicate top, or capping beam level, propping to the garden basement piled wall and a capping beam stabilisation of horizontal forces as part of the underpinning arrangement for the existing structure and so for the single storey minipile wall. This single storey minipile wall is located just within the pathway along the south side of the existing structure. Further details of the preliminary analysis assumptions necessary for these walls are given as follows:

- Trench sheets installed to allow the initial excavation to piling platform level (PPL) for the garden pile wall installation. Edge Structures drawing 1147/011 shows the existing ground level around the garden pile wall as +43.55mOD and drawing 1147/014 shows the PPL as +42.39mOD.

- The garden basement piled wall's general ground level is at +43.55mOD, taken as 20.70kN/m^2 of surcharge over a modelled ground level of +42.4mOD, top of the pile cap; with capping beam level prop at +42.1mOD; Formation Level at +36.75mOD; the wall is taken as being a 450mm diameter bored piled wall at 600mm max centres with a 7.25m embedment below Formation level. For retaining purpose a shorter of embedment is adequate for a pile wall in stiff London clay, however considering the vertical load from the 1m ground above the pile wall of (1m x 18kN/m3 x 15.2m) = 274kN/m and the 350mm ground floor slab of (0.35m x 25kN/m3 x 15.2m) = 133kN/m, using the LDSA (London District Survey Association) method the minimum required toe level to carry a vertical load of 407kN/m is +29.50mOD (Refer to appendix for calculation). Capping beam temporary prop stiffness is calculated to give an average k = 33 500 kN/m/m and this is used in the model.

- The single storey piled wall's local ground level, at the existing pathway is +43.55mOD, taken as a 9.9 kN/m2 ground surcharge over a modelled level of +43mOD. Additional surcharge to represent the neighbouring building's footing is assumed to be similar to No 44 Avenue Road structure with the strip footing width of 1.2m and the bearing pressure of 200kN/m2. This is also been inputted in the model with an offset distance of 2.05m away from the centre of the pile wall with a width of 1.2m.

  Capping beam prop level is taken at +42.5mOD where stabilisation is provided through connection to the existing structure. The 46 Avenue Road structure and its return walls will be providing a sufficient stiffness, probably equivalent to the calculated prop stiffness above. However the props are not spanning the full building length there conservatively reduced restraint stiffness of k = 16750 kN/m/m is taken in the model. (50% of garden wall capping beam prop stiffness); a local Formation Level of +40.3mOD (From Edge Structure drawing 1147/020 rev P6). The minipile wall is taken as being 300mm diameter bored/grouted piles at 450mm centres with a 3.8m embedment depth below Formation. Figure 1 & 2 below shows a cross-section of the existing condition of the site as it is and how it is simplified for modelling purpose.

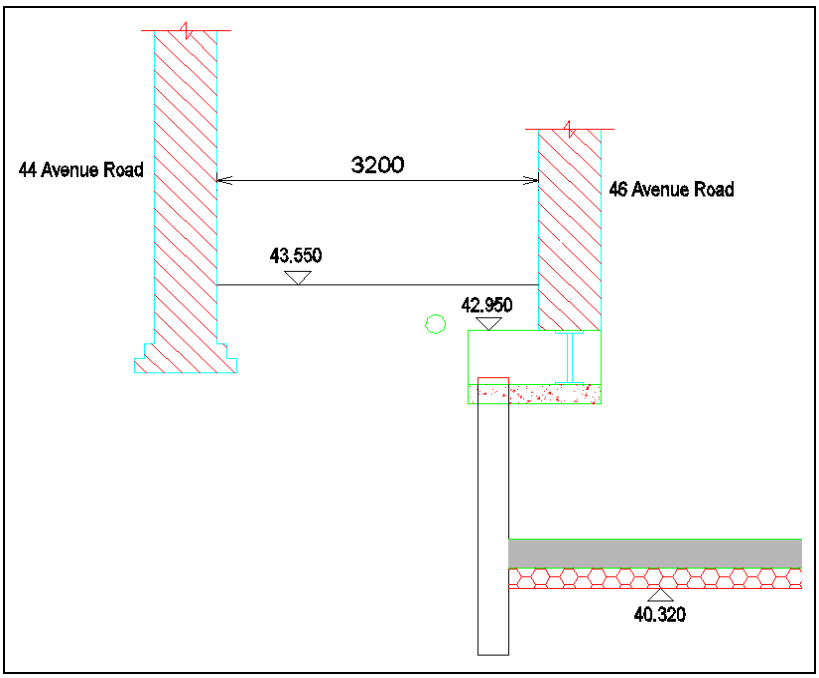


Figure 1: Section showing the existing site through minipiled wall

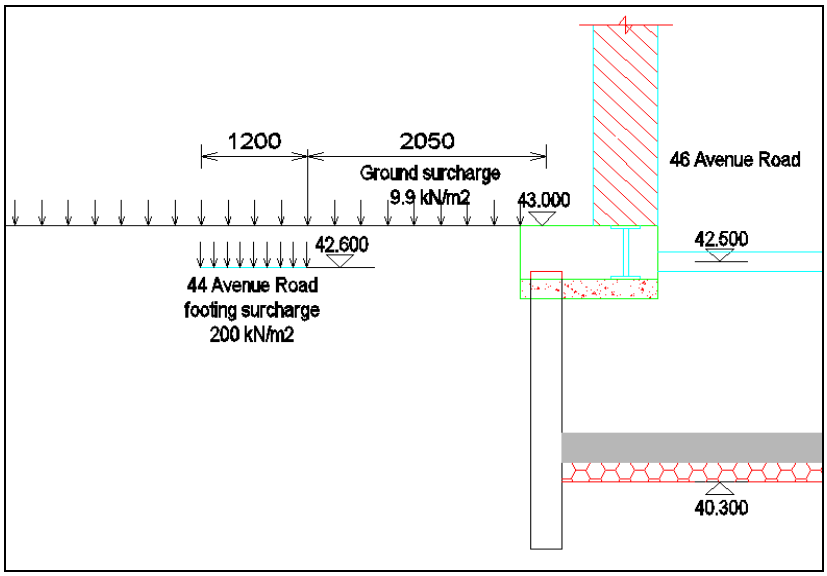


Figure 2: Section showing the modified modelled existing site through minipiled wall

It is assumed that during construction there will not be significant surcharging behind the piled and minipiled walls, i.e. any attempt to store heavy materials or impose significant plant loads. In addition, it is assumed that there are no further excavations behind the piled and minipile walls.

2.3 Workmanship of the wall installation & construction process

Good practice in construction is necessarily assumed. For example, each of the wall piles and minipiles are installed and concreted within a working shift and without allowing free (or surface water) into the bores prior to concreting. It is also assumed that the project is constructed at commercially sensible rates of construction given the site constraints, in particular (e.g.), that the works are not left after an excavation phase in an unfinished state for many months and prior to continuation and completion of the permanent structural works.

2.4 Geometry and Status of the neighbouring structures

The neighbouring structures of number 44 and number 48 Avenue Road have not been inspected from within these properties themselves. It is not known for example how recently they have been rendered/plastered and therefore what historic damage to the fabric may already exist that has been hidden by this process. Although it is not considered likely, were these structures to be already fragile with historic damage having occurred then the structures are more readily able to be damaged in relation to new imposed movements. The assessment made here necessarily assumes that the fabric of the structures has not already been subject to any significant historic damage.

3 Sources of Ground Movements & Assessment Methodology

In relation to all the new basement works, the sources of ground movement that have the potential to affect significantly the adjacent masonry structures of number 44 and number 48 Avenue Road are:

- The trench sheet & bored pile or minipile wall installation; and
- The basement excavation process.

Although appropriate analysis and design is also important, the ground movements caused due to these processes are also dependent on local ground conditions, method and construction details. For this reason, reference to the existing database of results and the use of empirical methods of determining movements is appropriate. Also, and by the same measure, the prediction accuracy of this process is governed by the natural variation of observed workmanship as well as the variation of precise ground and groundwater conditions and other construction variables of broadly similar projects.

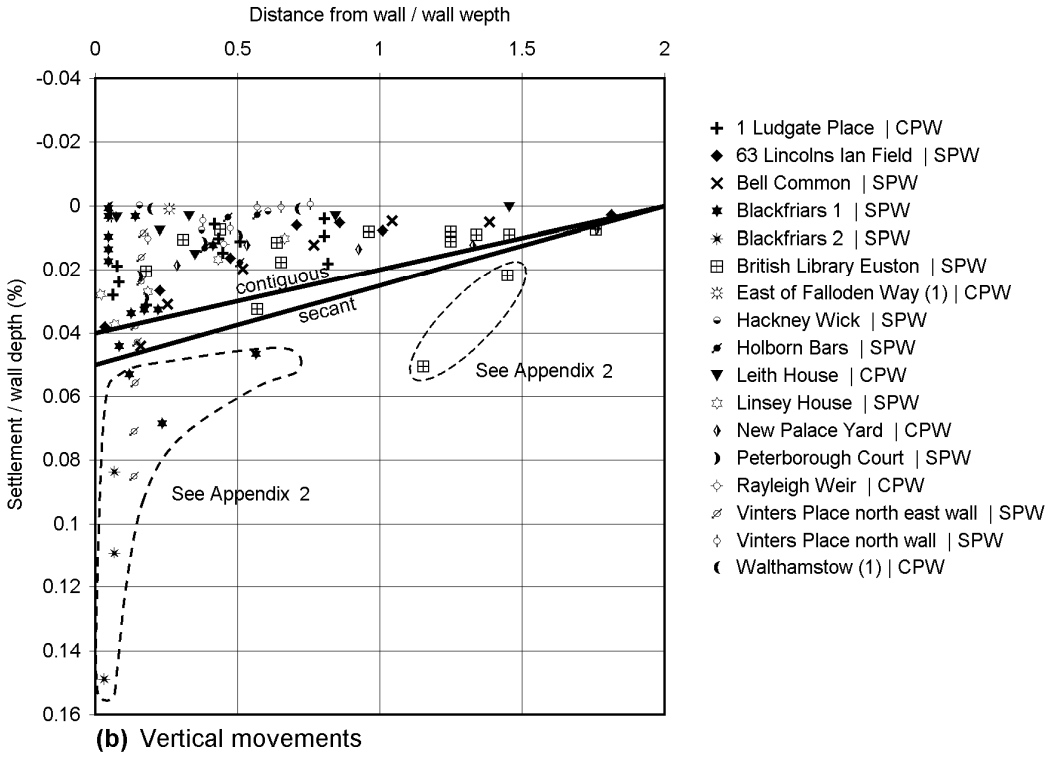


Figure 2.8 *Ground surface movements due to bored pile wall installation in stiff clay*

Reproduced from CIRIA C580 (Figure 2.8)

The data reproduced here above is taken from CIRIA C580 Report figure 2.8 for a variety of bored pile wall installations. The data shows much scatter and includes a number of relatively large projects historically but it is proposed that for conditions where London Clay rises very close to the ground surface and the bored pile geometries are not so comparably large, i.e. as for the proposed piled walls here, the amount of movement due to pile wall installation will be most similar to the smallest observed movement data here.

The basement excavation work itself, both beneath the existing structure and within the Garden area, gives rise to ground movements that can be considered to derive from both the immediate upward heave of the London Clay in response to its undrained unloading and also from the inward deflection of the walls that itself gives rise to local surface settlement behind the wall. These movements occur naturally at the same time and historic observations of movements behind piled walls as part of similar basement excavations include for both of these effects.

Measurements relating to the excavation of two central London deep basement excavations were reviewed and reported on in CIRIA C580 and back-analysis using FREW[2] gave rise to the proposed relationship between analysed wall deflections and ground surface settlements in the Report's figure 2.16 which is reproduced below. This shows settlement behind the retaining wall with the maximum settlement being half of the maximum horizontal deflection and this method is used here. Some preliminary FREW analysis has therefore been undertaken using the available Ground Investigation information and the assumptions listed above in Section 2. Note that this process does not address movements within the footprint of the excavation itself and the ground movements presented here are only for the ground outside of this footprint.

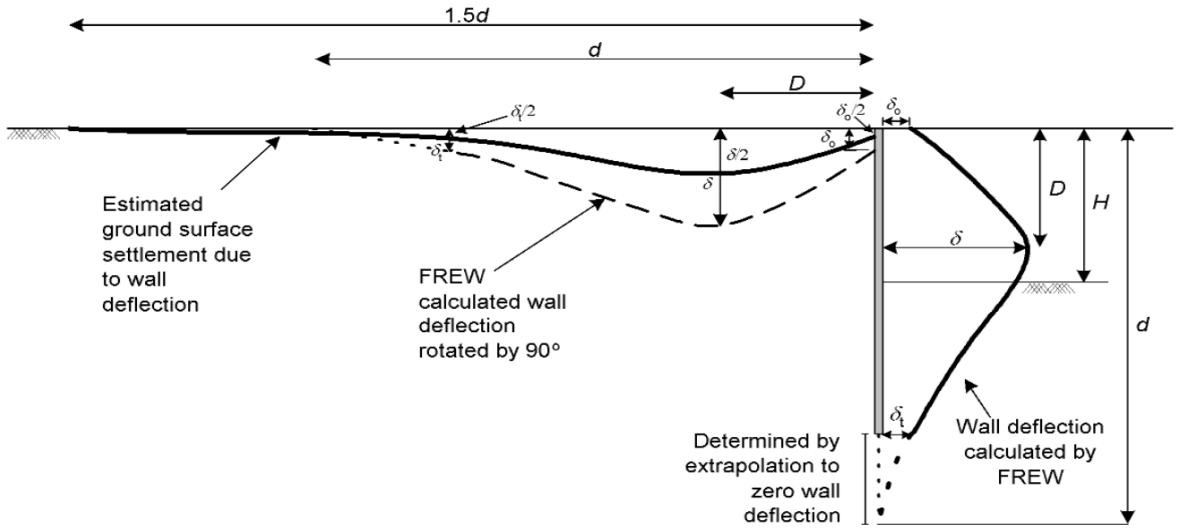


Figure 2.16 *Relationship between analysed lateral (propped) wall deflections and predicted ground surface settlements in stiff soil*

Reproduced from CIRIA C580 (Figure 2.16)

[2] FREW by OASYS software: http://www.oasys-software.com/products/geotechnical/retaining_walls/frew/

4 Results of Ground Movement Assessment

4.1 Bored Pile Wall Installation: Ground Settlements

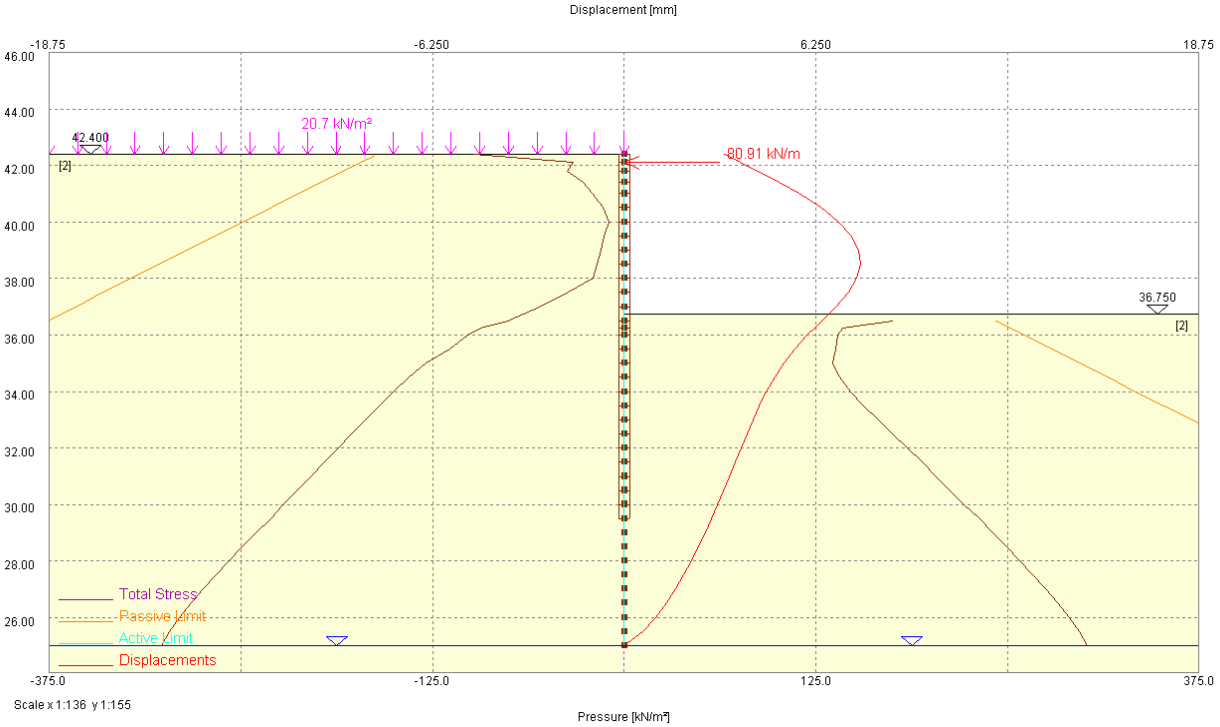
Following the description above, it is proposed that for the local conditions of wall installation here, the maximum vertical settlement behind the wall is taken as 0.04% of the wall depth and assuming that settlement decays away to 0% at distance from wall/ wall depth of 1.5.

For the Garden basement wall and with a total pile length of 14m, this gives rise to 5.6mm settlement immediately behind the wall. In accordance with this part of the dataset, this is taken to decay to zero at a distance of 21m behind the wall, viewed in plane strain[3].

For the minipile wall adjacent the existing structure, the pile length is 7m and this gives rise to 2.8mm of settlement immediately behind the wall similarly taken to decay to zero at a distance of 10.5m behind the wall.

4.2 Basement Excavation : Ground Surface Settlement

Initial excavation to the piling mat level is supported by trench sheet and the wall displacement due to this is calculated using EC7-Annex A, table c.1, the cantilever wall movement in dense soil is calculated and is 1.74mm for a cantilever depth of 1.16m (Refer to appendix for calculation). The effect of wall displacement on the adjacent ground uses the wall profiles derived from the FREW output illustrated for the two wall sections in figures 3 & 4. Complete FREW outputs are also attached in the appendix. The method combines this output with the empirical approach described above in which the settlements are half of these horizontal movements. The maximum wall deflection for the Garden basement piled wall is 7.7mm and 2.8mm for the single storey section beneath the structure.



STAGE 4 : Excavate to Formation Level

[3] i.e. with the Section through the wall considered as infinite.

Figure 3: Garden Basement Pile Wall: Horizontal Deflection

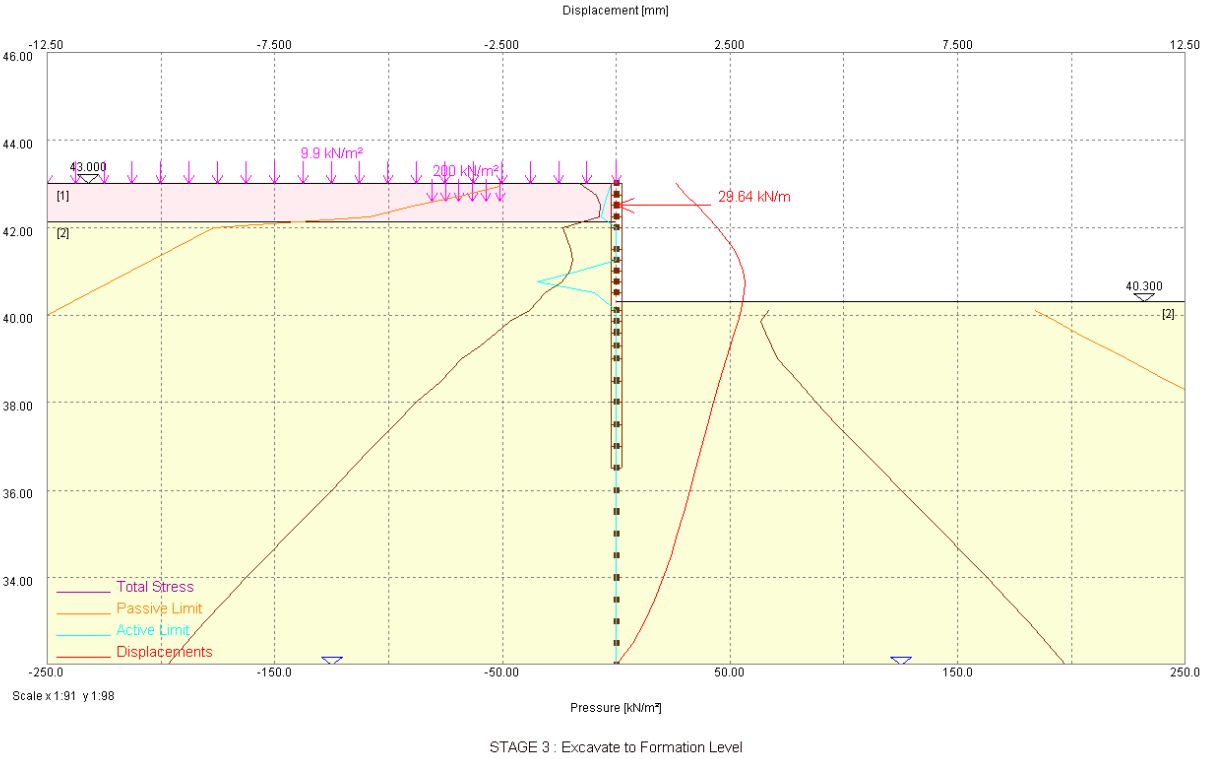


Figure 4: Minipile wall: Horizontal Deflection

The ‘greenfield’ vertical ground settlements around the outside of the excavated areas and arising cumulatively after basement excavation have been interpreted and traced as a set of contours. This is shown below in figure 3. For interpretation of the corner or 3D effects, the settlements in the section are taken as reducing to 2/3 of the plane strain values at the corners and in the same plane. This is based on the case history published by Prof.J B Burland[4].

The figure is based on a survey drawing that shows, for the southern half, the existing plan arrangement of the existing structure of number 46 Avenue road clearly and a part of the two adjacent above-ground structures of number 44 and number 48 Avenue road. The centreline of the two piled walls has been drawn on to indicate their positions. A critical dimension of 3.2m is given for the southern half, being the distance between the opposing faces of the two structures of numbers 44 and 46 Avenue Road at their closest points. The maximum calculated ground settlement due to installation and excavation is approximately 8.1mm around the garden wall piles and 3.4mm around the minipile wall, i.e. marginally more than the largest contour line given and at a position very close to the given8mm & 2mm contour line.

[4] J B Burland (1977). Underground Car Park at the House of Commons, London: Geotechnical Aspects. The Structural Engineer, 55(2) P.87-P.100.

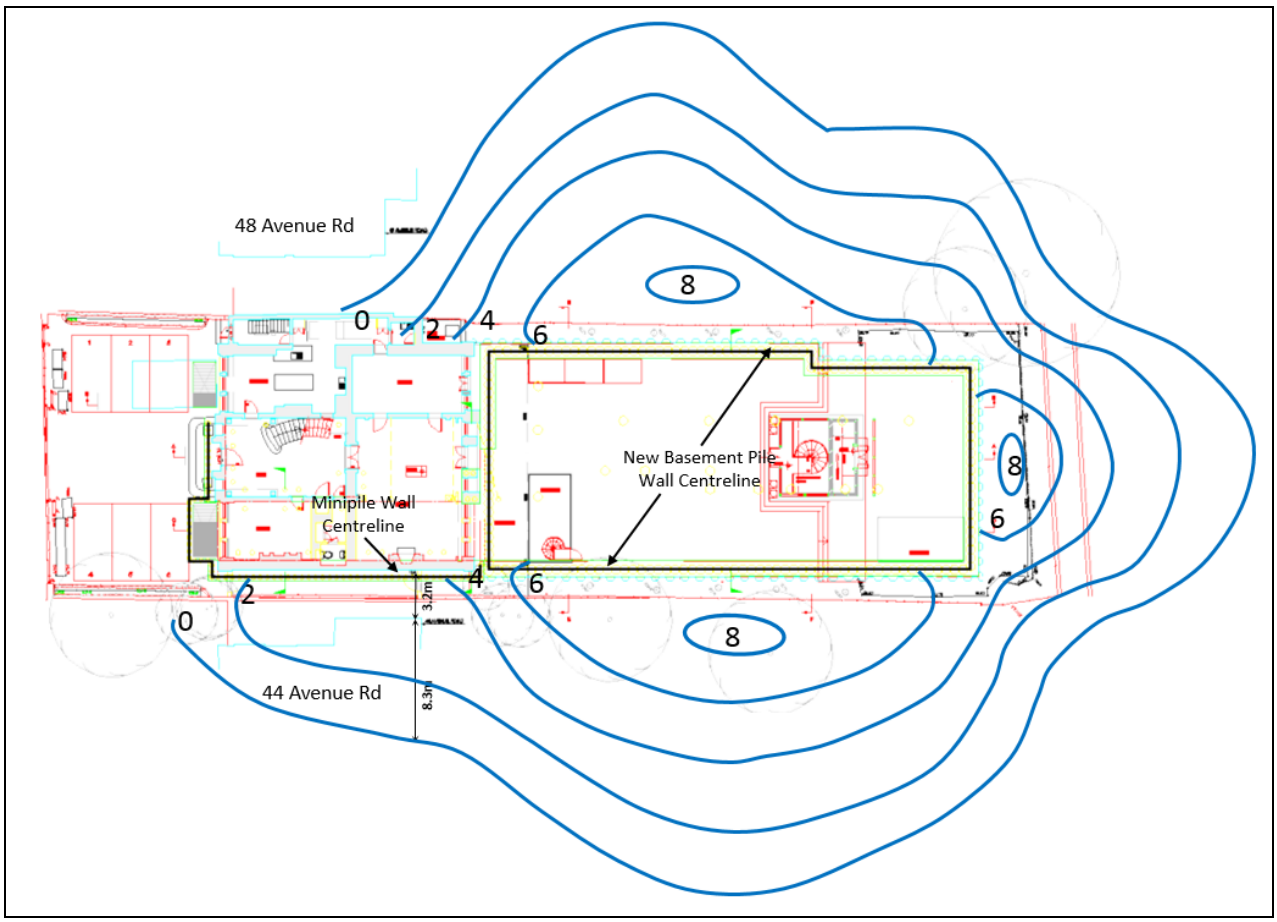


Figure 5: Contours of ground settlement arising after basement excavation (in mm)

4.3 Associated Damage Category

Particular structures that are visible around the site boundary have been assessed for the impact of the determined ground movements and as follows.

4.3.1 Number 44 Avenue Road

For number 44 Avenue Road, the most critical structural element in terms of damage sensitivity and from inspection of the contour diagram would be the rear façade wall, i.e. that facing the property's own garden. The contour diagram shows that a predicted maximum settlement of 3.4mm occurs at the end of this wall closest to number 46 Avenue Road. In addition to this, the following assumptions have been made using the proposed assessment method of Burland et al. (1977): his methodology assumes that the structure undergoing distortion can be considered as a simple uniform elastic beam of constant properties (H, L, E/G, ν) experiencing shear and bending distortions according to sagging or hogging actions. The hogging and sagging actions are treated differently in both the position of the neutral axis and while sagging considers the full length of the beam either side of the depression, hogging considers only that length of the structure that is cantilevering. The limits of the Damage Categories are obtained from these considerations. The distortion of the structure is characterised from a mobilised deflection ratio (Δ/L) and horizontal strain (εh) which derive from the input assumptions due to the construction processes.

From the contour diagram in figure 5 above, the wall nearer and parallel to minipiled wall is experiencing a very small sagging effect, however the potential distortion can be seen from the same contour diagram, the east side rear façade wall is experiencing the critical affect caused by hogging.

The structure's height to eaves (H) and overall length (L) are comparable to that of the structure of number 46 Avenue Road for which survey data has been made available, values of H = 9.50m & L=16.6m have been used.

For hogging effect, the maximum deflection ratio along the rear wall is then calculated as 0.041% (3.4/ 8 300), Horizontal strain is taken as the mean value across the part of the structure experiencing distortion, therefore $\varepsilon_h = (3.4/2)/8300 = 0.02\%$. The various Damage Categories and their descriptions are reproduced for reference in the figure below, from the BRE Report 251 and taken from CIRIA C580 as Table 2.5. From the stated assumptions here the calculated Damage Category is shown in the figure 6. It can be seen that the wall is within Category (1) or 'very slight'. Since this is the most critical element of the structure, it is inferred that the entire structure can be assessed as Category(1).

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

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

Notes

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

Reproduced from CIRIA C580 (Table 2.5)

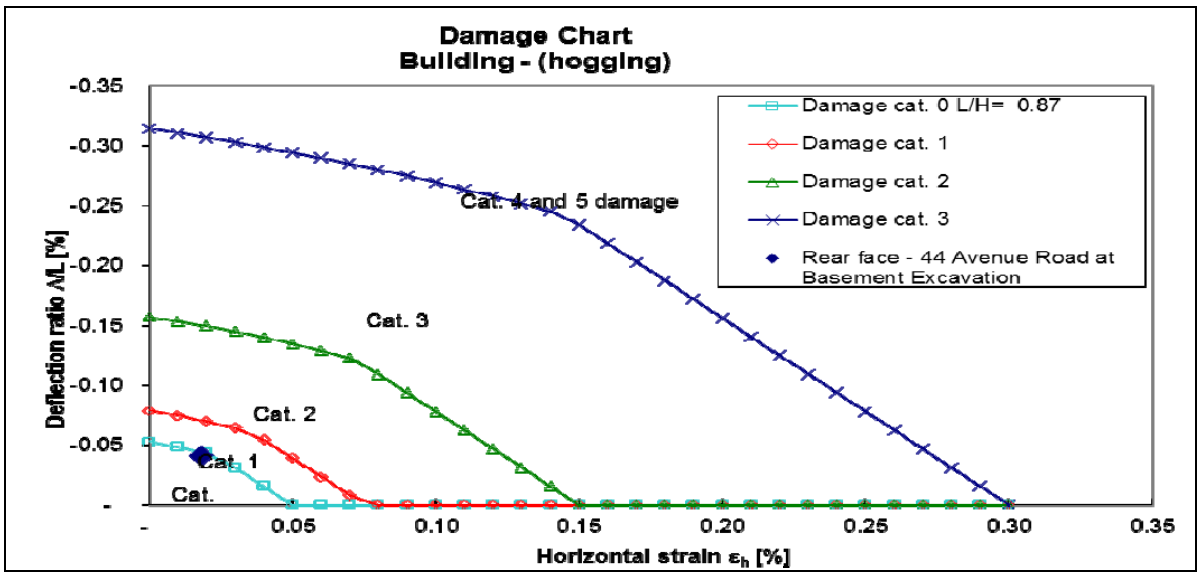


Figure 6: Damage Category Assessment for (critical) rear wall of number 44 Avenue Road

4.3.2 Number 48 Avenue Road

The contour diagram of figure 3 shows that there is negligible movement of the structure of number 48 Avenue Road in response to the basement excavation works and therefore it is evident that the Damage Category for the structure is Category (0) or 'negligible'.

5 Summary

This report has described theoretical estimates of ground movements and those that may be experienced by structures outside of the new basement excavation for number 46 Avenue Road. With respect to neighbouring structures beyond the Site boundary, these estimates are likely to be conservative and they ignore soil-structure interaction that is likely to be beneficial. The following has been determined:

- Variability in ground movements due to such basement works occurs in relation to the quality of workmanship in addition to the analytical and predictable assumptions that are offered as part of the assessment offered here. The assessment necessarily assumes a competent Contractor providing an acceptably good level of workmanship for all the processes involved in basement construction at this Site of known and investigated ground conditions. Some particular associated assumptions are described at the beginning of this report;
- The combined greenfield ground movements accumulating after basement excavation have been derived and then traced and plotted. These are all ground settlements outside of the basement excavation area. The maximum derived settlement at any location was approximately 8.1mm and the maximum derived settlement beneath an adjacent structure occurred at the nearest corner of number 44 Avenue Road and was 3.4mm;
- The adjacent structures of number 48 Avenue Road, to West side of the existing property of number 46 Avenue Road, is sufficiently far away that the Damage Category in this cases will be (0) or 'Negligible' in response to the proposed new basement works;
- The adjacent structures of number 44 Avenue Road, to East side of the existing property of number 46 Avenue Road, falls into the Damage Category (1) or 'Very Slight' in response to the proposed new basement works.

Appendix C

Calculation

RKD CONSULTANT LTD
Wigham House
16-30 Wakering Road
Barking
IG11 8QN
Tel: 020- 8591 9747
Fax: 020- 8594 1331

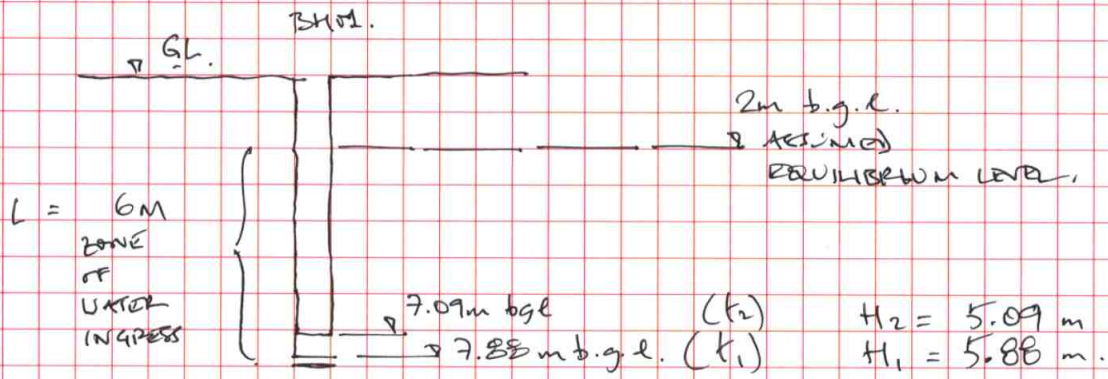
Contract: 46 AVE' RD'.

Prepared By: AH | Sheet No.: 1/1

Title: BH 01 : k FROM WATER LEVEL CHANGE

Checked by: | Date: 28/8/11

PERMEABILITY RESULT FROM OBSERVATIONS :-
(k)



D, diameter = 0.15m.

A, area = $0.0177 m^2$.

t_1 @ 15/7 a.m.
t_2 @ 29/7 a.m. i.e. 14 days later $\simeq 1.2 \times 10^6$ seconds later.

following Hvorslev's method as BS 5930 cl. 25.4.6.1.

Intake Factor $F = 2\pi D \Big/ \ln\left\{\frac{L}{D} + \left(1+\left(\frac{L}{D}\right)^2\right)^{1/2}\right\}$

$$F = 2\pi . 6.0 \Big/ \ln\left\{\frac{6.0}{0.15} + \left(1+\left(\frac{6.0}{0.15}\right)^2\right)^{1/2}\right\} = 8.6\ m$$

$$k = \frac{A}{F(t_2 - t_1)} \cdot \ln\left(\frac{H_1}{H_2}\right)$$

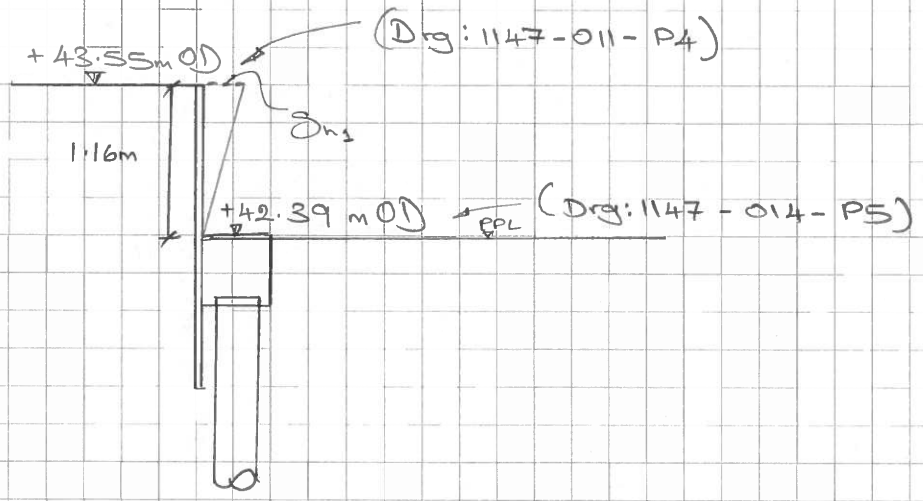
$$\therefore k = \frac{0.0177}{8.6 \times 1.2 \times 10^6} \cdot \ln\left(\frac{5.88}{5.09}\right) = 2.5 \times 10^{-10}\ m/s.$$

- RESULT POSSIBLE FOR LONDON CLAY WITHOUT HORIZONTAL LAYERS OF SILTS/SANDS
- SWELLING OF BOREHOLE PROBABLY DISTORTS RESULT WITH SOME WATER SUCKED OUT OF BORE; ACTUAL k LARGER $\simeq 10^{-9}$ m/s.

RKD CONSULTANT LTD

Wigham House
16-30 Wakering Road
Barking
IG11 8QN
Tel: 020- 8591 9747
Fax: 020- 8594 1331

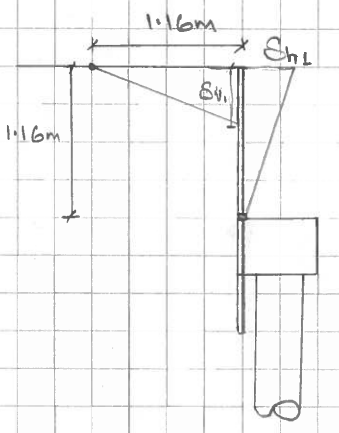
Contract:	Prepared By	Sheet No.
46 Avenue Road	HM	1
Title:	**Checked by**	**Date**
Horizontal & Vertical movement due to trench sheet installation		06/06/14



From EC7 - Annex A, table C.1 - Ratios V_s/h shows for a cantilever wall movement in dense soil, $V_s/h = 0.1\text{-}0.2\%$

$\therefore \delta_{h1}$ 0.15% × 1.16m

= 1.74mm



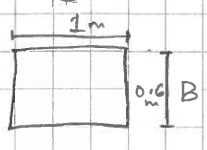
$\delta_{h1} = \delta_{v1} = 1.74$ mm

RKD CONSULTANT LTD

Wigham House
16-30 Wakering Road
Barking
IG11 8QN
Tel: 020- 8591 9747
Fax: 020- 8594 1331

Contract:	Prepared By	Sheet No.
46 Avenue Road.	HM.	2
Title:	**Checked by**	**Date**
Stiffness of capping beam & prop	AM	06/06/14

Capping Beam:



$$I = \frac{Bd^3}{12} = \frac{0.6 \times 1^3}{12} = 0.05\ m^4$$

$$E = 28 \times 10^6 \quad kN/m^2$$

$$k = \frac{Force}{\delta}$$

$$\delta = \frac{5}{384} \times \frac{WL^3}{EI}$$

$$\therefore k = \frac{W \times EI \times 384}{WL^3 \times 5} = \frac{384EI}{5L^3}$$

$$\therefore k = \frac{384 \times 28 \times 10^6 \times 0.05}{5 \times 13^3}$$

$$= 48939.5\ kN/m.$$

Prop:

$$k = \frac{P}{\Delta L} = \frac{EA}{L} \quad \text{where} \quad E = 210 \times 10^6\ kN/m^2.$$

$$L = 6.5\ m$$

Assuming prop is 254×254×73UC, $A = 0.00931\ m^2$

$$\therefore \frac{EA}{L} = 300.785\ kN/m$$

Assuming $w = 100\ kN/m$

$$P = 7 \times 100 = 700\ kN$$

$$\delta_{prop} = \frac{700}{300785} = 2.33\ mm$$

$$\delta_{cap\ (max)} = \frac{00}{48939} = 2.04\ mm$$

$$\delta = \delta_p + \tfrac{1}{2}\delta_{cap} = 2.33 + \tfrac{1}{2}(2.04)$$

$$= 3.35\ mm$$

$$\therefore k = \frac{100}{0.00335}$$

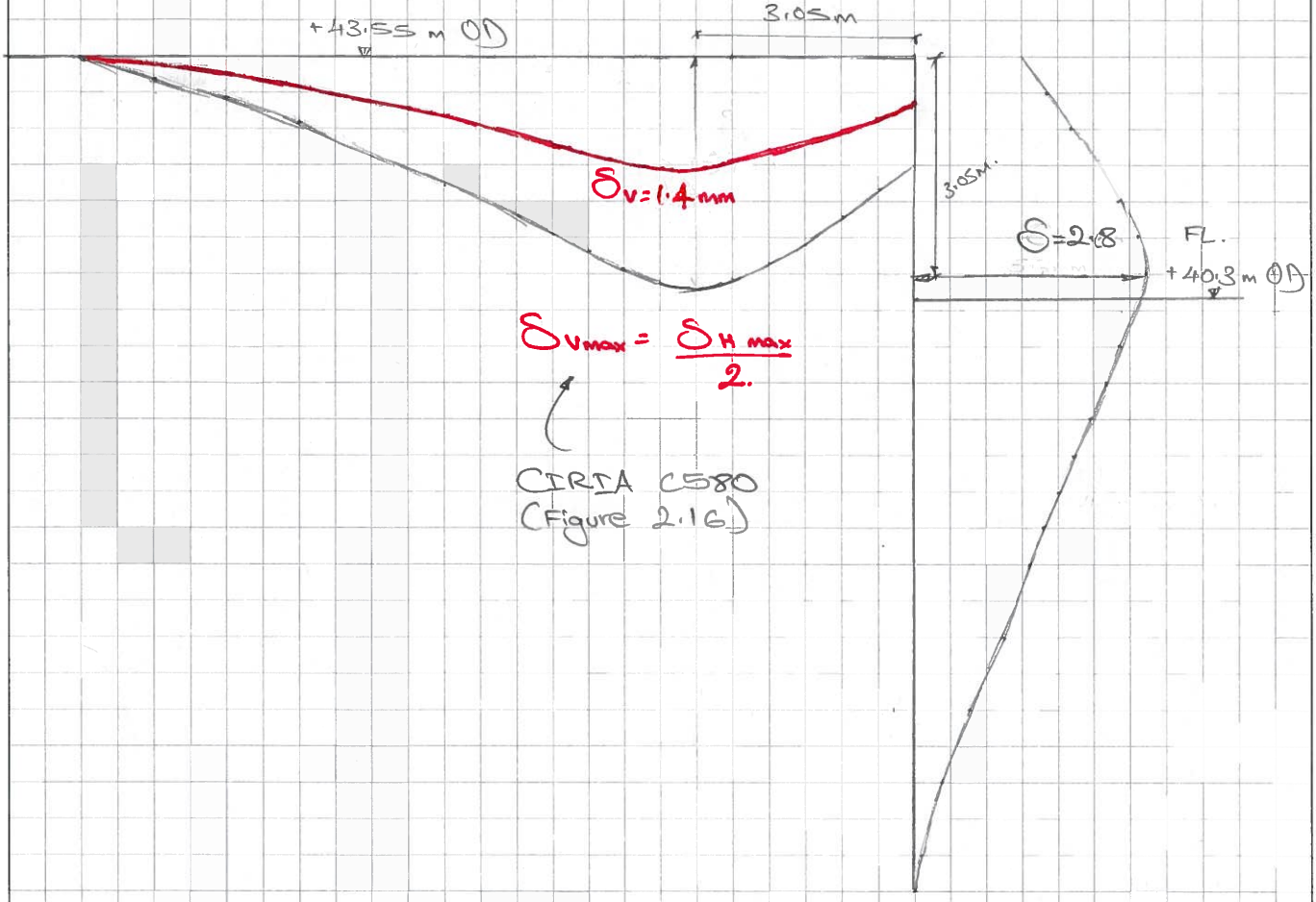
$$= 33500\ kN/m/m$$

RKD CONSULTANT LTD

Wigham House
16-30 Wakering Road
Barking
IG11 8QN
Tel: 020- 8591 9747
Fax: 020- 8594 1331

Contract:	Prepared By	Sheet No.
46 Avenue Road.	HM	3
Title:	**Checked by**	**Date**
Vertical & Horizontal movement due to installation & Excavation at southern site.	ACP	09/06/14.

Settlement due to excavation:



Vertical movement due to installation of mini pile @ Southern site.

The pile length = 7m. According to CIRIA C580 (figure 2.8)

contiguous wall settlement / wall depth = 0.04%.

∴ Maximum vertical settlement behind the wall = 2.8 mm

RKD CONSULTANT LTD

Wigham House
16-30 Wakering Road
Barking
IG11 8QN
Tel: 020- 8591 9747
Fax: 020- 8594 1331

Contract:	Prepared By	Sheet No.
46 Avenue Road	HM.	4
Title:	**Checked by**	**Date**
Vertical & Horizontal movement due to installation & excavation at Northern site	AL	09/06/14

Vertical movement due to installation of pile @ norther site:

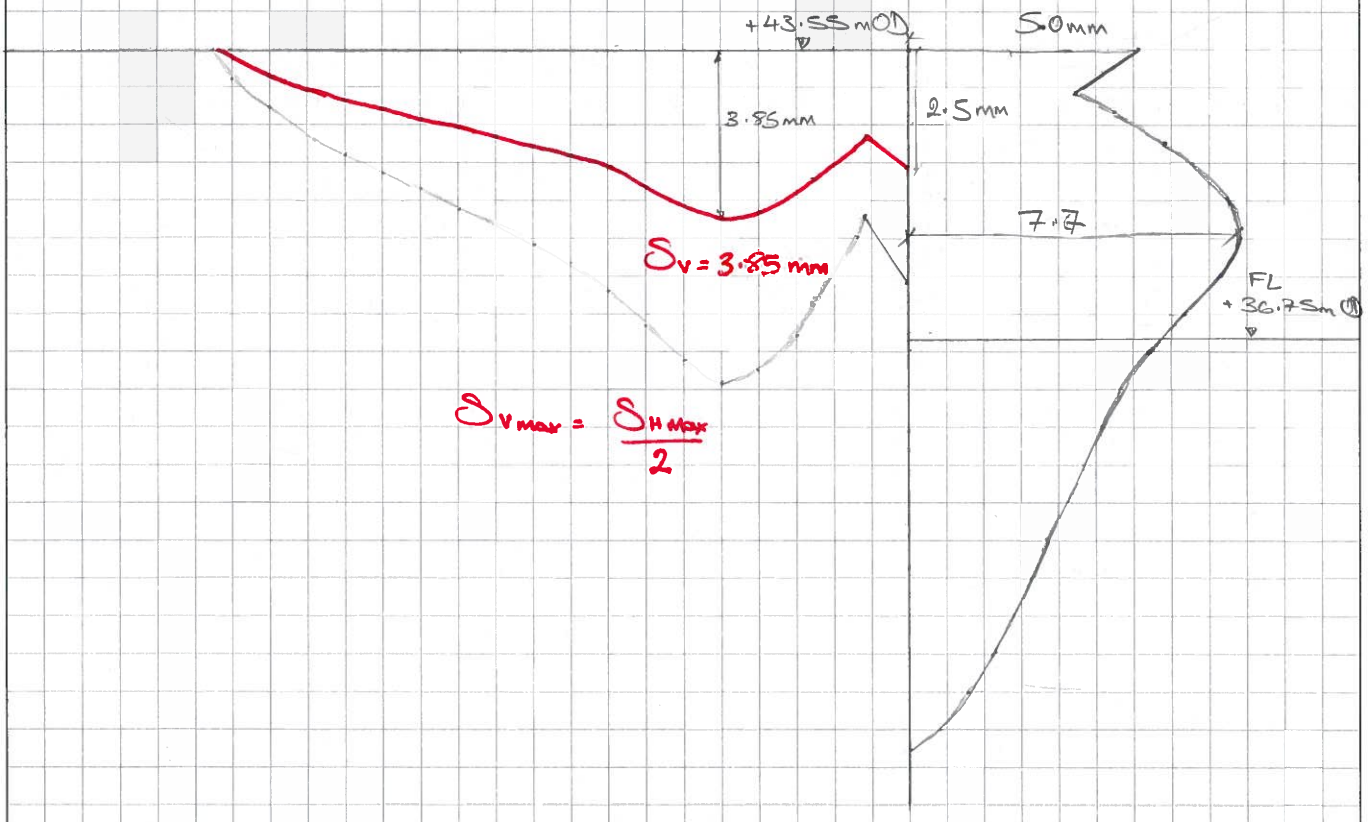
The pile length = 14 m . Using CIRIA C580 (Figure 2.8)

Contiguous wall settlement / wall depth = 0.04 %.

∴ Maximum vertical settlement behind the wall = 5.6 mm

Assuming that settlement decays to 0% at distance from wall / wall depth = 1.5.

Settlement due to excavation:



$$S_{V\,max} = \frac{S_{H\,Max}}{2}$$

LONDON CLAY PILE DESIGN
Circular Straight Shafted Piles in a WALL

Concrete Grade N/mm2	32
Wall Width (= Pile Diameter) mm	450
Pile Spacing m	0.6

Design Line	
Cu = Intercept + Slope Z	
Z = Penetration into London Clay(m)	
Intercept kN/m2	97.185 60+6.7(42.1-36.55)
Slope	6.7
Limiting value of average shaft Cu (kN/m^2)	220

Ultimate Shaft Capacity	
Qs(kN) = As*Cu(av)*Alpha	
As(mm^2) = Pen in L.C*Pile Circum	
Alpha = Shaft Adhesion Factor	0.5

Ultimate Base Capacity	
Qb(kN) = Ab*Cu(base)*Nc	
Ab(mm^2)=area of base	
Nc = Bearing Capacity Factor	7.5

Factors of Safety	
Fss=F o S for Shaft	1.2
Fsb=F o S for Base	3
Fs = F o S overall	2.6
Fso=FoS-Shaft(Overall)	1.2

Note Limiting value for average αCu is 110 kN/m2
(Skempton 1959)

Job Name : 46 Avenue Road
Wall Section : Garden wall
Pile Diameter : 450mm
Spacing : 0.6m
Excavation level : 36.55m (including 0.5m overdig)
Vertical Load
Pile to be designed for : 410kN/m

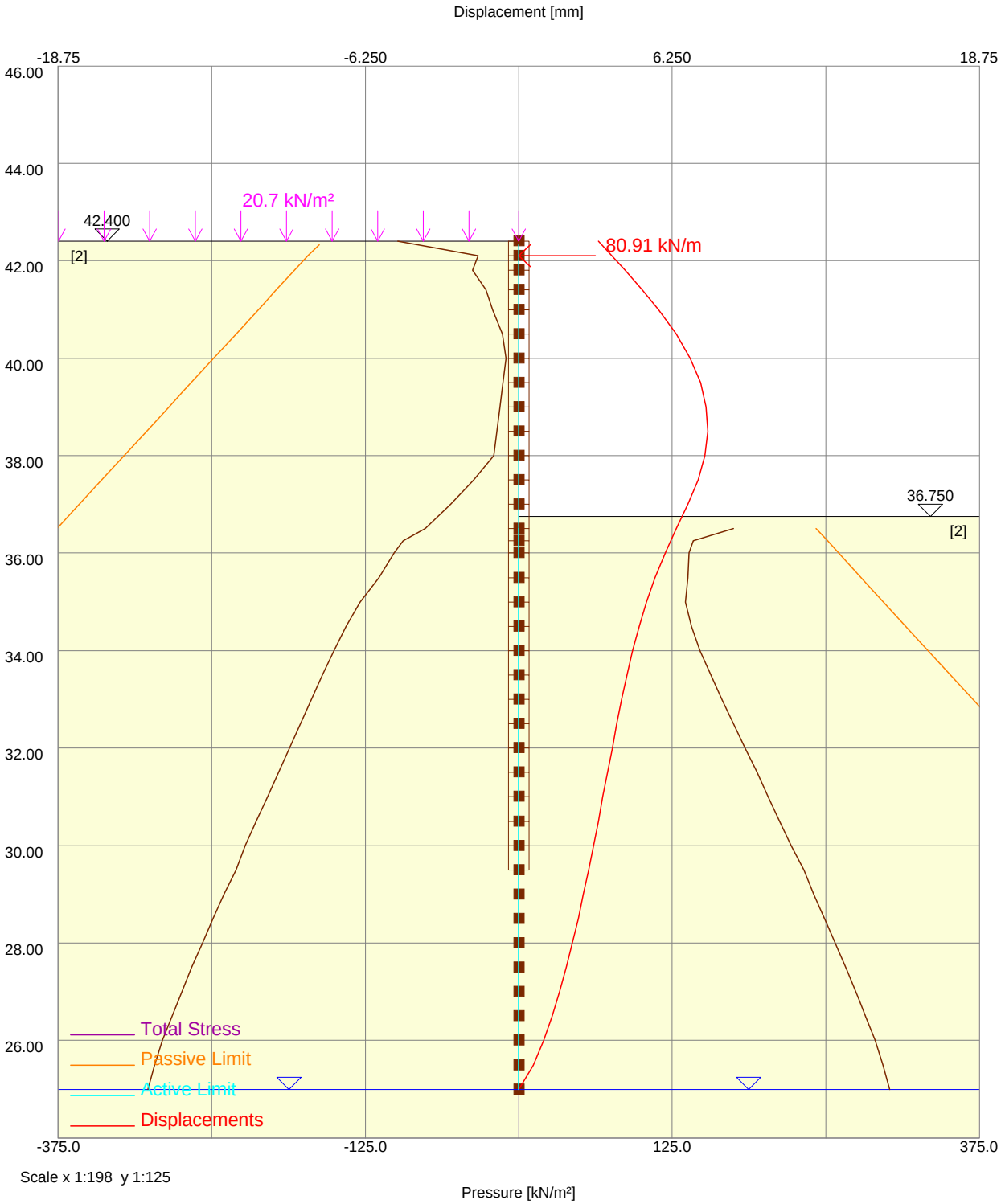
Pile Cut-off= 36.55 mOD

Penetration into London Clay(m)	Cu(kN/m2) Mid -level	Cu(kN/m2) Base	either WALL (single piles) Qs(kN)	or WALL (plate) Qs(kN)	(minimum) WALL Qs kN	WALL Qs(Working)kN	either WALL (single piles) Qb(kN)	or WALL (plate) Qb(kN)	(minimum) WALL Qb kN	WALL Qb(Working)kN	(Qs/Fss) +(Qb/Fsb)(kN)	(Qs+Qb)/Fs(kN)	Qs/Fso(kN)	Concrete Stress Limit(kN)	Design Load(kN)	Limiting Criteria	Design Toe Level mOD
0	97.185	97.185	0	0	0	0	193	328	193	64	64	74	0	2121	0	Shaft	36.55
1	100.535	103.885	118	101	101	84	207	351	207	69	153	118	84	2121	84	Shaft	35.55
2	103.885	110.585	245	208	208	173	220	373	220	73	246	164	173	2121	164	Overall	34.55
3	107.235	117.285	379	322	322	268	233	396	233	78	346	213	268	2121	213	Overall	33.55
4	110.585	123.985	521	442	442	369	246	418	246	82	451	265	369	2121	265	Overall	32.55
5	113.935	130.685	671	570	570	475	260	441	260	87	561	319	475	2121	319	Overall	31.55
6	117.285	137.385	829	704	704	586	273	464	273	91	677	376	586	2121	376	Overall	30.55
7	120.635	144.085	995	844	844	704	286	486	286	95	799	435	704	2121	435	Overall	29.55
8	123.985	150.785	1169	992	992	827	300	509	300	100	926	497	827	2121	497	Overall	28.55
9	127.335	157.485	1350	1146	1146	955	313	532	313	104	1059	561	955	2121	561	Overall	27.55
10	130.685	164.185	1540	1307	1307	1089	326	554	326	109	1198	628	1089	2121	628	Overall	26.55
11	134.035	170.885	1737	1474	1474	1229	340	577	340	113	1342	698	1229	2121	698	Overall	25.55
12	137.385	177.585	1942	1649	1649	1374	353	599	353	118	1492	770	1374	2121	770	Overall	24.55
13	140.735	184.285	2155	1830	1830	1525	366	622	366	122	1647	845	1525	2121	845	Overall	23.55
14	144.085	190.985	2376	2017	2017	1681	380	645	380	127	1808	922	1681	2121	922	Overall	22.55
15	147.435	197.685	2605	2212	2212	1843	393	667	393	131	1974	1002	1843	2121	1002	Overall	21.55
16	150.785	204.385	2842	2413	2413	2010	406	690	406	135	2146	1084	2010	2121	1084	Overall	20.55
17	154.135	211.085	3087	2620	2620	2184	420	712	420	140	2323	1169	2184	2121	1169	Overall	19.55
18	157.485	217.785	3340	2835	2835	2362	433	735	433	144	2507	1257	2362	2121	1257	Overall	18.55
19	160.835	224.485	3600	3056	3056	2547	446	758	446	149	2695	1347	2547	2121	1347	Overall	17.55
20	164.185	231.185	3869	3284	3284	2736	460	780	460	153	2890	1440	2736	2121	1440	Overall	16.55
21	167.535	237.885	4145	3518	3518	2932	473	803	473	158	3090	1535	2932	2121	1535	Overall	15.55

Appendix D

FREW

46 Avenue Road
Main Garden Basement - SLS
Preliminary - 450mm pile at 600mm c/c



STAGE 4 : Excavate to Formation Level

INITIAL DATA

Notes
Model for Deflection Purposes at Planning

Soil properties

No.	Description	Unit Wt [kN/m³]	K0	Ka	Kp	Kac	Kpc	Kr	Earth pressure coefficients.
1	Head	18.00	0.35	0.29	4.64	1.07	4.31	0.25	Calculated
	Deposits								
2	London Clay - Undrained	20.00	1.00	1.00	1.00	2.45	2.45	1.00	Calculated

No.	c0 [kN/m²]	y0 [m]	Gradient of c [kN/m²/m]	E0 [kN/m²]	Gradient of E [kN/m²/m]	Drained/ Undrained
1	0.00	43.40	0.00	15000.	0.00	Drained
2	60.00	42.00	6.70	45000.	5025.00	Undrained

Parameters used to calculate Earth pressure coefficients

No.	Phi [°]	Delta/Phi Ratio	Beta [°]	Cw/C Ratio
1	30.00	0.67	0.00	0.00
2	0.00	0.00	0.00	0.50

Surcharge properties

No.	Stage In	Stage Out	Side	Level [m]	Pressure Factor [kN/m²]	Partial	Offset [m]	Width [m]	Ks
1	0	-	Left	42.40	20.70		1.00		

Strut properties

No.	Stage In	Stage Out	Node	Level [m]	Prestress [kN/m]	Stiffness [kN/m/m]	Angle [°]	Lever arm [m]
1	3	-	2	42.10	0.00	33500.00	0.00	0.00

STAGE 0 : INITIAL CONDITION

Geometry

Node	Level [m]	Soil Left	Soil Right	Boundary Left	Boundary Right	EI below node [kNm2/m]
1	42.40	2	2	30.00	7.50	93935.
2	42.10	2	2	30.00	7.50	93935.
3	41.80	2	2	30.00	7.50	93935.
4	41.40	2	2	30.00	7.50	93935.
5	41.00	2	2	30.00	7.50	93935.
6	40.50	2	2	30.00	7.50	93935.
7	40.00	2	2	30.00	7.50	93935.
8	39.50	2	2	30.00	7.50	93935.
9	39.00	2	2	30.00	7.50	93935.
10	38.50	2	2	30.00	7.50	93935.
11	38.00	2	2	30.00	7.50	93935.
12	37.50	2	2	30.00	7.50	93935.
13	37.00	2	2	30.00	7.50	93935.
14	36.50	2	2	30.00	7.50	93935.
15	36.25	2	2	30.00	7.50	93935.
16	36.00	2	2	30.00	7.50	93935.
17	35.50	2	2	30.00	7.50	93935.
18	35.00	2	2	30.00	7.50	93935.
19	34.50	2	2	30.00	7.50	93935.
20	34.00	2	2	30.00	7.50	93935.
21	33.50	2	2	30.00	7.50	93935.
22	33.00	2	2	30.00	7.50	93935.
23	32.50	2	2	30.00	7.50	93935.
24	32.00	2	2	30.00	7.50	93935.
25	31.50	2	2	30.00	7.50	93935.
26	31.00	2	2	30.00	7.50	93935.
27	30.50	2	2	30.00	7.50	93935.
28	30.00	2	2	30.00	7.50	93935.
***29**	***29.50**	***2**	***2**	***30.00**	***7.50**	***0.0**
30	29.00	2	2	30.00	7.50	0.0
31	28.50	2	2	30.00	7.50	0.0
32	28.00	2	2	30.00	7.50	0.0
33	27.50	2	2	30.00	7.50	0.0
34	27.00	2	2	30.00	7.50	0.0
35	26.50	2	2	30.00	7.50	0.0
36	26.00	2	2	30.00	7.50	0.0
37	25.50	2	2	30.00	7.50	0.0
38	25.00	2	2	30.00	7.50	0.0

**** Wall toe level: 29.50***

Water data on LEFT side

No.	Level [m]	Pressure [kN/m²]	Unit wt. [kN/m³]
1	25.00	0.00	10.00

Water data on RIGHT side

No.	Level [m]	Pressure [kN/m²]	Unit wt. [kN/m³]
1	25.00	0.00	10.00

Analysis details
SAFE model with redistribution
and with friction at wall/soil interface

	Left	Right
E profile Generated		
Boundary distances [m] :	30.00	7.50

Convergence control parameters
Maximum number of iterations : 900
Tolerance for displacement convergence [mm] : 0.01
Tolerance for pressure convergence [kN/m²] : 0.10
Damping coefficient : 1.00
Maximum incremental displacement [m] : 1.00

Minimum equivalent fluid pressure parameters

Material	Left a [kN/m²/m]	Left yo [m]	Left b [kN/m²]	Right a [kN/m²/m]	Right yo [m]	Right b [kN/m²]
Head	0.00	0.00	0.00	0.00	0.00	0.00
Deposits						
London Clay - Undrained	5.00	42.10	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 0 : Initial condition

Surcharge or strut changes
Surcharge no. 1 applied at this stage

Calculation details
E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 42990. E at bottom node = 130430. kN/m²
On the RIGHT: E at ground level = 42990. E at bottom node = 130430. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc max displ [mm]	Node no. error. [mm]	Disp Node no.	Press Node error [kN/m²]	Node no.

Iter no.	Inc max displ	Node no.	Disp error.	Node no.	Press error	Node no.
	[mm]		[mm]		[kN/m²]	
1	0.0	1	1.2847	3	0.00	1
2	1.3	3	0.0000	3	0.00	1
3	1.3	3	0.0000	3	0.00	1

Ground level left = 42.40 Ground level right = 42.40

Node	Level	Disp	Stress Vt	Ve	Pt	Pore Pe	Pressure	Soil		Stress Vt	Ve	Pt	Pore Pe	Pressure	BM	SF
	[m]	[mm]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	Left	Right	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kNm/m]	[kN/m]
1	42.40	1.27	22.20	(22.20)	14.57	(14.57)	(0.00)	2	2	1.50	(1.50)	14.57	(14.57)	(0.00)	0.00	0.00
2	42.10	1.28	26.70	(26.70)	19.20	(19.20)	(0.00)	2	2	6.00	(6.00)	19.20	(19.20)	(0.00)	0.00	0.00
3	41.80	1.28	32.70	(32.70)	25.31	(25.31)	(0.00)	2	2	12.00	(12.00)	25.31	(25.31)	(0.00)	0.00	0.00
4	41.40	1.28	40.70	(40.70)	33.42	(33.42)	(0.00)	2	2	20.00	(20.00)	33.42	(33.42)	(0.00)	0.00	0.00
5	41.00	1.26	48.70	(48.70)	41.51	(41.51)	(0.00)	2	2	28.00	(28.00)	41.51	(41.51)	(0.00)	0.00	0.00
6	40.50	1.24	58.70	(58.70)	51.60	(51.60)	(0.00)	2	2	38.00	(38.00)	51.60	(51.60)	(0.00)	0.00	0.00
7	40.00	1.21	68.70	(68.70)	61.68	(61.68)	(0.00)	2	2	48.00	(48.00)	61.68	(61.68)	(0.00)	0.00	0.00
8	39.50	1.18	78.70	(78.70)	71.75	(71.75)	(0.00)	2	2	58.00	(58.00)	71.75	(71.75)	(0.00)	0.00	0.00
9	39.00	1.15	88.70	(88.70)	81.80	(81.80)	(0.00)	2	2	68.00	(68.00)	81.80	(81.80)	(0.00)	0.00	0.00
10	38.50	1.12	98.70	(98.70)	91.85	(91.85)	(0.00)	2	2	78.00	(78.00)	91.85	(91.85)	(0.00)	0.00	0.00
11	38.00	1.08	108.70	(108.70)	101.88	(101.88)	(0.00)	2	2	88.00	(88.00)	101.88	(101.88)	(0.00)	0.00	0.00
12	37.50	1.05	118.70	(118.70)	111.90	(111.90)	(0.00)	2	2	98.00	(98.00)	111.90	(111.90)	(0.00)	0.00	0.00
13	37.00	1.02	128.70	(128.70)	121.92	(121.92)	(0.00)	2	2	108.00	(108.00)	121.92	(121.92)	(0.00)	0.00	0.00
14	36.50	0.98	138.70	(138.70)	131.92	(131.92)	(0.00)	2	2	118.00	(118.00)	131.92	(131.92)	(0.00)	0.00	0.00
15	36.25	0.97	143.70	(143.70)	136.94	(136.94)	(0.00)	2	2	123.00	(123.00)	136.94	(136.94)	(0.00)	0.00	0.00
16	36.00	0.96	148.70	(148.70)	141.94	(141.94)	(0.00)	2	2	128.00	(128.00)	141.94	(141.94)	(0.00)	0.00	0.00
17	35.50	0.92	158.70	(158.70)	151.92	(151.92)	(0.00)	2	2	138.00	(138.00)	151.92	(151.92)	(0.00)	0.00	0.00
18	35.00	0.89	168.70	(168.70)	161.90	(161.90)	(0.00)	2	2	148.00	(148.00)	161.90	(161.90)	(0.00)	0.00	0.00
19	34.50	0.85	178.70	(178.70)	171.88	(171.88)	(0.00)	2	2	158.00	(158.00)	171.88	(171.88)	(0.00)	0.00	0.00
20	34.00	0.82	188.70	(188.70)	181.85	(181.85)	(0.00)	2	2	168.00	(168.00)	181.85	(181.85)	(0.00)	0.00	0.00
21	33.50	0.79	198.70	(198.70)	191.81	(191.81)	(0.00)	2	2	178.00	(178.00)	191.81	(191.81)	(0.00)	0.00	0.00
22	33.00	0.76	208.70	(208.70)	201.77	(201.77)	(0.00)	2	2	188.00	(188.00)	201.77	(201.77)	(0.00)	0.00	0.00
23	32.50	0.73	218.70	(218.70)	211.71	(211.71)	(0.00)	2	2	198.00	(198.00)	211.71	(211.71)	(0.00)	0.00	0.00
24	32.00	0.69	228.70	(228.70)	221.65	(221.65)	(0.00)	2	2	208.00	(208.00)	221.65	(221.65)	(0.00)	0.00	0.00
25	31.50	0.66	238.70	(238.70)	231.57	(231.57)	(0.00)	2	2	218.00	(218.00)	231.57	(231.57)	(0.00)	0.00	0.00
26	31.00	0.63	248.70	(248.70)	241.49	(241.49)	(0.00)	2	2	228.00	(228.00)	241.49	(241.49)	(0.00)	0.00	0.00
27	30.50	0.59	258.70	(258.70)	251.39	(251.39)	(0.00)	2	2	238.00	(238.00)	251.39	(251.39)	(0.00)	0.00	0.00
28	30.00	0.56	268.70	(268.70)	261.28	(261.28)	(0.00)	2	2	248.00	(248.00)	261.28	(261.28)	(0.00)	0.00	0.00
29	29.50	0.52	278.70	(278.70)	271.16	(271.16)	(0.00)	2	2	258.00	(258.00)	271.16	(271.16)	(0.00)	0.00	0.00
30	29.00	0.48	288.70	(288.70)	281.01	(281.01)	(0.00)	2	2	268.00	(268.00)	281.01	(281.01)	(0.00)	0.00	0.00
31	28.50	0.44	298.70	(298.70)	290.85	(290.85)	(0.00)	2	2	278.00	(278.00)	290.85	(290.85)	(0.00)	0.00	0.00
32	28.00	0.40	308.70	(308.70)	300.67	(300.67)	(0.00)	2	2	288.00	(288.00)	300.67	(300.67)	(0.00)	0.00	0.00
33	27.50	0.36	318.70	(318.70)	310.45	(310.45)	(0.00)	2	2	298.00	(298.00)	310.45	(310.45)	(0.00)	0.00	0.00
34	27.00	0.31	328.70	(328.70)	320.20	(320.20)	(0.00)	2	2	308.00	(308.00)	320.20	(320.20)	(0.00)	0.00	0.00
35	26.50	0.25	338.70	(338.70)	329.90	(329.90)	(0.00)	2	2	318.00	(318.00)	329.90	(329.90)	(0.00)	0.00	0.00
36	26.00	0.19	348.70	(348.70)	339.53	(339.53)	(0.00)	2	2	328.00	(328.00)	339.53	(339.53)	(0.00)	0.00	0.00
37	25.50	0.11	358.70	(358.70)	349.05	(349.05)	(0.00)	2	2	338.00	(338.00)	349.05	(349.05)	(0.00)	0.00	0.00
38	25.00	0.00	368.70	(368.70)	358.35	(358.35)	(0.00)	2	2	348.00	(348.00)	358.35	(358.35)	(0.00)	0.00	0.00

NOTE: Displacements from STAGE 0 are disregarded in later stages

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

Surcharge 1 present in this stage

STAGE 1 : INSTALL WALL

Geometry

Node	Level	Soil	Boundary		EI below node
	[m]	Left	Right	Left Right	[kNm2/m]
1	42.40	2	2	30.00 7.50	93935.
2	42.10	2	2	30.00 7.50	93935.
3	41.80	2	2	30.00 7.50	93935.
4	41.40	2	2	30.00 7.50	93935.
5	41.00	2	2	30.00 7.50	93935.
6	40.50	2	2	30.00 7.50	93935.
7	40.00	2	2	30.00 7.50	93935.
8	39.50	2	2	30.00 7.50	93935.
9	39.00	2	2	30.00 7.50	93935.
10	38.50	2	2	30.00 7.50	93935.
11	38.00	2	2	30.00 7.50	93935.
12	37.50	2	2	30.00 7.50	93935.
13	37.00	2	2	30.00 7.50	93935.
14	36.50	2	2	30.00 7.50	93935.
15	36.25	2	2	30.00 7.50	93935.
16	36.00	2	2	30.00 7.50	93935.
17	35.50	2	2	30.00 7.50	93935.
18	35.00	2	2	30.00 7.50	93935.
19	34.50	2	2	30.00 7.50	93935.
20	34.00	2	2	30.00 7.50	93935.
21	33.50	2	2	30.00 7.50	93935.
22	33.00	2	2	30.00 7.50	93935.
23	32.50	2	2	30.00 7.50	93935.
24	32.00	2	2	30.00 7.50	93935.
25	31.50	2	2	30.00 7.50	93935.
26	31.00	2	2	30.00 7.50	93935.
27	30.50	2	2	30.00 7.50	93935.
28	30.00	2	2	30.00 7.50	93935.
*	***29.50***	***2***	***2 30.00 7.50***		***0.0***
30	29.00	2	2	30.00 7.50	0.0
31	28.50	2	2	30.00 7.50	0.0
32	28.00	2	2	30.00 7.50	0.0
33	27.50	2	2	30.00 7.50	0.0
34	27.00	2	2	30.00 7.50	0.0
35	26.50	2	2	30.00 7.50	0.0
36	26.00	2	2	30.00 7.50	0.0
37	25.50	2	2	30.00 7.50	0.0
38	25.00	2	2	30.00 7.50	0.0

**** Wall toe level: 29.50***

Minimum equivalent fluid pressure parameters

Material	Left a	yo	b	Right a	yo	b
	[kN/m²/m]	[m]	[kN/m²]	[kN/m²/m]	[m]	[kN/m²]
Head	0.00	0.00	0.00	0.00	0.00	0.00
Deposits						
London Clay - Undrained	5.00	42.10	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 1 : Install Wall

Calculation details

E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 42990. E at bottom node = 130430. kN/m²
On the RIGHT: E at ground level = 42990. E at bottom node = 130430. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc max displ	Node no.	Disp error.	Node no.	Press error	Node no.
	[mm]		[mm]		[kN/m²]	
1	0.0	1	0.0000	16	0.00	1
2	0.0	16	0.0000	16	0.00	1
3	0.0	16	0.0000	16	0.00	1

Ground level left = 42.40 Ground level right = 42.40

Node	Level	Disp	Stress Vt	Ve	Pt	Pore Pe	Pressure	Soil		Stress Vt	Ve	Pt	Pore Pe	Pressure	BM	SF
	[m]	[mm]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	Left	Right	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kNm/m]	[kN/m]

Node	Level [m]	Disp [mm]	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe Pressure [kN/m²]	Soil	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]
							Left Right						
1	42.40	0.00	22.20	(22.20)	14.57	(14.57)	(0.00) 2 2	1.50	(1.50)	14.57	(14.57)	(0.00)	0.00	0.00
2	42.10	0.00	26.70	(26.70)	19.20	(19.20)	(0.00) 2 2	6.00	(6.00)	19.20	(19.20)	(0.00)	0.00	0.00
3	41.80	0.00	32.70	(32.70)	25.31	(25.31)	(0.00) 2 2	12.00	(12.00)	25.31	(25.31)	(0.00)	0.00	0.00
4	41.40	0.00	40.70	(40.70)	33.42	(33.42)	(0.00) 2 2	20.00	(20.00)	33.42	(33.42)	(0.00)	0.00	0.00
5	41.00	0.00	48.70	(48.70)	41.51	(41.51)	(0.00) 2 2	28.00	(28.00)	41.51	(41.51)	(0.00)	0.00	0.00
6	40.50	0.00	58.70	(58.70)	51.60	(51.60)	(0.00) 2 2	38.00	(38.00)	51.60	(51.60)	(0.00)	0.00	0.00
7	40.00	0.00	68.70	(68.70)	61.68	(61.68)	(0.00) 2 2	48.00	(48.00)	61.68	(61.68)	(0.00)	0.00	0.00
8	39.50	0.00	78.70	(78.70)	71.75	(71.75)	(0.00) 2 2	58.00	(58.00)	71.75	(71.75)	(0.00)	0.00	0.00
9	39.00	0.00	88.70	(88.70)	81.80	(81.80)	(0.00) 2 2	68.00	(68.00)	81.80	(81.80)	(0.00)	0.00	0.00
10	38.50	0.00	98.70	(98.70)	91.85	(91.85)	(0.00) 2 2	78.00	(78.00)	91.85	(91.85)	(0.00)	0.00	0.00
11	38.00	0.00	108.70	(108.70)	101.88	(101.88)	(0.00) 2 2	88.00	(88.00)	101.88	(101.88)	(0.00)	0.00	0.00
12	37.50	0.00	118.70	(118.70)	111.90	(111.90)	(0.00) 2 2	98.00	(98.00)	111.90	(111.90)	(0.00)	0.00	0.00
13	37.00	0.00	128.70	(128.70)	121.92	(121.92)	(0.00) 2 2	108.00	(108.00)	121.92	(121.92)	(0.00)	0.00	0.00
14	36.50	0.00	138.70	(138.70)	131.92	(131.92)	(0.00) 2 2	118.00	(118.00)	131.92	(131.92)	(0.00)	0.00	0.00
15	36.25	0.00	143.70	(143.70)	136.94	(136.94)	(0.00) 2 2	123.00	(123.00)	136.94	(136.94)	(0.00)	0.00	0.00
16	36.00	0.00	148.70	(148.70)	141.94	(141.94)	(0.00) 2 2	128.00	(128.00)	141.94	(141.94)	(0.00)	0.00	0.00
17	35.50	0.00	158.70	(158.70)	151.92	(151.92)	(0.00) 2 2	138.00	(138.00)	151.92	(151.92)	(0.00)	0.00	0.00
18	35.00	0.00	168.70	(168.70)	161.90	(161.90)	(0.00) 2 2	148.00	(148.00)	161.90	(161.90)	(0.00)	0.00	0.00
19	34.50	0.00	178.70	(178.70)	171.88	(171.88)	(0.00) 2 2	158.00	(158.00)	171.88	(171.88)	(0.00)	0.00	0.00
20	34.00	0.00	188.70	(188.70)	181.85	(181.85)	(0.00) 2 2	168.00	(168.00)	181.85	(181.85)	(0.00)	0.00	0.00
21	33.50	0.00	198.70	(198.70)	191.81	(191.81)	(0.00) 2 2	178.00	(178.00)	191.81	(191.81)	(0.00)	0.00	0.00
22	33.00	0.00	208.70	(208.70)	201.77	(201.77)	(0.00) 2 2	188.00	(188.00)	201.77	(201.77)	(0.00)	0.00	0.00
23	32.50	0.00	218.70	(218.70)	211.71	(211.71)	(0.00) 2 2	198.00	(198.00)	211.71	(211.71)	(0.00)	0.00	0.00
24	32.00	0.00	228.70	(228.70)	221.65	(221.65)	(0.00) 2 2	208.00	(208.00)	221.65	(221.65)	(0.00)	0.00	0.00
25	31.50	0.00	238.70	(238.70)	231.57	(231.57)	(0.00) 2 2	218.00	(218.00)	231.57	(231.57)	(0.00)	0.00	0.00
26	31.00	0.00	248.70	(248.70)	241.49	(241.49)	(0.00) 2 2	228.00	(228.00)	241.49	(241.49)	(0.00)	0.00	0.00
27	30.50	0.00	258.70	(258.70)	251.39	(251.39)	(0.00) 2 2	238.00	(238.00)	251.39	(251.39)	(0.00)	0.00	0.00
28	30.00	0.00	268.70	(268.70)	261.28	(261.28)	(0.00) 2 2	248.00	(248.00)	261.28	(261.28)	(0.00)	0.00	0.00
***29**	29.50	0.00	278.70	(278.70)	271.16	(271.16)	(0.00) 2 2	258.00	(258.00)	271.16	(271.16)	(0.00)	0.00	0.00
30	29.00	0.00	288.70	(288.70)	281.01	(281.01)	(0.00) 2 2	268.00	(268.00)	281.01	(281.01)	(0.00)	0.00	0.00
31	28.50	0.00	298.70	(298.70)	290.85	(290.85)	(0.00) 2 2	278.00	(278.00)	290.85	(290.85)	(0.00)	0.00	0.00
32	28.00	0.00	308.70	(308.70)	300.67	(300.67)	(0.00) 2 2	288.00	(288.00)	300.67	(300.67)	(0.00)	0.00	0.00
33	27.50	0.00	318.70	(318.70)	310.45	(310.45)	(0.00) 2 2	298.00	(298.00)	310.45	(310.45)	(0.00)	0.00	0.00
34	27.00	0.00	328.70	(328.70)	320.20	(320.20)	(0.00) 2 2	308.00	(308.00)	320.20	(320.20)	(0.00)	0.00	0.00
35	26.50	0.00	338.70	(338.70)	329.90	(329.90)	(0.00) 2 2	318.00	(318.00)	329.90	(329.90)	(0.00)	0.00	0.00
36	26.00	0.00	348.70	(348.70)	339.53	(339.53)	(0.00) 2 2	328.00	(328.00)	339.53	(339.53)	(0.00)	0.00	0.00
37	25.50	0.00	358.70	(358.70)	349.05	(349.05)	(0.00) 2 2	338.00	(338.00)	349.05	(349.05)	(0.00)	0.00	0.00
38	25.00	0.00	368.70	(368.70)	358.35	(358.35)	(0.00) 2 2	348.00	(348.00)	358.35	(358.35)	(0.00)	0.00	0.00

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

Wall toe level: 29.50

Note: for undrained materials with user-defined pore pressures, the total stresses are correct, but the pore pressures are the nominal values given by the user. For these cases, tabulated pore pressures and effective stresses are usually unrealistic, and are shown in brackets.

WARNING - Residual moment > 1% of peak moment in wall

EXTREME values so far

Displacements [mm]		Moments [kNm/m]		Shears [kN/m]	
Min	Max	Min	Max	Min	Max
0.00	0.00	0.00	0.00	0.00	0.00

Surcharge 1 present in this stage

STAGE 2 : EXCAVATE FOR TEMP PROP

Geometry

Node	Level [m]	Soil Left	Soil Right	Boundary Left	Boundary Right	EI below node [kNm2/m]
1	42.40	2	0	30.00	7.50	93935.
2	42.10	2	0	30.00	7.50	93935.
3	41.80	2	0	30.00	7.50	93935.
4	41.40	2	2	30.00	7.50	93935.
5	41.00	2	2	30.00	7.50	93935.
6	40.50	2	2	30.00	7.50	93935.
7	40.00	2	2	30.00	7.50	93935.
8	39.50	2	2	30.00	7.50	93935.
9	39.00	2	2	30.00	7.50	93935.
10	38.50	2	2	30.00	7.50	93935.
11	38.00	2	2	30.00	7.50	93935.
12	37.50	2	2	30.00	7.50	93935.
13	37.00	2	2	30.00	7.50	93935.
14	36.50	2	2	30.00	7.50	93935.
15	36.25	2	2	30.00	7.50	93935.
16	36.00	2	2	30.00	7.50	93935.
17	35.50	2	2	30.00	7.50	93935.
18	35.00	2	2	30.00	7.50	93935.
19	34.50	2	2	30.00	7.50	93935.
20	34.00	2	2	30.00	7.50	93935.
21	33.50	2	2	30.00	7.50	93935.
22	33.00	2	2	30.00	7.50	93935.
23	32.50	2	2	30.00	7.50	93935.
24	32.00	2	2	30.00	7.50	93935.
25	31.50	2	2	30.00	7.50	93935.
26	31.00	2	2	30.00	7.50	93935.
27	30.50	2	2	30.00	7.50	93935.
28	30.00	2	2	30.00	7.50	93935.
***29**	***29.50**	***2**	***2**	***30.00**	***7.50**	***0.0**
30	29.00	2	2	30.00	7.50	0.0
31	28.50	2	2	30.00	7.50	0.0
32	28.00	2	2	30.00	7.50	0.0
33	27.50	2	2	30.00	7.50	0.0
34	27.00	2	2	30.00	7.50	0.0
35	26.50	2	2	30.00	7.50	0.0
36	26.00	2	2	30.00	7.50	0.0
37	25.50	2	2	30.00	7.50	0.0
38	25.00	2	2	30.00	7.50	0.0

Wall toe level: 29.50

Minimum equivalent fluid pressure parameters

Material	Left a [kN/m²/m]	Left yo [m]	Left b [kN/m²]	Right a [kN/m²/m]	Right yo [m]	Right b [kN/m²]
Head Deposits	0.00	0.00	0.00	0.00	0.00	0.00
London Clay - Undrained	5.00	42.10	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 2 : Excavate for Temp Prop

Calculation details

E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 42990. E at bottom node = 130430. kN/m²
On the RIGHT: E at ground level = 47010. E at bottom node = 130430. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc max displ [mm]	Node no.	Disp error. [mm]	Node no.	Press error [kN/m²]	Node no.
1	0.0	1	1.4265	1	0.00	1
2	1.4	1	0.0084	1	5.86	1
3	1.4	1	0.0005	1	0.36	1
4	1.4	1	0.0000	1	0.00	1

Ground level left = 42.40 Ground level right = 41.60

Node	Level	Disp	Stress Vt	Stress Ve	Stress Pt	Pore Pe Pressure	Soil	Stress Vt	Stress Ve	Stress Pt	Pore Pe Pressure	BM	SF

	[m]	[mm]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]		Left	Right	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kNm/m]	[kN/m]
1	42.40	1.44	22.20	(22.20)	-0.00	(-0.00)	(0.00)	a	2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	42.10	1.38	26.70	(26.70)	5.70	(5.70)	(0.00)		2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.85
3	41.80	1.32	32.70	(32.70)	15.79	(15.79)	(0.00)		2	0	0.00	0.00	0.00	0.00	0.00	-0.51	4.47
4	41.40	1.25	40.70	(40.70)	25.34	(25.34)	(0.00)		2	2	4.00	(4.00)	37.90	(37.90)	(0.00)	-3.41	4.72
5	41.00	1.18	48.70	(48.70)	34.93	(34.93)	(0.00)		2	2	12.00	(12.00)	39.42	(39.42)	(0.00)	-4.29	1.20
6	40.50	1.11	58.70	(58.70)	45.81	(45.81)	(0.00)		2	2	22.00	(22.00)	48.52	(48.52)	(0.00)	-4.39	-0.49
7	40.00	1.04	68.70	(68.70)	56.56	(56.56)	(0.00)		2	2	32.00	(32.00)	57.36	(57.36)	(0.00)	-3.80	-1.37
8	39.50	0.99	78.70	(78.70)	66.93	(66.93)	(0.00)		2	2	42.00	(42.00)	66.86	(66.86)	(0.00)	-3.02	-1.55
9	39.00	0.95	88.70	(88.70)	77.10	(77.10)	(0.00)		2	2	52.00	(52.00)	76.63	(76.63)	(0.00)	-2.25	-1.42
10	38.50	0.91	98.70	(98.70)	87.16	(87.16)	(0.00)		2	2	62.00	(62.00)	86.56	(86.56)	(0.00)	-1.60	-1.15
11	38.00	0.87	108.70	(108.70)	97.14	(97.14)	(0.00)		2	2	72.00	(72.00)	96.57	(96.57)	(0.00)	-1.10	-0.86
12	37.50	0.84	118.70	(118.70)	107.09	(107.09)	(0.00)		2	2	82.00	(82.00)	106.62	(106.62)	(0.00)	-0.74	-0.60
13	37.00	0.81	128.70	(128.70)	116.98	(116.98)	(0.00)		2	2	92.00	(92.00)	116.72	(116.72)	(0.00)	-0.50	-0.42
14	36.50	0.78	138.70	(138.70)	126.64	(126.64)	(0.00)		2	2	102.00	(102.00)	127.04	(127.04)	(0.00)	-0.33	-0.43
15	36.25	0.77	143.70	(143.70)	132.34	(132.34)	(0.00)		2	2	107.00	(107.00)	131.35	(131.35)	(0.00)	-0.20	-0.38
16	36.00	0.75	148.70	(148.70)	137.27	(137.27)	(0.00)		2	2	112.00	(112.00)	136.40	(136.40)	(0.00)	-0.14	-0.09
17	35.50	0.72	158.70	(158.70)	146.64	(146.64)	(0.00)		2	2	122.00	(122.00)	146.95	(146.95)	(0.00)	-0.17	-0.01
18	35.00	0.70	168.70	(168.70)	156.77	(156.77)	(0.00)		2	2	132.00	(132.00)	156.74	(156.74)	(0.00)	-0.13	-0.07
19	34.50	0.67	178.70	(178.70)	166.70	(166.70)	(0.00)		2	2	142.00	(142.00)	166.70	(166.70)	(0.00)	-0.10	-0.06
20	34.00	0.64	188.70	(188.70)	176.64	(176.64)	(0.00)		2	2	152.00	(152.00)	176.64	(176.64)	(0.00)	-0.06	-0.06
21	33.50	0.62	198.70	(198.70)	186.56	(186.56)	(0.00)		2	2	162.00	(162.00)	186.56	(186.56)	(0.00)	-0.03	-0.07
22	33.00	0.59	208.70	(208.70)	196.47	(196.47)	(0.00)		2	2	172.00	(172.00)	196.47	(196.47)	(0.00)	0.00	-0.07
23	32.50	0.57	218.70	(218.70)	206.37	(206.37)	(0.00)		2	2	182.00	(182.00)	206.36	(206.36)	(0.00)	0.04	-0.07
24	32.00	0.54	228.70	(228.70)	216.25	(216.25)	(0.00)		2	2	192.00	(192.00)	216.23	(216.23)	(0.00)	0.07	-0.06
25	31.50	0.51	238.70	(238.70)	226.13	(226.13)	(0.00)		2	2	202.00	(202.00)	226.08	(226.08)	(0.00)	0.10	-0.04
26	31.00	0.49	248.70	(248.70)	235.99	(235.99)	(0.00)		2	2	212.00	(212.00)	235.90	(235.90)	(0.00)	0.12	-0.01
27	30.50	0.46	258.70	(258.70)	245.83	(245.83)	(0.00)		2	2	222.00	(222.00)	245.71	(245.71)	(0.00)	0.11	0.05
28	30.00	0.43	268.70	(268.70)	255.64	(255.64)	(0.00)		2	2	232.00	(232.00)	255.50	(255.50)	(0.00)	0.07	0.11
***29**	29.50	0.40	278.70	(278.70)	265.20	(265.20)	(0.00)		2	2	242.00	(242.00)	265.49	(265.49)	(0.00)	0.00	0.00
30	29.00	0.37	288.70	(288.70)	275.09	(275.09)	(0.00)		2	2	252.00	(252.00)	275.09	(275.09)	(0.00)	0.00	0.00
31	28.50	0.34	298.70	(298.70)	284.80	(284.80)	(0.00)		2	2	262.00	(262.00)	284.80	(284.80)	(0.00)	0.00	0.00
32	28.00	0.31	308.70	(308.70)	294.46	(294.46)	(0.00)		2	2	272.00	(272.00)	294.46	(294.46)	(0.00)	0.00	0.00
33	27.50	0.28	318.70	(318.70)	304.08	(304.08)	(0.00)		2	2	282.00	(282.00)	304.08	(304.08)	(0.00)	0.00	0.00
34	27.00	0.24	328.70	(328.70)	313.63	(313.63)	(0.00)		2	2	292.00	(292.00)	313.63	(313.63)	(0.00)	0.00	0.00
35	26.50	0.20	338.70	(338.70)	323.10	(323.10)	(0.00)		2	2	302.00	(302.00)	323.10	(323.10)	(0.00)	0.00	0.00
36	26.00	0.15	348.70	(348.70)	332.45	(332.45)	(0.00)		2	2	312.00	(312.00)	332.45	(332.45)	(0.00)	0.00	0.00
37	25.50	0.08	358.70	(358.70)	341.58	(341.58)	(0.00)		2	2	322.00	(322.00)	341.58	(341.58)	(0.00)	0.00	0.00
38	25.00	0.00	368.70	(368.70)	350.35	(350.35)	(0.00)		2	2	332.00	(332.00)	350.35	(350.35)	(0.00)	0.00	0.00

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

**** Wall toe level: 29.50***

Note: for undrained materials with user-defined pore pressures, the total stresses are correct, but the pore pressures are the nominal values given by the user. For these cases, tabulated pore pressures and effective stresses are usually unrealistic, and are shown in brackets.

EXTREME values so far

Displacements [mm]		Moments [kNm/m]		Shears [kN/m]	
Min	Max	Min	Max	Min	Max
0.00	1.44	-4.39	0.12	-1.55	4.72

Surcharge 1 present in this stage

STAGE 3 : INSTALL TEMP PROP

Minimum equivalent fluid pressure parameters

Material	Left			Right		
	a [kN/m²/m]	yo [m]	b [kN/m²]	a [kN/m²/m]	yo [m]	b [kN/m²]
Head	0.00	0.00	0.00	0.00	0.00	0.00
Deposits						
London Clay - Undrained	5.00	42.10	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 3 : Install Temp Prop

Surcharge or strut changes
Strut no 1 inserted at this stage

Calculation details
E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 42990. E at bottom node = 130430. kN/m²
On the RIGHT: E at ground level = 47010. E at bottom node = 130430. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc Node max displ [mm]	Node no.	Disp error [mm]	Node no.	Press error [kN/m²]	Node no.
1	0.0	1	0.0000	1	0.00	1
2	0.0	1	0.0000	1	0.00	1
3	0.0	1	0.0000	1	0.00	1

Ground level left = 42.40 Ground level right = 41.60

Node	Level [m]	Disp [mm]	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pressure Pe [kN/m²]	Pore Pressure [kN/m²]	Soil	Left	Right	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pressure Pe [kN/m²]	Pore Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]
1	42.40	1.44	22.20	(22.20)	0.00	(0.00)	(0.00)	a	2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	42.10	1.38	26.70	(26.70)	5.70	(5.70)	(0.00)		2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.85
	42.10															0.00	0.85
3	41.80	1.32	32.70	(32.70)	15.79	(15.79)	(0.00)		2	0	0.00	0.00	0.00	0.00	0.00	-0.51	4.47
4	41.40	1.25	40.70	(40.70)	25.34	(25.34)	(0.00)		2	2	4.00	(4.00)	37.90	(37.90)	(0.00)	-3.41	4.72
5	41.00	1.18	48.70	(48.70)	34.93	(34.93)	(0.00)		2	2	12.00	(12.00)	39.42	(39.42)	(0.00)	-4.29	1.20
6	40.50	1.11	58.70	(58.70)	45.81	(45.81)	(0.00)		2	2	22.00	(22.00)	48.52	(48.52)	(0.00)	-4.39	-0.49
7	40.00	1.04	68.70	(68.70)	56.56	(56.56)	(0.00)		2	2	32.00	(32.00)	57.36	(57.36)	(0.00)	-3.80	-1.37
8	39.50	0.99	78.70	(78.70)	66.93	(66.93)	(0.00)		2	2	42.00	(42.00)	66.86	(66.86)	(0.00)	-3.02	-1.55
9	39.00	0.95	88.70	(88.70)	77.10	(77.10)	(0.00)		2	2	52.00	(52.00)	76.63	(76.63)	(0.00)	-2.25	-1.42
10	38.50	0.91	98.70	(98.70)	87.16	(87.16)	(0.00)		2	2	62.00	(62.00)	86.56	(86.56)	(0.00)	-1.60	-1.15
11	38.00	0.87	108.70	(108.70)	97.14	(97.14)	(0.00)		2	2	72.00	(72.00)	96.57	(96.57)	(0.00)	-1.10	-0.86
12	37.50	0.84	118.70	(118.70)	107.09	(107.09)	(0.00)		2	2	82.00	(82.00)	106.62	(106.62)	(0.00)	-0.74	-0.60
13	37.00	0.81	128.70	(128.70)	116.98	(116.98)	(0.00)		2	2	92.00	(92.00)	116.72	(116.72)	(0.00)	-0.50	-0.42
14	36.50	0.78	138.70	(138.70)	126.64	(126.64)	(0.00)		2	2	102.00	(102.00)	127.04	(127.04)	(0.00)	-0.33	-0.43
15	36.25	0.77	143.70	(143.70)	132.34	(132.34)	(0.00)		2	2	107.00	(107.00)	131.35	(131.35)	(0.00)	-0.20	-0.38
16	36.00	0.75	148.70	(148.70)	137.27	(137.27)	(0.00)		2	2	112.00	(112.00)	136.40	(136.40)	(0.00)	-0.14	-0.09
17	35.50	0.72	158.70	(158.70)	146.64	(146.64)	(0.00)		2	2	122.00	(122.00)	146.95	(146.95)	(0.00)	-0.17	-0.01
18	35.00	0.70	168.70	(168.70)	156.77	(156.77)	(0.00)		2	2	132.00	(132.00)	156.74	(156.74)	(0.00)	-0.13	-0.07
19	34.50	0.67	178.70	(178.70)	166.70	(166.70)	(0.00)		2	2	142.00	(142.00)	166.70	(166.70)	(0.00)	-0.10	-0.06
20	34.00	0.64	188.70	(188.70)	176.64	(176.64)	(0.00)		2	2	152.00	(152.00)	176.64	(176.64)	(0.00)	-0.06	-0.06
21	33.50	0.62	198.70	(198.70)	186.56	(186.56)	(0.00)		2	2	162.00	(162.00)	186.56	(186.56)	(0.00)	-0.03	-0.07
22	33.00	0.59	208.70	(208.70)	196.47	(196.47)	(0.00)		2	2	172.00	(172.00)	196.47	(196.47)	(0.00)	0.00	-0.07
23	32.50	0.57	218.70	(218.70)	206.37	(206.37)	(0.00)		2	2	182.00	(182.00)	206.36	(206.36)	(0.00)	0.04	-0.07
24	32.00	0.54	228.70	(228.70)	216.25	(216.25)	(0.00)		2	2	192.00	(192.00)	216.23	(216.23)	(0.00)	0.07	-0.06
25	31.50	0.51	238.70	(238.70)	226.13	(226.13)	(0.00)		2	2	202.00	(202.00)	226.08	(226.08)	(0.00)	0.10	-0.04
26	31.00	0.49	248.70	(248.70)	235.99	(235.99)	(0.00)		2	2	212.00	(212.00)	235.90	(235.90)	(0.00)	0.12	-0.01
27	30.50	0.46	258.70	(258.70)	245.83	(245.83)	(0.00)		2	2	222.00	(222.00)	245.71	(245.71)	(0.00)	0.11	0.05
28	30.00	0.43	268.70	(268.70)	255.64	(255.64)	(0.00)		2	2	232.00	(232.00)	255.50	(255.50)	(0.00)	0.07	0.11
***29**	29.50	0.40	278.70	(278.70)	265.20	(265.20)	(0.00)		2	2	242.00	(242.00)	265.49	(265.49)	(0.00)	0.00	0.00
30	29.00	0.37	288.70	(288.70)	275.09	(275.09)	(0.00)		2	2	252.00	(252.00)	275.09	(275.09)	(0.00)	0.00	0.00
31	28.50	0.34	298.70	(298.70)	284.80	(284.80)	(0.00)		2	2	262.00	(262.00)	284.80	(284.80)	(0.00)	0.00	0.00
32	28.00	0.31	308.70	(308.70)	294.46	(294.46)	(0.00)		2	2	272.00	(272.00)	294.46	(294.46)	(0.00)	0.00	0.00
33	27.50	0.28	318.70	(318.70)	304.08	(304.08)	(0.00)		2	2	282.00	(282.00)	304.08	(304.08)	(0.00)	0.00	0.00
34	27.00	0.24	328.70	(328.70)	313.63	(313.63)	(0.00)		2	2	292.00	(292.00)	313.63	(313.63)	(0.00)	0.00	0.00
35	26.50	0.20	338.70	(338.70)	323.10	(323.10)	(0.00)		2	2	302.00	(302.00)	323.10	(323.10)	(0.00)	0.00	0.00
36	26.00	0.15	348.70	(348.70)	332.45	(332.45)	(0.00)		2	2	312.00	(312.00)	332.45	(332.45)	(0.00)	0.00	0.00
37	25.50	0.08	358.70	(358.70)	341.58	(341.58)	(0.00)		2	2	322.00	(322.00)	341.58	(341.58)	(0.00)	0.00	0.00
38	25.00	0.00	368.70	(368.70)	350.35	(350.35)	(0.00)		2	2	332.00	(332.00)	350.35	(350.35)	(0.00)	0.00	0.00

Vt, Ve : vertical total and effective stress

Node	Level [m]	Disp [mm]	Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe Pressure [kN/m²]	Soil Left Right	Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]

Pt, Pe : horizontal total and effective stress

Wall toe level: 29.50

Note: for undrained materials with user-defined pore pressures, the total stresses are correct, but the pore pressures are the nominal values given by the user. For these cases, tabulated pore pressures and effective stresses are usually unrealistic, and are shown in brackets.

EXTREME values so far

Displacements [mm]		Moments [kNm/m]		Shears [kN/m]	
Min	Max	Min	Max	Min	Max
0.00	1.44	-4.39	0.12	-1.55	4.72

Surcharge 1 present in this stage

Strut Forces

No.	Node no.	Strut force [kN/m]	Horiz force [kN/m]	Moment [kNm/m]	Max strut force [kN/m]
1	2	0.00	0.00	0.00	0.00

STAGE 4 : EXCAVATE TO FORMATION LEVEL

Geometry

Node	Level [m]	Soil Left	Soil Right	Boundary Left	Boundary Right	EI below node [kNm2/m]
1	42.40	2	0	30.00	7.50	93935.
2	42.10	2	0	30.00	7.50	93935.
3	41.80	2	0	30.00	7.50	93935.
4	41.40	2	0	30.00	7.50	93935.
5	41.00	2	0	30.00	7.50	93935.
6	40.50	2	0	30.00	7.50	93935.
7	40.00	2	0	30.00	7.50	93935.
8	39.50	2	0	30.00	7.50	93935.
9	39.00	2	0	30.00	7.50	93935.
10	38.50	2	0	30.00	7.50	93935.
11	38.00	2	0	30.00	7.50	93935.
12	37.50	2	0	30.00	7.50	93935.
13	37.00	2	0	30.00	7.50	93935.
14	36.50	2	2	30.00	7.50	93935.
15	36.25	2	2	30.00	7.50	93935.
16	36.00	2	2	30.00	7.50	93935.
17	35.50	2	2	30.00	7.50	93935.
18	35.00	2	2	30.00	7.50	93935.
19	34.50	2	2	30.00	7.50	93935.
20	34.00	2	2	30.00	7.50	93935.
21	33.50	2	2	30.00	7.50	93935.
22	33.00	2	2	30.00	7.50	93935.
23	32.50	2	2	30.00	7.50	93935.
24	32.00	2	2	30.00	7.50	93935.
25	31.50	2	2	30.00	7.50	93935.
26	31.00	2	2	30.00	7.50	93935.
27	30.50	2	2	30.00	7.50	93935.
28	30.00	2	2	30.00	7.50	93935.
***29**	***29.50**	***2**	***2**	***30.00**	***7.50**	***0.0**
30	29.00	2	2	30.00	7.50	0.0
31	28.50	2	2	30.00	7.50	0.0
32	28.00	2	2	30.00	7.50	0.0
33	27.50	2	2	30.00	7.50	0.0
34	27.00	2	2	30.00	7.50	0.0
35	26.50	2	2	30.00	7.50	0.0
36	26.00	2	2	30.00	7.50	0.0
37	25.50	2	2	30.00	7.50	0.0
38	25.00	2	2	30.00	7.50	0.0

Wall toe level: 29.50

Minimum equivalent fluid pressure parameters

Material	Left a [kN/m²/m]	Left yo [m]	Left b [kN/m²]	Right a [kN/m²/m]	Right yo [m]	Right b [kN/m²]
Head	0.00	0.00	0.00	0.00	0.00	0.00
Deposits						
London Clay - Undrained	5.00	42.10	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 4 : Excavate to Formation Level

Calculation details

E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 42990. E at bottom node = 130430. kN/m²
On the RIGHT: E at ground level = 71381. E at bottom node = 130430. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc max displ [mm]	Node no.	Disp error. [mm]	Node no.	Press error [kN/m²]	Node no.
1	0.0	1	6.7427	10	0.00	1
2	6.7	10	0.0172	8	4.41	9
3	6.8	10	0.0132	8	2.61	9
4	6.8	10	0.0096	8	1.85	10
5	6.8	10	0.0067	8	1.25	10
10	6.8	10	0.0019	7	0.24	11
14	6.8	10	0.0008	6	0.07	11

Ground level left = 42.40 Ground level right = 36.75

Node	Level [m]	Disp [mm]	Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe Pressure [kN/m²]	Soil Left	Soil Right	Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]
1	42.40	3.25	22.20	(22.20)	98.46	(98.46)	(0.00)	2	0	0.00	0.00	0.00	0.00	0.00	0.00
2	42.10	3.79	26.70	(26.70)	33.16	(33.16)	(0.00)	2	0	0.00	0.00	0.00	0.00	-4.43	19.74
	42.10													-4.43	-61.16
3	41.80	4.34	32.70	(32.70)	37.73	(37.73)	(0.00)	2	0	0.00	0.00	0.00	0.00	12.43	-49.58
4	41.40	5.04	40.70	(40.70)	27.14	(27.14)	(0.00)	2	0	0.00	0.00	0.00	0.00	29.62	-37.55
5	41.00	5.70	48.70	(48.70)	21.42	(21.42)	(0.00)	2	0	0.00	0.00	0.00	0.00	42.47	-27.30
6	40.50	6.42	58.70	(58.70)	13.76	(13.76)	(0.00)	2	0	0.00	0.00	0.00	0.00	53.71	-19.04
7	40.00	6.99	68.70	(68.70)	10.51	(10.51)	(0.00) mA	2	0	0.00	0.00	0.00	0.00	61.51	-12.97
8	39.50	7.41	78.70	(78.70)	13.00	(13.00)	(0.00) mA	2	0	0.00	0.00	0.00	0.00	66.68	-7.10
9	39.00	7.64	88.70	(88.70)	15.47	(15.47)	(0.00) mA	2	0	0.00	0.00	0.00	0.00	68.61	0.02
10	38.50	7.70	98.70	(98.70)	17.94	(17.94)	(0.00) mA	2	0	0.00	0.00	0.00	0.00	66.66	8.37
11	38.00	7.58	108.70	(108.70)	20.43	(20.43)	(0.00) mA	2	0	0.00	0.00	0.00	0.00	60.23	17.97
12	37.50	7.30	118.70	(118.70)	36.70	(36.70)	(0.00)	2	0	0.00	0.00	0.00	0.00	48.70	32.25
13	37.00	6.90	128.70	(128.70)	55.62	(55.62)	(0.00)	2	0	0.00	0.00	0.00	0.00	27.99	55.33
14	36.50	6.43	138.70	(138.70)	76.45	(76.45)	(0.00)	2	2	5.00	(5.00)	175.11	(175.11) (0.00)	-6.63	50.73
15	36.25	6.19	143.70	(143.70)	94.15	(94.15)	(0.00)	2	2	10.00	(10.00)	142.46	(142.46) (0.00)	-14.69	26.20
16	36.00	5.97	148.70	(148.70)	101.83	(101.83)	(0.00)	2	2	15.00	(15.00)	138.99	(138.99) (0.00)	-19.73	13.19
17	35.50	5.56	158.70	(158.70)	114.21	(114.21)	(0.00)	2	2	25.00	(25.00)	137.68	(137.68) (0.00)	-22.84	0.36
18	35.00	5.20	168.70	(168.70)	129.18	(129.18)	(0.00)	2	2	35.00	(35.00)	135.94	(135.94) (0.00)	-20.09	-7.20
19	34.50	4.90	178.70	(178.70)	140.53	(140.53)	(0.00)	2	2	45.00	(45.00)	140.74	(140.74) (0.00)	-15.64	-8.95
20	34.00	4.64	188.70	(188.70)	150.59	(150.59)	(0.00)	2	2	55.00	(55.00)	147.85	(147.85) (0.00)	-11.14	-8.31
21	33.50	4.41	198.70	(198.70)	159.88	(159.88)	(0.00)	2	2	65.00	(65.00)	156.34	(156.34) (0.00)	-7.33	-6.74
22	33.00	4.20	208.70	(208.70)	168.83	(168.83)	(0.00)	2	2	75.00	(75.00)	165.53	(165.53) (0.00)	-4.40	-5.03
23	32.50	4.00	218.70	(218.70)	177.69	(177.69)	(0.00)	2	2	85.00	(85.00)	175.00	(175.00) (0.00)	-2.30	-3.53
24	32.00	3.81	228.70	(228.70)	186.59	(186.59)	(0.00)	2	2	95.00	(95.00)	184.51	(184.51) (0.00)	-0.87	-2.34
25	31.50	3.62	238.70	(238.70)	195.59	(195.59)	(0.00)	2	2	105.00	(105.00)	193.95	(193.95) (0.00)	0.04	-1.41
26	31.00	3.43	248.70	(248.70)	204.68	(204.68)	(0.00)	2	2	115.00	(115.00)	203.26	(203.26) (0.00)	0.54	-0.64
27	30.50	3.24	258.70	(258.70)	213.81	(213.81)	(0.00)	2	2	125.00	(125.00)	212.46	(212.46) (0.00)	0.68	0.05
28	30.00	3.05	268.70	(268.70)	222.85	(222.85)	(0.00)	2	2	135.00	(135.00)	221.67	(221.67) (0.00)	0.49	0.68
***29**	29.50	2.86	278.70	(278.70)	230.33	(230.33)	(0.00)	2	2	145.00	(145.00)	232.28	(232.28) (0.00)	0.00	0.00

Node	Level [m]	Disp [mm]	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Pore Pt [kN/m²]	Pore Pe Pressure [kN/m²]	Soil Left	Soil Right	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Pore Pt [kN/m²]	Pore Pe Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]
30	29.00	2.65	288.70	(288.70)	240.25	(240.25)	(0.00)	2	2	155.00	(155.00)	240.25	(240.25)	(0.00)	0.00	0.00
31	28.50	2.43	298.70	(298.70)	249.06	(249.06)	(0.00)	2	2	165.00	(165.00)	249.06	(249.06)	(0.00)	0.00	0.00
32	28.00	2.20	308.70	(308.70)	257.74	(257.74)	(0.00)	2	2	175.00	(175.00)	257.74	(257.74)	(0.00)	0.00	0.00
33	27.50	1.95	318.70	(318.70)	266.24	(266.24)	(0.00)	2	2	185.00	(185.00)	266.24	(266.24)	(0.00)	0.00	0.00
34	27.00	1.68	328.70	(328.70)	274.51	(274.51)	(0.00)	2	2	195.00	(195.00)	274.51	(274.51)	(0.00)	0.00	0.00
35	26.50	1.38	338.70	(338.70)	282.47	(282.47)	(0.00)	2	2	205.00	(205.00)	282.47	(282.47)	(0.00)	0.00	0.00
36	26.00	1.03	348.70	(348.70)	290.03	(290.03)	(0.00)	2	2	215.00	(215.00)	290.03	(290.03)	(0.00)	0.00	0.00
37	25.50	0.60	358.70	(358.70)	296.43	(296.43)	(0.00)	2	2	225.00	(225.00)	296.43	(296.43)	(0.00)	0.00	0.00
38	25.00	0.00	368.70	(368.70)	301.85	(301.85)	(0.00)	2	2	235.00	(235.00)	301.85	(301.85)	(0.00)	0.00	0.00

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

**** Wall toe level: 29.50***

Note: for undrained materials with user-defined pore pressures, the total stresses are correct, but the pore pressures are the nominal values given by the user. For these cases, tabulated pore pressures and effective stresses are usually unrealistic, and are shown in brackets.

EXTREME values so far

Displacements [mm]		Moments [kNm/m]		Shears [kN/m]	
Min	Max	Min	Max	Min	Max
0.00	7.70	-22.84	68.61	-61.16	55.33

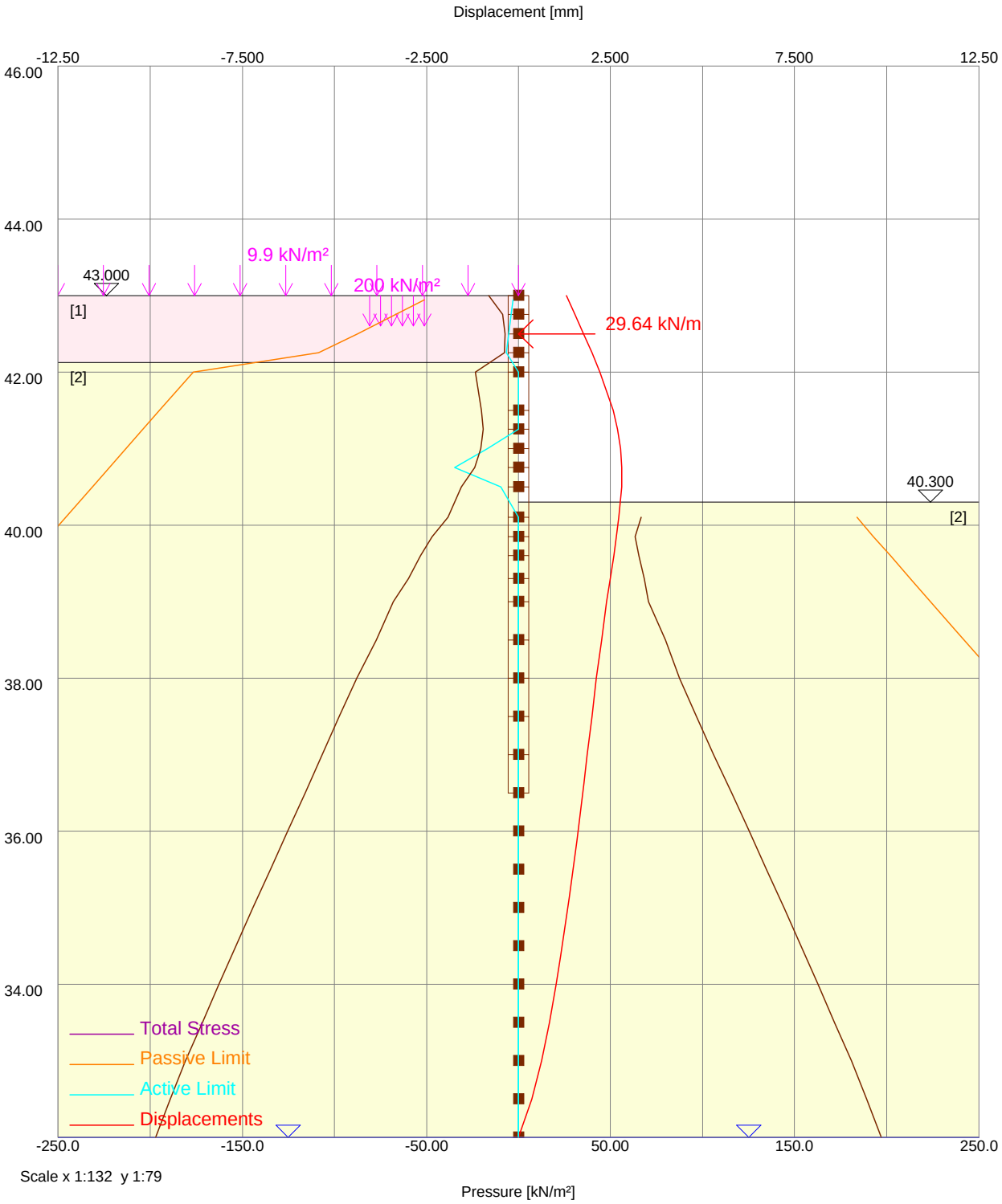
Surcharge 1 present in this stage

Strut Forces

No.	Node no.	Strut force [kN/m]	Horiz force [kN/m]	Moment [kNm/m]	Max strut force [kN/m]
1	2	80.91	80.91	0.00	80.91

Results Envelope

Node	Level [m]	Displacements [mm] Min	Max	Moments [kNm/m] Min	Max	Shears [kN/m] Min	Max
1	42.40	0.00	3.25	0.00	0.00	0.00	0.00
2	42.10	0.00	3.79	-4.43	0.00	-61.16	19.74
3	41.80	0.00	4.34	-0.51	12.43	-49.58	4.47
4	41.40	0.00	5.04	-3.41	29.62	-37.55	4.72
5	41.00	0.00	5.70	-4.29	42.47	-27.30	1.20
6	40.50	0.00	6.42	-4.39	53.71	-19.04	0.00
7	40.00	0.00	6.99	-3.80	61.51	-12.97	0.00
8	39.50	0.00	7.41	-3.02	66.68	-7.10	0.00
9	39.00	0.00	7.64	-2.25	68.61	-1.42	0.02
10	38.50	0.00	7.70	-1.60	66.66	-1.15	8.37
11	38.00	0.00	7.58	-1.10	60.23	-0.86	17.97
12	37.50	0.00	7.30	-0.74	48.70	-0.60	32.25
13	37.00	0.00	6.90	-0.50	27.99	-0.42	55.33
14	36.50	0.00	6.43	-6.63	0.00	-0.43	50.73
15	36.25	0.00	6.19	-14.69	0.00	-0.38	26.20
16	36.00	0.00	5.97	-19.73	0.00	-0.09	13.19
17	35.50	0.00	5.56	-22.84	0.00	-0.01	0.36
18	35.00	0.00	5.20	-20.09	0.00	-7.20	0.00
19	34.50	0.00	4.90	-15.64	0.00	-8.95	0.00
20	34.00	0.00	4.64	-11.14	0.00	-8.31	0.00
21	33.50	0.00	4.41	-7.33	0.00	-6.74	0.00
22	33.00	0.00	4.20	-4.40	0.00	-5.03	0.00
23	32.50	0.00	4.00	-2.30	0.04	-3.53	0.00
24	32.00	0.00	3.81	-0.87	0.07	-2.34	0.00
25	31.50	0.00	3.62	0.00	0.10	-1.41	0.00
26	31.00	0.00	3.43	0.00	0.54	-0.64	0.00
27	30.50	0.00	3.24	0.00	0.68	0.00	0.05
28	30.00	0.00	3.05	0.00	0.49	0.00	0.68
29	***29.50***	***0.00***	***2.86***	***0.00***	***0.00***	***0.00***	***0.00***
30	29.00	0.00	2.65	0.00	0.00	0.00	0.00
31	28.50	0.00	2.43	0.00	0.00	0.00	0.00
32	28.00	0.00	2.20	0.00	0.00	0.00	0.00
33	27.50	0.00	1.95	0.00	0.00	0.00	0.00
34	27.00	0.00	1.68	0.00	0.00	0.00	0.00
35	26.50	0.00	1.38	0.00	0.00	0.00	0.00
36	26.00	0.00	1.03	0.00	0.00	0.00	0.00
37	25.50	0.00	0.60	0.00	0.00	0.00	0.00
38	25.00	0.00	0.00	0.00	0.00	0.00	0.00



STAGE 3 : Excavate to Formation Level

INITIAL DATA

Notes

Model for Deflection Purposes at Planning

Soil properties

No.	Description	Unit Wt [kN/m³]	K0	Ka	Kp	Kac	Kpc	Kr	Earth pressure coefficients.
1	Head Deposits	18.00	0.35	0.29	4.64	1.07	4.31	0.25	Calculated
2	London Clay - Undrained	20.00	1.00	1.00	1.00	2.45	2.45	1.00	Calculated

No.	c0 [kN/m²]	y0 [m]	Gradient of c [kN/m²/m]	E0 [kN/m²]	Gradient of E [kN/m²/m]	Drained/ Undrained
1	0.00	43.40	0.00	15000.	0.00	Drained
2	60.00	42.10	6.70	45000.	5025.00	Undrained

Parameters used to calculate Earth pressure coefficients

No.	Phi [°]	Delta/Phi Ratio	Beta [°]	Cw/C Ratio
1	30.00	0.67	0.00	0.00
2	0.00	0.00	0.00	0.50

Surcharge properties

No.	Stage In	Stage Out	Side	Level [m]	Pressure [kN/m²]	Partial Factor	Offset [m]	Width [m]	Ks
1	0	-	Left	43.00	9.90	1.00			
2	0	-	Left	42.60	200.00	1.00	2.05	1.20	0.25

Strut properties

No.	Stage In	Stage Out	Node	Level [m]	Prestress [kN/m]	Stiffness [kN/m/m]	Angle [°]	Lever arm [m]
1	2	-	3	42.50	0.00	16750.00	0.00	0.00

STAGE 0 : INITIAL CONDITION

Geometry

Node	Level [m]	Soil Left	Soil Right	Boundary Left	Boundary Right	EI below node [kNm2/m]
1	43.00	1	1	30.00	7.50	24740.
2	42.75	1	1	30.00	7.50	24740.
3	42.50	1	1	30.00	7.50	24740.
4	42.25	1	1	30.00	7.50	24740.
5	42.00	2	2	30.00	7.50	24740.
6	41.50	2	2	30.00	7.50	24740.
7	41.25	2	2	30.00	7.50	24740.
8	41.00	2	2	30.00	7.50	24740.
9	40.75	2	2	30.00	7.50	24740.
10	40.50	2	2	30.00	7.50	24740.
11	40.10	2	2	30.00	7.50	24740.
12	39.85	2	2	30.00	7.50	24740.
13	39.60	2	2	30.00	7.50	24740.
14	39.30	2	2	30.00	7.50	24740.
15	39.00	2	2	30.00	7.50	24740.
16	38.50	2	2	30.00	7.50	24740.
17	38.00	2	2	30.00	7.50	24740.
18	37.50	2	2	30.00	7.50	24740.
19	37.00	2	2	30.00	7.50	24740.
*****	***36.50***	***2***	***2***	***30.00***	***7.50***	***0.0***
21	36.00	2	2	30.00	7.50	0.0
22	35.50	2	2	30.00	7.50	0.0
23	35.00	2	2	30.00	7.50	0.0
24	34.50	2	2	30.00	7.50	0.0
25	34.00	2	2	30.00	7.50	0.0
26	33.50	2	2	30.00	7.50	0.0
27	33.00	2	2	30.00	7.50	0.0
28	32.50	2	2	30.00	7.50	0.0
29	32.00	2	2	30.00	7.50	0.0

**** Wall toe level: 36.50***

Water data on LEFT side

No.	Level [m]	Pressure [kN/m²]	Unit wt. [kN/m³]
1	32.00	0.00	10.00

Water data on RIGHT side

No.	Level [m]	Pressure [kN/m²]	Unit wt. [kN/m³]
1	32.00	0.00	10.00

Analysis details

SAFE model with redistribution
and with friction at wall/soil interface

	Left	Right
E profile Generated		
Boundary distances [m] :	30.00	7.50

Convergence control parameters

Maximum number of iterations : 900
Tolerance for displacement convergence [mm] : 0.01
Tolerance for pressure convergence [kN/m²] : 0.10
Damping coefficient : 1.00
Maximum incremental displacement [m] : 1.00

Minimum equivalent fluid pressure parameters

Material	Left a [kN/m²/m]	Left yo [m]	Left b [kN/m²]	Right a [kN/m²/m]	Right yo [m]	Right b [kN/m²]
Head Deposits	0.00	0.00	0.00	0.00	0.00	0.00
London Clay - Undrained	5.00	43.00	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 0 : Initial condition

Surcharge or strut changes

Surcharge no. 1 applied at this stage
Surcharge no. 2 applied at this stage

Calculation details

E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 28837. E at bottom node = 106410. kN/m²
On the RIGHT: E at ground level = 28837. E at bottom node = 106410. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc Node max displ [mm]	Disp Node no. error. [mm]	Press Node no. error [kN/m²]	Node no.
1	0.0	1 0.8729	5 0.00	1
2	0.9	5 0.0044	1 0.44	1
3	0.9	5 0.0028	1 0.22	2
4	0.9	5 0.0018	1 0.19	2
5	0.9	5 0.0012	1 0.14	2
7	0.9	5 0.0005	1 0.05	2

Iter no.	Inc Node max displ	Node no.	Disp error.	Node no.	Press error	Node no.
	[mm]		[mm]		[kN/m²]	

Ground level left = 43.00 Ground level right = 43.00

Node	Level	Disp	Vt	Stress Ve	Pt	Pe	Pore Pressure		Soil Left	Right	Vt	Stress Ve	Pt	Pe	Pore Pressure	BM	SF
	[m]	[mm]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]				[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kNm/m]	[kN/m]
1	43.00	0.78	11.02	11.02	3.14	3.14	0.00	a	1	1	1.13	1.13	3.14	3.14	0.00	0.00	0.00
2	42.75	0.80	14.40	14.40	4.06	4.06	0.00	a	1	1	4.50	4.50	4.06	4.06	0.00	0.00	0.00
3	42.50	0.82	18.91	18.91	5.84	5.84	0.00		1	1	9.00	9.00	5.84	5.84	0.00	0.00	0.00
4	42.25	0.85	23.70	23.70	9.00	9.00	0.00		1	1	13.50	13.50	9.00	9.00	0.00	0.00	0.00
5	42.00	0.87	29.56	(29.56)	28.25	(28.25)	(0.00)		2	2	18.25	(18.25)	28.25	(28.25)	(0.00)	0.00	0.00
6	41.50	0.86	44.92	(44.92)	39.70	(39.70)	(0.00)		2	2	28.25	(28.25)	39.70	(39.70)	(0.00)	0.00	0.00
7	41.25	0.85	53.79	(53.79)	44.96	(44.96)	(0.00)		2	2	33.25	(33.25)	44.96	(44.96)	(0.00)	0.00	0.00
8	41.00	0.84	62.98	(62.98)	49.99	(49.99)	(0.00)		2	2	38.25	(38.25)	49.99	(49.99)	(0.00)	0.00	0.00
9	40.75	0.82	72.15	(72.15)	54.85	(54.85)	(0.00)		2	2	43.25	(43.25)	54.85	(54.85)	(0.00)	0.00	0.00
10	40.50	0.80	81.04	(81.04)	59.59	(59.59)	(0.00)		2	2	48.25	(48.25)	59.59	(59.59)	(0.00)	0.00	0.00
11	40.10	0.76	94.32	(94.32)	67.05	(67.05)	(0.00)		2	2	56.25	(56.25)	67.05	(67.05)	(0.00)	0.00	0.00
12	39.85	0.74	101.95	(101.95)	71.69	(71.69)	(0.00)		2	2	61.25	(61.25)	71.69	(71.69)	(0.00)	0.00	0.00
13	39.60	0.71	109.06	(109.06)	76.33	(76.33)	(0.00)		2	2	66.25	(66.25)	76.33	(76.33)	(0.00)	0.00	0.00
14	39.30	0.68	116.99	(116.99)	81.93	(81.93)	(0.00)		2	2	72.25	(72.25)	81.93	(81.93)	(0.00)	0.00	0.00
15	39.00	0.65	124.32	(124.32)	87.56	(87.56)	(0.00)		2	2	78.25	(78.25)	87.56	(87.56)	(0.00)	0.00	0.00
16	38.50	0.60	135.51	(135.51)	97.00	(97.00)	(0.00)		2	2	88.25	(88.25)	97.00	(97.00)	(0.00)	0.00	0.00
17	38.00	0.55	145.75	(145.75)	106.55	(106.55)	(0.00)		2	2	98.25	(98.25)	106.55	(106.55)	(0.00)	0.00	0.00
18	37.50	0.51	155.37	(155.37)	116.17	(116.17)	(0.00)		2	2	108.25	(108.25)	116.17	(116.17)	(0.00)	0.00	0.00
19	37.00	0.47	164.60	(164.60)	125.86	(125.86)	(0.00)		2	2	118.25	(118.25)	125.86	(125.86)	(0.00)	0.00	0.00
20	36.50	0.42	173.59	(173.59)	135.58	(135.58)	(0.00)		2	2	128.25	(128.25)	135.58	(135.58)	(0.00)	0.00	0.00
21	36.00	0.38	182.46	(182.46)	145.34	(145.34)	(0.00)		2	2	138.25	(138.25)	145.34	(145.34)	(0.00)	0.00	0.00
22	35.50	0.34	191.27	(191.27)	155.12	(155.12)	(0.00)		2	2	148.25	(148.25)	155.12	(155.12)	(0.00)	0.00	0.00
23	35.00	0.31	200.07	(200.07)	164.92	(164.92)	(0.00)		2	2	158.25	(158.25)	164.92	(164.92)	(0.00)	0.00	0.00
24	34.50	0.27	208.89	(208.89)	174.72	(174.72)	(0.00)		2	2	168.25	(168.25)	174.72	(174.72)	(0.00)	0.00	0.00
25	34.00	0.23	217.74	(217.74)	184.52	(184.52)	(0.00)		2	2	178.25	(178.25)	184.52	(184.52)	(0.00)	0.00	0.00
26	33.50	0.18	226.64	(226.64)	194.31	(194.31)	(0.00)		2	2	188.25	(188.25)	194.31	(194.31)	(0.00)	0.00	0.00
27	33.00	0.13	235.59	(235.59)	204.07	(204.07)	(0.00)		2	2	198.25	(198.25)	204.07	(204.07)	(0.00)	0.00	0.00
28	32.50	0.08	244.60	(244.60)	213.79	(213.79)	(0.00)		2	2	208.25	(208.25)	213.79	(213.79)	(0.00)	0.00	0.00
29	32.00	0.00	253.65	(253.65)	223.40	(223.40)	(0.00)		2	2	218.25	(218.25)	223.40	(223.40)	(0.00)	0.00	0.00

NOTE: Displacements from STAGE 0 are disregarded in later stages

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

Surcharge 1 present in this stage
Surcharge 2 present in this stage

STAGE 1 : INSTALL WALL

Geometry

Node	Level	Soil	Boundary Left	Right	EI below node
	[m]	Left Right			[kNm2/m]
1	43.00	1 1	30.00	7.50	24740.
2	42.75	1 1	30.00	7.50	24740.
3	42.50	1 1	30.00	7.50	24740.
4	42.25	1 1	30.00	7.50	24740.
5	42.00	2 2	30.00	7.50	24740.
6	41.50	2 2	30.00	7.50	24740.
7	41.25	2 2	30.00	7.50	24740.
8	41.00	2 2	30.00	7.50	24740.
9	40.75	2 2	30.00	7.50	24740.
10	40.50	2 2	30.00	7.50	24740.
11	40.10	2 2	30.00	7.50	24740.
12	39.85	2 2	30.00	7.50	24740.
13	39.60	2 2	30.00	7.50	24740.
14	39.30	2 2	30.00	7.50	24740.
15	39.00	2 2	30.00	7.50	24740.
16	38.50	2 2	30.00	7.50	24740.
17	38.00	2 2	30.00	7.50	24740.
18	37.50	2 2	30.00	7.50	24740.
19	37.00	2 2	30.00	7.50	24740.
***20**	***36.50**	***2 2**	***30.00**	***7.50**	***0.0***
21	36.00	2 2	30.00	7.50	0.0
22	35.50	2 2	30.00	7.50	0.0
23	35.00	2 2	30.00	7.50	0.0
24	34.50	2 2	30.00	7.50	0.0
25	34.00	2 2	30.00	7.50	0.0
26	33.50	2 2	30.00	7.50	0.0
27	33.00	2 2	30.00	7.50	0.0
28	32.50	2 2	30.00	7.50	0.0
29	32.00	2 2	30.00	7.50	0.0

**** Wall toe level: 36.50***

Minimum equivalent fluid pressure parameters

Material	Left a	yo	b	Right a	yo	b
	[kN/m²/m]	[m]	[kN/m²]	[kN/m²/m]	[m]	[kN/m²]
Head	0.00	0.00	0.00	0.00	0.00	0.00
Deposits						
London Clay - Undrained	5.00	43.00	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 1 : Install Wall

Calculation details

E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 28837. E at bottom node = 106410. kN/m²
On the RIGHT: E at ground level = 28837. E at bottom node = 106410. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc Node max displ	Node no.	Disp error.	Node no.	Press error	Node no.
	[mm]		[mm]		[kN/m²]	
1	0.0	1	0.0002	1	0.05	2
2	0.0	1	0.0001	1	0.02	2
3	0.0	1	0.0000	1	0.00	2

Ground level left = 43.00 Ground level right = 43.00

Node	Level	Disp	Vt	Stress Ve	Pt	Pe	Pore Pressure		Soil Left	Right	Vt	Stress Ve	Pt	Pe	Pore Pressure	BM	SF
	[m]	[mm]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]				[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kN/m²]	[kNm/m]	[kN/m]
1	43.00	0.00	11.02	11.02	3.14	3.14	0.00	a	1	1	1.13	1.13	3.14	3.14	0.00	0.00	0.00
2	42.75	0.00	14.40	14.40	4.10	4.10	0.00	a	1	1	4.50	4.50	4.06	4.06	0.00	0.00	0.01
3	42.50	0.00	18.91	18.91	5.80	5.80	0.00		1	1	9.00	9.00	5.84	5.84	0.00	-0.00	0.01
4	42.25	0.00	23.70	23.70	8.99	8.99	0.00		1	1	13.50	13.50	9.00	9.00	0.00	-0.00	0.00
5	42.00	0.00	29.56	(29.56)	28.24	(28.24)	(0.00)		2	2	18.25	(18.25)	28.25	(28.25)	(0.00)	-0.00	-0.00
6	41.50	0.00	44.92	(44.92)	39.70	(39.70)	(0.00)		2	2	28.25	(28.25)	39.70	(39.70)	(0.00)	-0.00	-0.00
7	41.25	0.00	53.79	(53.79)	44.96	(44.96)	(0.00)		2	2	33.25	(33.25)	44.96	(44.96)	(0.00)	-0.00	-0.00
8	41.00	0.00	62.98	(62.98)	49.99	(49.99)	(0.00)		2	2	38.25	(38.25)	49.99	(49.99)	(0.00)	-0.00	-0.00
9	40.75	0.00	72.15	(72.15)	54.85	(54.85)	(0.00)		2	2	43.25	(43.25)	54.85	(54.85)	(0.00)	-0.00	-0.00
10	40.50	0.00	81.04	(81.04)	59.59	(59.59)	(0.00)		2	2	48.25	(48.25)	59.59	(59.59)	(0.00)	-0.00	-0.00
11	40.10	0.00	94.32	(94.32)	67.05	(67.05)	(0.00)		2	2	56.25	(56.25)	67.05	(67.05)	(0.00)	-0.00	-0.00
12	39.85	0.00	101.95	(101.95)	71.69	(71.69)	(0.00)		2	2	61.25	(61.25)	71.69	(71.69)	(0.00)	-0.00	-0.00
13	39.60	0.00	109.06	(109.06)	76.33	(76.33)	(0.00)		2	2	66.25	(66.25)	76.33	(76.33)	(0.00)	0.00	-0.00
14	39.30	0.00	116.99	(116.99)	81.93	(81.93)	(0.00)		2	2	72.25	(72.25)	81.93	(81.93)	(0.00)	0.00	-0.00
15	39.00	0.00	124.32	(124.32)	87.56	(87.56)	(0.00)		2	2	78.25	(78.25)	87.56	(87.56)	(0.00)	0.00	0.00
16	38.50	0.00	135.51	(135.51)	97.00	(97.00)	(0.00)		2	2	88.25	(88.25)	97.00	(97.00)	(0.00)	0.00	0.00
17	38.00	0.00	145.75	(145.75)	106.55	(106.55)	(0.00)		2	2	98.25	(98.25)	106.55	(106.55)	(0.00)	0.00	0.00
18	37.50	0.00	155.37	(155.37)	116.17	(116.17)	(0.00)		2	2	108.25	(108.25)	116.17	(116.17)	(0.00)	0.00	0.00
19	37.00	0.00	164.60	(164.60)	125.86	(125.86)	(0.00)		2	2	118.25	(118.25)	125.86	(125.86)	(0.00)	0.00	0.00
***20**	36.50	0.00	173.59	(173.59)	135.58	(135.58)	(0.00)		2	2	128.25	(128.25)	135.58	(135.58)	(0.00)	0.00	0.00
21	36.00	0.00	182.46	(182.46)	145.34	(145.34)	(0.00)		2	2	138.25	(138.25)	145.34	(145.34)	(0.00)	0.00	0.00

Node	Level [m]	Disp [mm]	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe [kN/m²]	Pore Pressure [kN/m²]	Soil Left	Soil Right	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe [kN/m²]	Pore Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]
22	35.50	0.00	191.27	(191.27)	155.12	(155.12)	(0.00)	2	2	148.25	(148.25)	155.12	(155.12)	(0.00)	0.00	0.00
23	35.00	0.00	200.07	(200.07)	164.92	(164.92)	(0.00)	2	2	158.25	(158.25)	164.92	(164.92)	(0.00)	0.00	0.00
24	34.50	0.00	208.89	(208.89)	174.72	(174.72)	(0.00)	2	2	168.25	(168.25)	174.72	(174.72)	(0.00)	0.00	0.00
25	34.00	0.00	217.74	(217.74)	184.52	(184.52)	(0.00)	2	2	178.25	(178.25)	184.52	(184.52)	(0.00)	0.00	0.00
26	33.50	0.00	226.64	(226.64)	194.31	(194.31)	(0.00)	2	2	188.25	(188.25)	194.31	(194.31)	(0.00)	0.00	0.00
27	33.00	0.00	235.59	(235.59)	204.07	(204.07)	(0.00)	2	2	198.25	(198.25)	204.07	(204.07)	(0.00)	0.00	0.00
28	32.50	0.00	244.60	(244.60)	213.79	(213.79)	(0.00)	2	2	208.25	(208.25)	213.79	(213.79)	(0.00)	0.00	0.00
29	32.00	0.00	253.65	(253.65)	223.40	(223.40)	(0.00)	2	2	218.25	(218.25)	223.40	(223.40)	(0.00)	0.00	0.00

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

Wall toe level: 36.50

Note: for undrained materials with user-defined pore pressures, the total stresses are correct, but the pore pressures are the nominal values given by the user. For these cases, tabulated pore pressures and effective stresses are usually unrealistic, and are shown in brackets.

EXTREME values so far

Displacements [mm]		Moments [kNm/m]		Shears [kN/m]	
Min	Max	Min	Max	Min	Max
0.00	0.00	-0.00	0.00	-0.00	0.01

Surcharge 1 present in this stage
Surcharge 2 present in this stage

STAGE 2 : INSTALL TEMP PROP

Geometry

Node	Level [m]	Soil Left	Soil Right	Boundary Left	Boundary Right	EI below node [kNm2/m]
1	43.00	1	0	30.00	7.50	24740.
2	42.75	1	0	30.00	7.50	24740.
3	42.50	1	0	30.00	7.50	24740.
4	42.25	1	0	30.00	7.50	24740.
5	42.00	2	2	30.00	7.50	24740.
6	41.50	2	2	30.00	7.50	24740.
7	41.25	2	2	30.00	7.50	24740.
8	41.00	2	2	30.00	7.50	24740.
9	40.75	2	2	30.00	7.50	24740.
10	40.50	2	2	30.00	7.50	24740.
11	40.10	2	2	30.00	7.50	24740.
12	39.85	2	2	30.00	7.50	24740.
13	39.60	2	2	30.00	7.50	24740.
14	39.30	2	2	30.00	7.50	24740.
15	39.00	2	2	30.00	7.50	24740.
16	38.50	2	2	30.00	7.50	24740.
17	38.00	2	2	30.00	7.50	24740.
18	37.50	2	2	30.00	7.50	24740.
19	37.00	2	2	30.00	7.50	24740.
20	***36.50***	***2***	***2***	***30.00***	***7.50***	***0.0***
21	36.00	2	2	30.00	7.50	0.0
22	35.50	2	2	30.00	7.50	0.0
23	35.00	2	2	30.00	7.50	0.0
24	34.50	2	2	30.00	7.50	0.0
25	34.00	2	2	30.00	7.50	0.0
26	33.50	2	2	30.00	7.50	0.0
27	33.00	2	2	30.00	7.50	0.0
28	32.50	2	2	30.00	7.50	0.0
29	32.00	2	2	30.00	7.50	0.0

Wall toe level: 36.50

Minimum equivalent fluid pressure parameters

Material	Left a [kN/m²/m]	Left yo [m]	Left b [kN/m²]	Right a [kN/m²/m]	Right yo [m]	Right b [kN/m²]
Head	0.00	0.00	0.00	0.00	0.00	0.00
Deposits						
London Clay - Undrained	5.00	43.00	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 2 : Install Temp Prop

Surcharge or strut changes
Strut no 1 inserted at this stage

Calculation details
E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 28837. E at bottom node = 106410. kN/m²
On the RIGHT: E at ground level = 44874. E at bottom node = 95753. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc max displ [mm]	Node no.	Disp error. [mm]	Node no.	Press error [kN/m²]	Node no.
1	0.0	1	0.7175	10	0.00	2
2	0.7	10	0.0000	10	0.00	2
3	0.7	10	0.0000	1	1.18	1
4	0.7	10	0.0000	1	0.00	1

Ground level left = 43.00 Ground level right = 42.13

Node	Level [m]	Disp [mm]	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe [kN/m²]	Pore Pressure [kN/m²]	Soil Left	Soil Right	Stress Vt [kN/m²]	Stress Ve [kN/m²]	Stress Pt [kN/m²]	Pore Pe [kN/m²]	Pore Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]
1	43.00	0.48	11.02	11.02	4.32	4.32	0.00	1	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	42.75	0.51	14.40	14.40	4.12	4.12	0.00	1	0	0.00	0.00	0.00	0.00	0.00	-0.14	1.05
3	42.50	0.55	18.91	18.91	5.52	5.52	0.00	1	0	0.00	0.00	0.00	0.00	0.00	-0.53	2.26
	42.50														-0.53	-6.94
4	42.25	0.59	23.70	23.70	8.13	8.13	0.00	1	0	0.00	0.00	0.00	0.00	0.00	1.03	-5.23
5	42.00	0.62	29.56	(29.56)	26.43	(26.43)	(0.00)	2	2	2.50	(2.50)	16.97	(16.97)	(0.00)	2.09	-2.44
6	41.50	0.68	44.92	(44.92)	35.05	(35.05)	(0.00)	2	2	12.50	(12.50)	32.10	(32.10)	(0.00)	2.42	-0.12
7	41.25	0.69	53.79	(53.79)	39.27	(39.27)	(0.00)	2	2	17.50	(17.50)	37.28	(37.28)	(0.00)	2.31	0.69
8	41.00	0.71	62.98	(62.98)	43.91	(43.91)	(0.00)	2	2	22.50	(22.50)	43.37	(43.37)	(0.00)	2.08	1.00
9	40.75	0.71	72.15	(72.15)	48.46	(48.46)	(0.00)	2	2	27.50	(27.50)	48.55	(48.55)	(0.00)	1.81	1.06
10	40.50	0.72	81.04	(81.04)	53.81	(53.81)	(0.00)	2	2	32.50	(32.50)	53.39	(53.39)	(0.00)	1.55	1.11
11	40.10	0.71	94.32	(94.32)	60.40	(60.40)	(0.00)	2	2	40.50	(40.50)	61.72	(61.72)	(0.00)	1.08	0.97
12	39.85	0.71	101.95	(101.95)	65.46	(65.46)	(0.00)	2	2	45.50	(45.50)	65.76	(65.76)	(0.00)	0.89	0.72
13	39.60	0.70	109.06	(109.06)	70.15	(70.15)	(0.00)	2	2	50.50	(50.50)	70.62	(70.62)	(0.00)	0.72	0.61
14	39.30	0.69	116.99	(116.99)	75.60	(75.60)	(0.00)	2	2	56.50	(56.50)	76.26	(76.26)	(0.00)	0.56	0.45
15	39.00	0.67	124.32	(124.32)	81.77	(81.77)	(0.00)	2	2	62.50	(62.50)	81.57	(81.57)	(0.00)	0.45	0.39
16	38.50	0.65	135.51	(135.51)	90.83	(90.83)	(0.00)	2	2	72.50	(72.50)	91.43	(91.43)	(0.00)	0.23	0.28
17	38.00	0.62	145.75	(145.75)	100.59	(100.59)	(0.00)	2	2	82.50	(82.50)	100.68	(100.68)	(0.00)	0.17	0.11
18	37.50	0.59	155.37	(155.37)	110.23	(110.23)	(0.00)	2	2	92.50	(92.50)	110.21	(110.21)	(0.00)	0.12	0.10
19	37.00	0.55	164.60	(164.60)	119.90	(119.90)	(0.00)	2	2	102.50	(102.50)	119.81	(119.81)	(0.00)	0.07	0.12
20	36.50	0.52	173.59	(173.59)	129.39	(129.39)	(0.00)	2	2	112.50	(112.50)	129.68	(129.68)	(0.00)	0.00	0.00
21	36.00	0.48	182.46	(182.46)	139.21	(139.21)	(0.00)	2	2	122.50	(122.50)	139.21	(139.21)	(0.00)	0.00	0.00
22	35.50	0.44	191.27	(191.27)	148.90	(148.90)	(0.00)	2	2	132.50	(132.50)	148.90	(148.90)	(0.00)	0.00	0.00
23	35.00	0.40	200.07	(200.07)	158.59	(158.59)	(0.00)	2	2	142.50	(142.50)	158.59	(158.59)	(0.00)	0.00	0.00
24	34.50	0.36	208.89	(208.89)	168.26	(168.26)	(0.00)	2	2	152.50	(152.50)	168.26	(168.26)	(0.00)	0.00	0.00
25	34.00	0.31	217.74	(217.74)	177.89	(177.89)	(0.00)	2	2	162.50	(162.50)	177.89	(177.89)	(0.00)	0.00	0.00
26	33.50	0.25	226.64	(226.64)	187.49	(187.49)	(0.00)	2	2	172.50	(172.50)	187.49	(187.49)	(0.00)	0.00	0.00
27	33.00	0.19	235.59	(235.59)	197.02	(197.02)	(0.00)	2	2	182.50	(182.50)	197.02	(197.02)	(0.00)	0.00	0.00
28	32.50	0.11	244.60	(244.60)	206.38	(206.38)	(0.00)	2	2	192.50	(192.50)	206.38	(206.38)	(0.00)	0.00	0.00
29	32.00	0.00	253.65	(253.65)	215.50	(215.50)	(0.00)	2	2	202.50	(202.50)	215.50	(215.50)	(0.00)	0.00	0.00

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

Node	Level [m]	Disp [mm]	Vt [kN/m²]	Stress Ve [kN/m²]	Pt [kN/m²]	Pore Pe [kN/m²]	Pressure	Soil Left Right	Vt [kN/m²]	Stress Ve [kN/m²]	Pt [kN/m²]	Pore Pe [kN/m²]	Pressure	BM [kNm/m]	SF [kN/m]

** Wall toe level: 36.50*

Note: for undrained materials with user-defined pore pressures, the total stresses are correct, but the pore pressures are the nominal values given by the user. For these cases, tabulated pore pressures and effective stresses are usually unrealistic, and are shown in brackets.

EXTREME values so far

Displacements [mm] Min	Max	Moments [kNm/m] Min	Max	Shears [kN/m] Min	Max
0.00	0.72	-0.53	2.42	-6.94	2.26

Surcharge 1 present in this stage
Surcharge 2 present in this stage

Strut Forces

No.	Node no.	Strut force [kN/m]	Horiz force [kN/m]	Moment [kNm/m]	Max strut force [kN/m]
1	3	9.20	9.20	0.00	9.20

STAGE 3 : EXCAVATE TO FORMATION LEVEL

Geometry

Node	Level [m]	Soil Left	Soil Right	Boundary Left	Boundary Right	EI below node [kNm2/m]
1	43.00	1	0	30.00	7.50	24740.
2	42.75	1	0	30.00	7.50	24740.
3	42.50	1	0	30.00	7.50	24740.
4	42.25	1	0	30.00	7.50	24740.
5	42.00	2	0	30.00	7.50	24740.
6	41.50	2	0	30.00	7.50	24740.
7	41.25	2	0	30.00	7.50	24740.
8	41.00	2	0	30.00	7.50	24740.
9	40.75	2	0	30.00	7.50	24740.
10	40.50	2	0	30.00	7.50	24740.
11	40.10	2	2	30.00	7.50	24740.
12	39.85	2	2	30.00	7.50	24740.
13	39.60	2	2	30.00	7.50	24740.
14	39.30	2	2	30.00	7.50	24740.
15	39.00	2	2	30.00	7.50	24740.
16	38.50	2	2	30.00	7.50	24740.
17	38.00	2	2	30.00	7.50	24740.
18	37.50	2	2	30.00	7.50	24740.
19	37.00	2	2	30.00	7.50	24740.
** 20*	*36.50*	*2*	*2*	*30.00*	*7.50*	*0.0*
21	36.00	2	2	30.00	7.50	0.0
22	35.50	2	2	30.00	7.50	0.0
23	35.00	2	2	30.00	7.50	0.0
24	34.50	2	2	30.00	7.50	0.0
25	34.00	2	2	30.00	7.50	0.0
26	33.50	2	2	30.00	7.50	0.0
27	33.00	2	2	30.00	7.50	0.0
28	32.50	2	2	30.00	7.50	0.0
29	32.00	2	2	30.00	7.50	0.0

** Wall toe level: 36.50*

Minimum equivalent fluid pressure parameters

Material	Left a [kN/m²/m]	Left yo [m]	Left b [kN/m²]	Right a [kN/m²/m]	Right yo [m]	Right b [kN/m²]
Head	0.00	0.00	0.00	0.00	0.00	0.00
Deposits						
London Clay - Undrained	5.00	43.00	0.00	0.00	0.00	0.00

RESULTS FOR STAGE 3 : Excavate to Formation Level

Calculation details

E Profiles assumed for calculation (generated):
On the LEFT: E at ground level = 28837. E at bottom node = 106410. kN/m²
On the RIGHT: E at ground level = 54045. E at bottom node = 95753. kN/m²
Minimum equivalent fluid pressure used in this stage.

Iter no.	Inc max displ [mm]	Node no.	Disp error. [mm]	Node no.	Press error [kN/m²]	Node no.
1	0.0	1	2.0992	9	0.00	1
2	2.1	9	0.0000	9	0.00	1
3	2.1	9	0.0000	9	0.00	1

Ground level left = 43.00 Ground level right = 40.30

Node	Level [m]	Disp [mm]	Vt [kN/m²]	Stress Ve [kN/m²]	Pt [kN/m²]	Pore Pe [kN/m²]	Pressure	Soil Left Right	Vt [kN/m²]	Stress Ve [kN/m²]	Pt [kN/m²]	Pore Pe [kN/m²]	Pressure	BM [kNm/m]	SF [kN/m]
1	43.00	1.31	11.02	11.02	16.46	16.46	0.00	1 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	42.75	1.54	14.40	14.40	8.63	8.63	0.00	1 0	0.00	0.00	0.00	0.00	0.00	-0.51	3.14
3	42.50	1.77	18.91	18.91	7.29	7.29	0.00	1 0	0.00	0.00	0.00	0.00	0.00	-1.57	5.12
	42.50													-1.57	-24.51
4	42.25	2.00	23.70	23.70	7.82	7.82	0.00	1 0	0.00	0.00	0.00	0.00	0.00	4.33	-22.63
5	42.00	2.22	29.56	(29.56)	23.54	(23.54)	(0.00)	2 0	0.00	0.00	0.00	0.00	0.00	9.74	-17.23
6	41.50	2.58	44.92	(44.92)	20.15	(20.15)	(0.00)	2 0	0.00	0.00	0.00	0.00	0.00	16.16	-9.04
7	41.25	2.70	53.79	(53.79)	19.14	(19.14)	(0.00)	2 0	0.00	0.00	0.00	0.00	0.00	17.47	-2.87
8	41.00	2.78	62.98	(62.98)	20.52	(20.52)	(0.00)	2 0	0.00	0.00	0.00	0.00	0.00	17.59	2.08
9	40.75	2.81	72.15	(72.15)	24.03	(24.03)	(0.00) a	2 0	0.00	0.00	0.00	0.00	0.00	16.43	7.65
10	40.50	2.81	81.04	(81.04)	31.28	(31.28)	(0.00)	2 0	0.00	0.00	0.00	0.00	0.00	13.76	15.74
11	40.10	2.73	94.32	(94.32)	38.34	(38.34)	(0.00)	2 2	4.00	(4.00)	66.92	(66.92)	(0.00)	5.43	16.18
12	39.85	2.67	101.95	(101.95)	46.96	(46.96)	(0.00)	2 2	9.00	(9.00)	63.43	(63.43)	(0.00)	2.55	9.48
13	39.60	2.59	109.06	(109.06)	53.16	(53.16)	(0.00)	2 2	14.00	(14.00)	65.59	(65.59)	(0.00)	0.70	5.71
14	39.30	2.50	116.99	(116.99)	59.84	(59.84)	(0.00)	2 2	20.00	(20.00)	68.36	(68.36)	(0.00)	-0.51	2.72
15	39.00	2.40	124.32	(124.32)	68.23	(68.23)	(0.00)	2 2	26.00	(26.00)	70.81	(70.81)	(0.00)	-0.94	0.93
16	38.50	2.26	135.51	(135.51)	77.32	(77.32)	(0.00)	2 2	36.00	(36.00)	79.86	(79.86)	(0.00)	-1.15	-0.22
17	38.00	2.12	145.75	(145.75)	87.78	(87.78)	(0.00)	2 2	46.00	(46.00)	87.68	(87.68)	(0.00)	-0.72	-0.83
18	37.50	2.00	155.37	(155.37)	97.36	(97.36)	(0.00)	2 2	56.00	(56.00)	96.75	(96.75)	(0.00)	-0.31	-0.65
19	37.00	1.87	164.60	(164.60)	106.84	(106.84)	(0.00)	2 2	66.00	(66.00)	106.09	(106.09)	(0.00)	-0.06	-0.31
**20*	36.50	1.75	173.59	(173.59)	116.05	(116.05)	(0.00)	2 2	76.00	(76.00)	115.79	(115.79)	(0.00)	0.00	0.00
21	36.00	1.62	182.46	(182.46)	125.36	(125.36)	(0.00)	2 2	86.00	(86.00)	125.36	(125.36)	(0.00)	0.00	0.00
22	35.50	1.49	191.27	(191.27)	134.79	(134.79)	(0.00)	2 2	96.00	(96.00)	134.79	(134.79)	(0.00)	0.00	0.00
23	35.00	1.35	200.07	(200.07)	144.17	(144.17)	(0.00)	2 2	106.00	(106.00)	144.17	(144.17)	(0.00)	0.00	0.00
24	34.50	1.20	208.89	(208.89)	153.48	(153.48)	(0.00)	2 2	116.00	(116.00)	153.48	(153.48)	(0.00)	0.00	0.00
25	34.00	1.03	217.74	(217.74)	162.71	(162.71)	(0.00)	2 2	126.00	(126.00)	162.71	(162.71)	(0.00)	0.00	0.00
26	33.50	0.85	226.64	(226.64)	171.80	(171.80)	(0.00)	2 2	136.00	(136.00)	171.80	(171.80)	(0.00)	0.00	0.00
27	33.00	0.63	235.59	(235.59)	180.76	(180.76)	(0.00)	2 2	146.00	(146.00)	180.76	(180.76)	(0.00)	0.00	0.00
28	32.50	0.37	244.60	(244.60)	189.17	(189.17)	(0.00)	2 2	156.00	(156.00)	189.17	(189.17)	(0.00)	0.00	0.00
29	32.00	0.00	253.65	(253.65)	197.18	(197.18)	(0.00)	2 2	166.00	(166.00)	197.18	(197.18)	(0.00)	0.00	0.00

Vt, Ve : vertical total and effective stress
Pt, Pe : horizontal total and effective stress

** Wall toe level: 36.50*

Note: for undrained materials with user-defined pore pressures, the total stresses are correct, but the pore pressures are the nominal values given by the user. For these cases, tabulated pore pressures and effective stresses are usually unrealistic, and are shown in brackets.

Node	Level [m]	Disp [mm]	Stress Vt [kN/m²]	Ve [kN/m²]	Pt [kN/m²]	Pe Pressure [kN/m²]	Soil Left Right	Stress Vt [kN/m²]	Ve [kN/m²]	Pt [kN/m²]	Pe Pressure [kN/m²]	BM [kNm/m]	SF [kN/m]

EXTREME values so far

Displacements [mm]		Moments [kNm/m]		Shears [kN/m]	
Min		Max	Min	Max	Min	Max
0.00		2.81	-1.57	17.59	-24.51	16.18

Surcharge 1 present in this stage

Surcharge 2 present in this stage

Strut Forces

No.	Node no.	Strut force [kN/m]	Horiz force [kN/m]	Moment [kNm/m]	Max strut force [kN/m]
1	3	29.64	29.64	0.00	29.64

Results Envelope

Node	Level [m]	Displacements [mm] Min	Max	Moments [kNm/m] Min	Max	Shears [kN/m] Min	Max
1	43.00	0.00	1.31	0.00	0.00	0.00	0.00
2	42.75	0.00	1.54	-0.51	0.00	0.00	3.14
3	42.50	0.00	1.77	-1.57	0.00	-24.51	5.12
4	42.25	0.00	2.00	-0.00	4.33	-22.63	0.00
5	42.00	0.00	2.22	-0.00	9.74	-17.23	0.00
6	41.50	0.00	2.58	-0.00	16.16	-9.04	0.00
7	41.25	0.00	2.70	-0.00	17.47	-2.87	0.69
8	41.00	0.00	2.78	-0.00	17.59	-0.00	2.08
9	40.75	0.00	2.81	-0.00	16.43	-0.00	7.65
10	40.50	0.00	2.81	-0.00	13.76	-0.00	15.74
11	40.10	0.00	2.73	-0.00	5.43	-0.00	16.18
12	39.85	0.00	2.67	-0.00	2.55	-0.00	9.48
13	39.60	0.00	2.59	0.00	0.72	-0.00	5.71
14	39.30	0.00	2.50	-0.51	0.56	-0.00	2.72
15	39.00	0.00	2.40	-0.94	0.45	0.00	0.93
16	38.50	0.00	2.26	-1.15	0.23	-0.22	0.28
17	38.00	0.00	2.12	-0.72	0.17	-0.83	0.11
18	37.50	0.00	2.00	-0.31	0.12	-0.65	0.10
19	37.00	0.00	1.87	-0.06	0.07	-0.31	0.12
20	***36.50***	***0.00***	***1.75***	***0.00***	***0.00***	***0.00***	***0.00***
21	36.00	0.00	1.62	0.00	0.00	0.00	0.00
22	35.50	0.00	1.49	0.00	0.00	0.00	0.00
23	35.00	0.00	1.35	0.00	0.00	0.00	0.00
24	34.50	0.00	1.20	0.00	0.00	0.00	0.00
25	34.00	0.00	1.03	0.00	0.00	0.00	0.00
26	33.50	0.00	0.85	0.00	0.00	0.00	0.00
27	33.00	0.00	0.63	0.00	0.00	0.00	0.00
28	32.50	0.00	0.37	0.00	0.00	0.00	0.00
29	32.00	0.00	0.00	0.00	0.00	0.00	0.00