Basement Impact Assessment

in connection with proposed redevelopment at

Marine Ices
4-8 Haverstock Hill
Camden
NW3 2BL

for

Bellis Construction Ltd

LBH4278 Ver 2.0

May 2017

LBH WEMBLEY

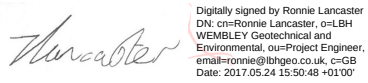
ENGINEERING

Project No: LBH4278

Report Ref: LBH4278 Ver 2.0

Date: 24th May 2017

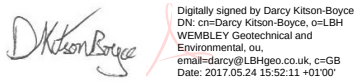
Report prepared by:



Ronnie Lancaster

BSc (Hons) MSc DIC FGS

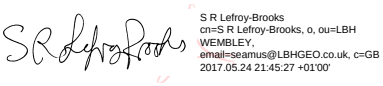
Report approved by:



Darcy Kitson-Boyce

MEng (Hons) GMICE FGS FRGS

Report approved by:



Seamus R Lefroy-Brooks

BSc (Hons) MSc CEng MICE CGeol FGS CEnv MIEnvSc FRGS SiLC RoGEP UK Registered Ground Engineering Adviser

LBH WEMBLEY ENGINEERING

12 Little Balmer

Buckingham Industrial Park

Buckingham

MK18 1TF

Tel: 01280 812310

email: enquiry@lbhgeo.co.uk

website: www.lbhgeo.co.uk

Contents

Foreword-Guidance Notes

GENERAL

This report has been prepared for a specific client and to meet a specific brief. The preparation of this report may have been affected by limitations of scope, resources or time scale required by the client. Should any part of this report be relied on by a third party, that party does so wholly at its own risk and LBH Wembley Engineering disclaims any liability to such parties.

The observations and conclusions described in this report are based solely upon the agreed scope of work. LBH Wembley Engineering has not performed any observations, investigations, studies or testing not specifically set out in the agreed scope of work and cannot accept any liability for the existence of any condition, the discovery of which would require performance of services beyond the agreed scope of work.

VALIDITY

Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances shall be at the client's sole and own risk. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should therefore not be relied upon in the future and any such reliance on the report in the future shall again be at the client's own and sole risk. LBH Wembley Engineering should in all such altered circumstances be commissioned to review and update this report accordingly.

THIRD PARTY INFORMATION

The report may present an opinion on the disposition, configuration and composition of soils, strata and any contamination within or near the site based upon information received from third parties. However, no liability can be accepted for any inaccuracies or omissions in that information.

DRAWINGS

Any plans or drawings provided in this report are not meant to be an accurate base plan, but are used to present the general relative locations of features on, and surrounding, the site.

1. Introduction

1.1 Background

A Basement Impact Assessment (BIA) was submitted to London Borough of Camden (LBC) in January 2015 for the construction of a split-level basement, to a depth of approximately 9m with a deepened rear section to around 11m depth. A top-down form of construction was proposed to build the basement.

Planning permission (ref: 2015/0487/P) was subsequently granted subject to a Section 106 Legal Agreement by the Camden in December 2016.

Following this, the basement proposals have now been altered and a shallower basement is now proposed, which will be built by a bottom-up form of construction. A revised BIA has been prepared to take into account the current scheme.

1.2 Brief

LBH WEMBLEY have been appointed by Bellis Construction Ltd to carry out a new Basement Impact Assessment (BIA) in order to take account of the revised scheme, for submission to LBC in order to satisfy the specific requirements of Camden Planning Policy DP27 on Basements and Lightwells and Supplementary Planning Guidance CPG4 on Basements and Lightwells.

1.3 Planning Policy

The CPG4 Planning Guidance on Basements and Lightwells refers primarily to Planning Policy DP27 on Basements and Lightwells.

The DP27 Policy reads as follows:

In determining proposals for basement and other underground development, the Council will require an assessment of the scheme's impact on drainage, flooding, groundwater conditions and structural stability, where appropriate. The Council will only permit basement and other underground development that does not cause harm to the built and natural environment and local amenity and does not result in flooding or ground instability. We will require developers to demonstrate by methodologies appropriate to the site that schemes:

a) maintain the structural stability of the building and neighbouring properties;
b) avoid adversely affecting drainage and run-off or causing other damage to the water environment;
c) avoid cumulative impacts upon structural stability or the water environment in the local area;

and we will consider whether schemes:

d) harm the amenity of neighbours;
e) lead to the loss of open space or trees of townscape or amenity value;
f) provide satisfactory landscaping, including adequate soil depth;
g) harm the appearance or setting of the property or the established character of the surrounding area; and
h) protect important archaeological remains.

The Council will not permit basement schemes which include habitable rooms and other sensitive uses in areas prone to flooding. In determining applications for lightwells, the Council will consider whether:

i) the architectural character of the building is protected;
j) the character and appearance of the surrounding area is harmed; and
k) the development results in the loss of more than 50% of the front garden or amenity area.

In addition to DP27, the CPG4 Guidance on Basements and Lightwells also supports the following Local Development Framework policies:

Core Strategies:

- CS5 Managing the impact of growth and development
- CS14 Promoting high quality places and conserving our heritage
- CS15 Protecting and improving our parks and open spaces & encouraging biodiversity
- CS17 Making Camden a safer place
- CS18 Dealing with our waste and encouraging recycling

Development Policies:

- DP23 Water
- DP24 Securing high quality design
- DP25 Conserving Camden's heritage
- DP26 Managing the impact of development on occupiers and neighbours

1.4 Report Structure

The report commences with a comprehensive desk study and characterisation of the site, before progressing to BIA screening and scoping assessments, whereby consideration is given to identifying the potential hydrogeological, hydrological and stability impacts to be associated with the proposed development. Following this the findings of an intrusive ground investigation are reported and a ground model is developed, followed by a discussion of the geotechnical issues.

Finally, an Impact Assessment is presented, including an assessment of the ground movements associated with the proposed works, along with consideration of the potential damage to the host building and neighbouring structures.

1.5 Documents Consulted

The following documents have been consulted during the preparation of this document:

1. Proposed Structural Drawings , by HTS, dated 17th May 2017, Project No. 1715 sheet No. 1.
2. Proposed Pile Drawings , by HTS, dated 22nd May 2017, Project No. 1715 sheet No. 1.
3. Camden Planning Guidance 4, Basements and Lightwells, 2015
4. Camden Development Policies DP27 – Basements and Lightwells, 2010
5. London Borough of Camden Geological, Hydrogeological and Hydrological Study (CHGGS), by Ove Arup & Partners Limited, dated 18th November 2010, Issue 01

2. The Site

2.1 Site Location

The site is situated on the gentle lower southeastern slopes of Hampstead Hill within the designated Camden Town Centre and sits at the junction of Haverstock Hill and Crogsland Road, approximately 80m northeast of Chalk Farm Station. The site may also be located approximately by postcode NW3 2BL or by National Grid Reference 528190,184435.

2.2 Site Description

The site is irregular in shape and consists of the buildings of the former Marine Ices Restaurant and ice cream factory. The ground floor level of the buildings is set at approximately +31m OD.

The buildings wrap around a three storey Victorian pub sited on the junction of Haverstock Hill and Crogsland Road, giving the site a frontage onto both Haverstock Hill to the southwest (the restaurant section) and Crogsland Road to the southeast (garages and storage sections). The restaurant section is a single storey brick building whereas the garages and storage and production areas are three storey steel or concrete framed behind an earlier period Crogsland Road façade of London stock brickwork (which is to be retained). To the northeast lie the grounds of Haverstock Hill School and to the northwest the site is abutted by a modern Salvation Army Hall.

2.3 Proposed Development

It is proposed to redevelop this site into a mixed use complex with the basement and ground floors as either cinema/restaurant or retail space, alongside accompanying plant rooms, toilets, stairwells and a lift-shaft. Above this will be four storeys of residential units arranged in two buildings separated by a podium amenity space.

The proposed redevelopment includes demolition of the existing properties on site, retaining the Crogsland Road façade, followed by excavation of the site to allow for the construction of a basement to a depth of approximately 6m (+25m OD), with two slightly deepened sections for a lift shaft and sump, set at approximately +24m OD.

The excavation will be retained by a contiguous bored pile wall, following which the basement will be supported by piled foundations.

3. Desk Study

3.1 Site History

In the nineteenth century the site comprised a terrace of residential properties along Haverstock Hill and part of a further residential terrace ran along Crogsland Road. A final terrace ran northwest off of Crogsland Road; parallel to Haverstock Hill, along a now demolished road that was called Kirkwood Place. The southwestern boundaries of the back gardens to these properties formed the northern boundary of the site.

The northern underground line was constructed beneath Haverstock Hill with Chalk Farm station adjacent to the site at the outset of the last century.

Between the Wars an ice cream parlour was established on the site and a Salvation Army Citadel was constructed on the adjoining land.

The ice-cream factory was extended after the 2nd World War and in the 1970s and 1980s the buildings were further extended to cover the whole of the site along with extensive alterations to Nos. 45 and 47 Crogsland Road.

In 2002 the Salvation Army Citadel adjacent to the northwest of the site was rebuilt in its present form.

Production of Marine Ices ceased in 2012 and the restaurant closed in August 2014.

3.2 Geological Information

The BGS records that the site is underlain by London Clay Formation. No superficial deposits are recorded. Archive water well records suggest that the London Clay extends to 60m overlying almost 10m of Woolwich & Reading Beds and less than 5m of Thanet Sand overlying the Upper Chalk Formation.

3.3 Hydrogeological / Hydrological Information

The nearest surface water feature is the now culverted River Fleet, that is believed to flow some 300m to the northeast of the site.

The London Clay Formation is classified as Unproductive Strata

4. Stages 1 & 2 - Screening & Scoping Assessments

The Screening & Scoping Assessments have been undertaken with reference to Appendices E and F of the CGHSS, which is a process for determining whether or not a BIA is usually required.

4.1 Screening Assessment

The Screening Assessment consists of a series of checklists that identifies any matters of concern relating to the following:

- Subterranean (groundwater) flow
- Surface flow and flooding
- Slope stability

4.1.1 Screening Checklist for Subterranean (Groundwater) Flow

Question	Response	Justification
Is the site is located directly above an aquifer?	**No**	The BGS records that the site is underlain by London Clay Formation. No superficial deposits are recorded.
Will the proposed basement extend beneath the water table surface?	**No**	No groundwater is expected within the London Clay.
Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	**No**	The nearest surface water feature is the River Fleet, now culverted, that is believed to flow some 300m to the northeast of the site.
Is the site within the catchment of the pond chains on Hampstead Heath?	**No**	The site is not within catchment of the Hampstead Heath Ponds
Will the proposed development result in a change in the area of hard-surfaced/paved areas?	**NO**	The site is presently 100% covered by buildings and the proposed development also involves 100% coverage
Will more surface water (e.g. rainfall and run-off) than at present will be discharged to the ground (e.g. via soakaways and/or SUDS)?	**No**	There is no drainage to the ground.
Is the lowest point of the proposed 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?	**No**	There are no nearby surface water features.

4.1.2 Screening Checklist for Surface Flow and Flooding

Question	Response	Justification
Is the site within the catchment area of the pond chains on Hampstead Heath?	**No**	The site is outside of the catchment areas of the Hampstead Heath ponds as shown in Figure 14 of the CGHHS
As part of the site drainage, will surface water flows (e.g. rainfall and run-off) be materially changed from the existing route?	**No**	Surface water flows will be disposed of by the existing means.
Will the proposed basement development result in a change in the proportion of hard-surfaced/paved areas?	**No**	The site is presently 100% covered by buildings and the proposed development also involves 100% coverage
Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface-water being received by adjacent properties or downstream watercourses?	**No**	All drainage is to the sewer as per existing.
Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	**No**	All drainage is to the sewer as per existing.
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?	**No**	Environment Agency (EA) maps indicate that the site is also identified as being at a very low risk of surface water flooding.

4.1.3 Screening Checklist for Stability

Question	Response	Justification
Does the existing site include slopes, natural or manmade, greater than 7 degrees?	**No**	The site is level.
Does the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees?	**No**	No re-profiling of the site is planned.
Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees?	**No**	The neighbouring roads and the school grounds to the rear are flat-lying.
Is the site within a wider hillside setting in which the general slope is greater than 7 degrees?	**No**	No. Figure 16 of the CGHHS shows the site to be in an area of zero to seven degrees slope.

Is London Clay the shallowest strata at the site?	**YES**	The British Geological Survey (BGS) records indicate that the site is underlain by the London Clay Formation.
Will trees be felled as part of the proposed development and/or are works proposed within tree protection zones where trees are to be retained?	**No**	No trees are present on the site.
Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	**No**	No evidence of cracks or building movements was evident upon visiting the site and no effects were noted in any of the adjacent and surrounding buildings.
Is the site within 100m of a watercourse of a potential spring line?	**No**	The nearest surface water feature is the River Fleet, now culverted, that is believed to flow some 300m to the northeast of the site.
Is the site within an area of previously worked ground?	**NO**	No. Figure 2 of the CGHHS shows the site not to be in an area of worked ground.
Is the site within an aquifer?	**No**	The London Clay Formation is classified as Unproductive Strata.
Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	**No**	No water table is expected to be present.
Is the site within 50m of the Hampstead Heath ponds?	**No**	The Hampstead Heath ponds are over 2km to the north of the site.
Is the site within 5m of a highway or pedestrian right of way?	**Yes**	
Will the proposed basement significantly increase the differential depth of foundations relative to the neighbouring properties?	**Yes**	
Is the site over (or within the exclusion zone of) tunnels, e.g. railway lines?	**Yes**	

4.2 Scoping Assessment

Where the checklist is answered with a “yes” or “unknown” to any of the questions posed in the flowcharts, these matters are carried forward to the scoping stage of the BIA process.

The scoping produces a statement which defines further the matters of concern identified in the screening stage. This defining should be in terms of ground processes, in order that a site specific BIA can be designed and executed (Section 6.3 of the CGHHS).

4.2.1 Scoping for Stability

- **London Clay is the shallowest strata at the site.**

The guidance advises that of the at-surface soil strata present in LB Camden, the London Clay is the most prone to seasonal shrink-swell (subsidence and heave).

- **The site is within 5m of a highway or pedestrian right of way.**

The guidance advises that excavation for a basement may result in damage to the road, pathway or any underground services buried in trenches beneath the road or pathway.

- **The proposed basement will significantly increase the differential depth of foundations relative to the neighbouring properties.**

The guidance advises that excavation for a basement may result in structural damage to neighbouring properties if there is a significant differential depth between adjacent foundations.

- **The site is over (or within the exclusion zone of) tunnels, e.g. railway lines.**

The guidance advises that excavation for a basement may result in damage to the tunnel.

5. Stage 3 – Site Investigation

5.1 Exploratory Work

In early November 2014, an intrusive site investigation was undertaken comprising two cable percussion boreholes constructed to a depth of 30m by a cut-down cable percussion rig.

In January 2016, eight structural trial pits were constructed to expose the party wall foundations and the details of these have been recorded by the structural engineers.

The exploratory records and test results are included in the Appendix to this report.

5.2 Ground Conditions

The intrusive investigation has confirmed that, beneath a limited thickness of made ground, the London Clay Formation is present.

5.3 Made Ground

Beneath the existing concrete flooring, made ground is present to a depth of around 1.5m.

The made ground consisted of dirty brown clayey sandy soil with stones, brick and concrete fragments.

5.4 London Clay Formation

Directly beneath the made ground, the London Clay Formation is present, which comprised firm to stiff, becoming stiff to very stiff, orange-brown and mottled grey silty clay. The upper zone of brown weathered clay was found to pass down into typical unweathered grey clay at approximately 9.5m depth.

The results of the plasticity index testing have confirmed the stratum to be of high shrinkability.

No claystones were encountered in the boreholes, but can be expected to be present within the stratum.

5.5 Groundwater

No groundwater was encountered during the formation of the boreholes and both boreholes were recorded as dry upon completion. Groundwater standpipes were installed in both boreholes to permit future monitoring for the presence of any groundwater. A further monitoring visit was carried out in January 2016, and found that both of the standpipes were dry.

6. Discussion of Geotechnical Issues

The proposed development includes the excavation of the entirety of the site to a depth of approximately 6-7m.

Given the ground conditions encountered and the scale of the development a contiguous bored piled wall is to be used to form the basement perimeter walls and temporary propping will be installed at a high level to allow a bottom-up excavation.

6.1 Selected Values for Geotechnical Design

Made Ground

A thickness of up to approximately 2m of made ground is expected. A nominal bulk unit weight of 17 kN/m^3 is ascribed to this material.

London Clay

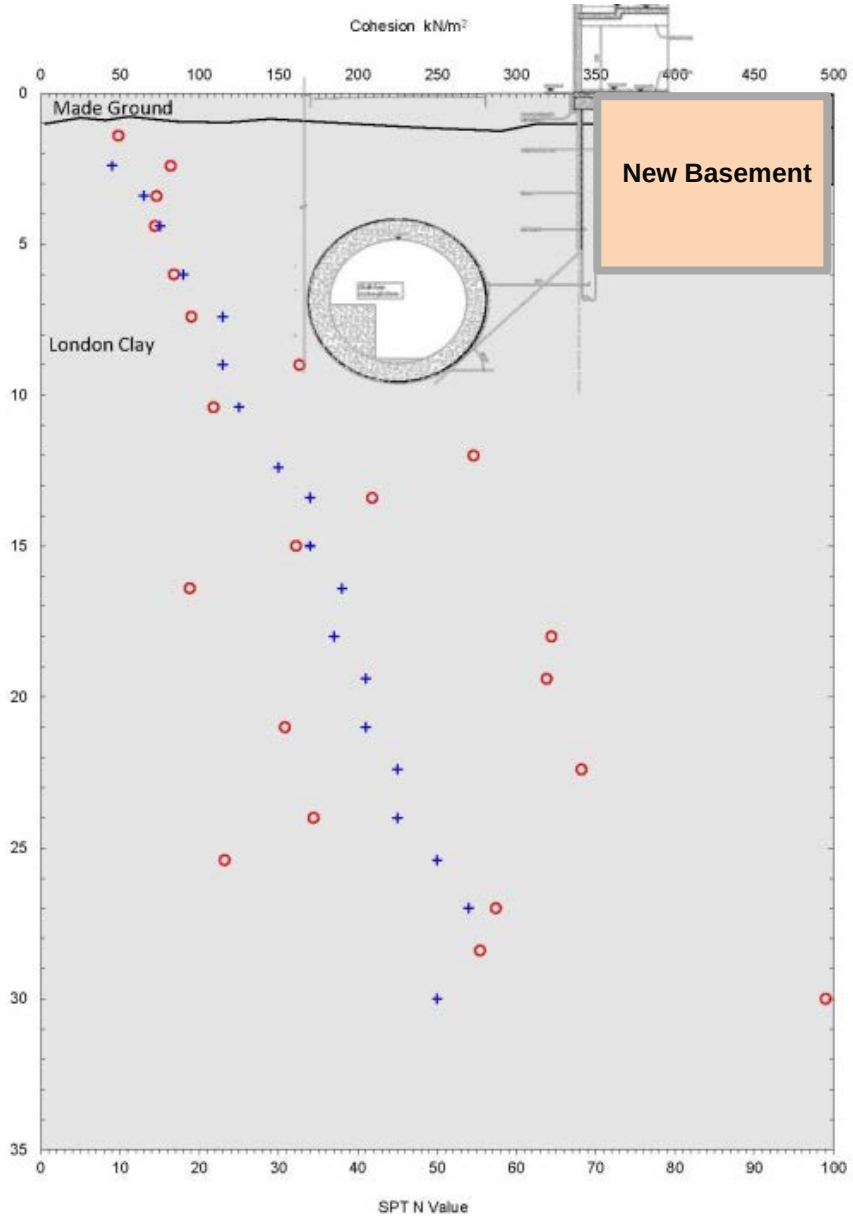
The London Clay extends to some 60m depth. A bulk unit weight of this material has been taken to be 18 kN/m^3. For the purposes of undrained foundation design this stratum has been assumed to be cohesive. The plot of undrained cohesion versus depth shown here suggests an average undrained cohesion is taken to be 55 kN/m^2 at the surface of the Clay (approximately +30 mOD) increasing at 5kN/m^2 per m depth.

(Red Circles denote Triaxial Compression Test results and blue crosses denote in-situ Standard Penetration Test results)

In the drained situation, an effective cohesion of zero may be used in conjunction with an effective angle of internal friction of 20 degrees.

Groundwater

The London Clay is assumed to be saturated, with an assumed piezometric surface at 1m depth.



6.2 Basement Construction

A key factor in the design of the new basement construction will be the need to preserve the stability of the adjacent buildings, tunnel and highway at all times, both during excavation and construction and in the permanent situation.

The perimeter wall of piling and additional internal piles (with low cut-offs) are to be installed following demolition of the existing buildings.

Temporary propping will then be installed at pile cap level to provide support to the perimeter walls, following which the excavation will commence using a bottom-up construction methodology. Once the basement is constructed, the permanent ground floor slab will be cast, which will act as permanent propping to the perimeter piling.

6.3 Piled Foundations

Piled foundations are to be adopted and these will transfer the new structural loading down into the London Clay Formation at depth.

To assist the initial assessment of pile capacity, preliminary graphs of Pile Safe Working Load (SWL) based on Combination 2 ULS GEO are appended for 450mm, 600mm and 750mm diameter piles. It should be these graphs do not take any account of any sleeving and are based upon an α-value of 0.4, N_c of 9 and conservative geotechnical parameters.

The advice of a specialist piling contractor should be sought both in the selection of pile type and to provide a suitable pile design for the proposed scheme.

It should be noted that the piles may encounter obstructions presented by previous buildings beneath the site footprint.

6.4 Basement Waterproofing

Groundwater was not encountered during the investigation within the depth of the proposed basement excavation. However, there is the potential for water to collect around the basement structure in the long term. Hence, the basement should be fully waterproofed and it will be necessary for the basement to be designed to withstand hydrostatic pressures in accordance with the guidance provided in BS8102:2009, Code of Practice for the Protection of Below-Ground Structures against Water from the Ground.

6.5 London Underground

A ground movement assessment of the northern line has been submitted to London Underground, and sets out mitigation of the potential risks occurring to the adjacent Chalk Farm station during demolition, excavation and construction. This has now been approved and the mitigation has been incorporated into the scheme.

7. Stage 4 - Impact Assessment

The screening and scoping stages have identified potential effects of the development on those attributes or features of the geological, hydrogeological and hydrological environment. This stage is concerned with evaluating the direct and indirect implications of each of these potential impacts.

7.1 Buried Infrastructure

A ground movement assessment of the northern line was previously prepared on the basis of a top-down form of construction.

The revised construction methodology will need to be agreed by London Underground.

7.2 Shrink / Swell

The results of the plasticity index testing have confirmed the London Clay beneath the site to be of high shrinkability. There are no tree-related issues at this site and the depth of the proposed construction will obviate concerns regarding seasonal movements.

7.3 Pedestrian Right of Way

Given the construction of a moderate stiffness basement retaining wall, as detailed in the section below, it is concluded that there will be no significant risk to the integrity of the adjacent highways or to the services that have been identified as lying beneath these and the pavements.

7.4 Neighbouring Buildings

The key factor to consider when undertaking a ground movement assessment for the development is that the design of the new basement construction will need to preserve the stability of the adjacent buildings, both during excavation and construction and in the permanent situation.

7.4.1 Neighbouring Structures

7.4.1.1 Salvation Army Citadel

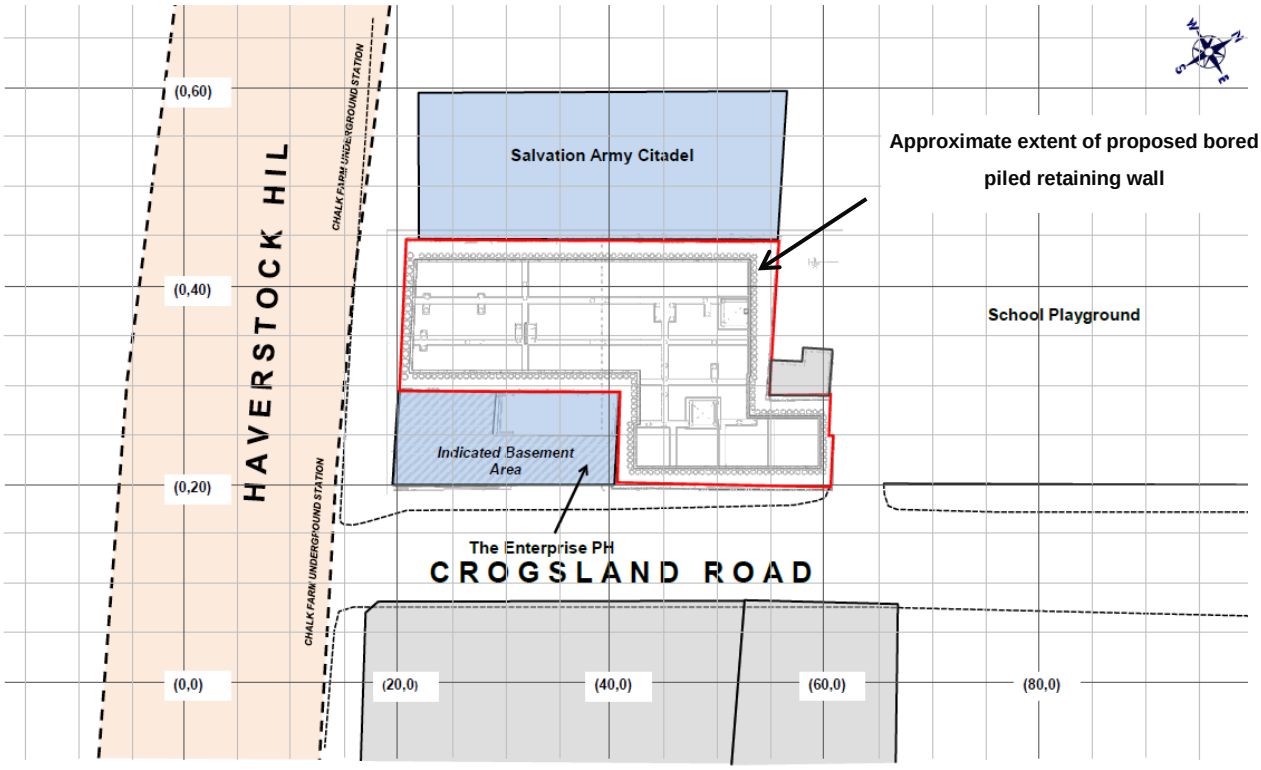
Immediately northwest of the site is the Salvation Army Citadel. This is a modern building, constructed in 2002 and has no basement. Replacing an earlier brick built Salvation Army Citadel on the same site; the present building is two storeys in height with a barrel vaulted roof. It has no basement spaces apart from a small (half metre) deep area at its rear beneath the stage which houses a boiler room. The structural trial pits along the wall bounding this building have indicated that the party wall foundations extend to a depth of approximately 1 metre below ground level.

7.4.1.2 The Enterprise Pub

Immediately southeast of the site is The Enterprise Public House. This three storey brick pub is the same age as the houses that were originally on the site, and shares a matching façade to that of the Crogsland Road frontage of the site. It is believed to be of a brick construction and has a cellar across approximately three quarters of its footprint, with the remaining quarter being closest to the proposed basement excavation. In the area of no basement, the boundary wall foundations are approximately 1.3m deep, whilst the cellar itself extends to a depth of approximately 1.5m, and foundations are estimated to lie at approximately 2 metres depth.

7.4.1.3 Crogsland Road Façade

Although it appears that this façade has been retained through a previous rearrangement of the rear part of the existing building, the existing foundations to this wall are indicated to lie at less than 1m below street level. The structure will be supported while the new basement perimeter wall is installed immediately behind it. While the structure will be tied into the new building as part of the planned construction, some degree of inevitable movement is likely to affect this façade in the short term.



Site plan showing neighbouring structures (blue) assessed for the purpose of ground movement

7.4.2 Modelled Ground Conditions

Excavation of the basement will result in unloading of the clay leading to theoretical heave movement of the underlying soil in both the short and long term, depending upon any reapplication of loading.

An analysis of the movements has been carried for a modelled situation, based on a soil model devised from both published information on the London Clay and the results of the ground investigation. The soil layers of this model are detailed in the table below.

Analysis Layer:	Upper Boundary (+m OD)	Thickness (m)	Average C_u (kN/m^2)	Soil Stiffness (kN/m^2)	
				E_u	E'
London Clay Formation	25.00	2	80	36000	20000
London Clay Formation	23.00	5	90	40500	22500
London Clay Formation	18.00	5	140	63000	35000
London Clay Formation	13.00	5	175	78750	43750
London Clay Formation	8.00	5	225	101250	56250
London Clay Formation	3.00	5	275	123750	68750
London Clay Formation	-2.00	5	325	146250	81250
London Clay Formation	-7.00	13	375	168750	93750
Assumed Rigid Boundary	-20.00				

The Undrained Modulus of Elasticity (Eu) has been based upon an empirical relationship of Eu = 450 x Cu, and the Drained Modulus of Elasticity (E') has been based upon an empirical relationship of 250 x Cu.

Poisson's Ratios of 0.5 and 0.1 have been used for short term (undrained) and long term (drained) conditions respectively.

Based on the above parameters and loading/unloading and ignoring any benefit gained from the loading of previous buildings on site, the potential vertical displacements and the post construction movements have been analysed.

The analysis uses classic modified Boussinesq elastic theory, assuming a fully flexible foundation applying a uniform loading/unloading to a semi-infinite elastic half-space, using the above parameters for stratified homogeneity and with the introduction of an assumed rigid boundary at approximately 45m depth (-20.00m OD).

The programme calculates the theoretical Boussinesq elastic stress increase/decrease due to the applied net loadings/unloadings (over the given loaded/unloaded areas) at the mid-level of each stratum.

Short-term and long-term displacements are then calculated at each calculation point for each stratum, using the given values of Stiffness Moduli and Poisson's Ratio of the whole area of the site on a 1m calculation grid.

7.4.3 Short Term Movements to Neighbouring Structures

There are three components of short term movements that will interact to affect the neighbouring structures. These are settlements and horizontal movements associated with the pile installation, settlements and horizontal movements behind the wall due to yielding of the completed wall as excavation in front of the wall proceeds and lastly vertical heave movements due to demolition and soil unloading as the excavation proceeds.

However, the heave movements due to demolition and soil unloading will have no impact on the neighbouring structures as the vertical heave movements will occur within the bored piled wall retaining area. Similarly, long term movements due to soil loading from the construction of the new building will also have no impact on the neighbouring structures.

7.4.3.1 Ground Surface Movements due to Installation of Piles

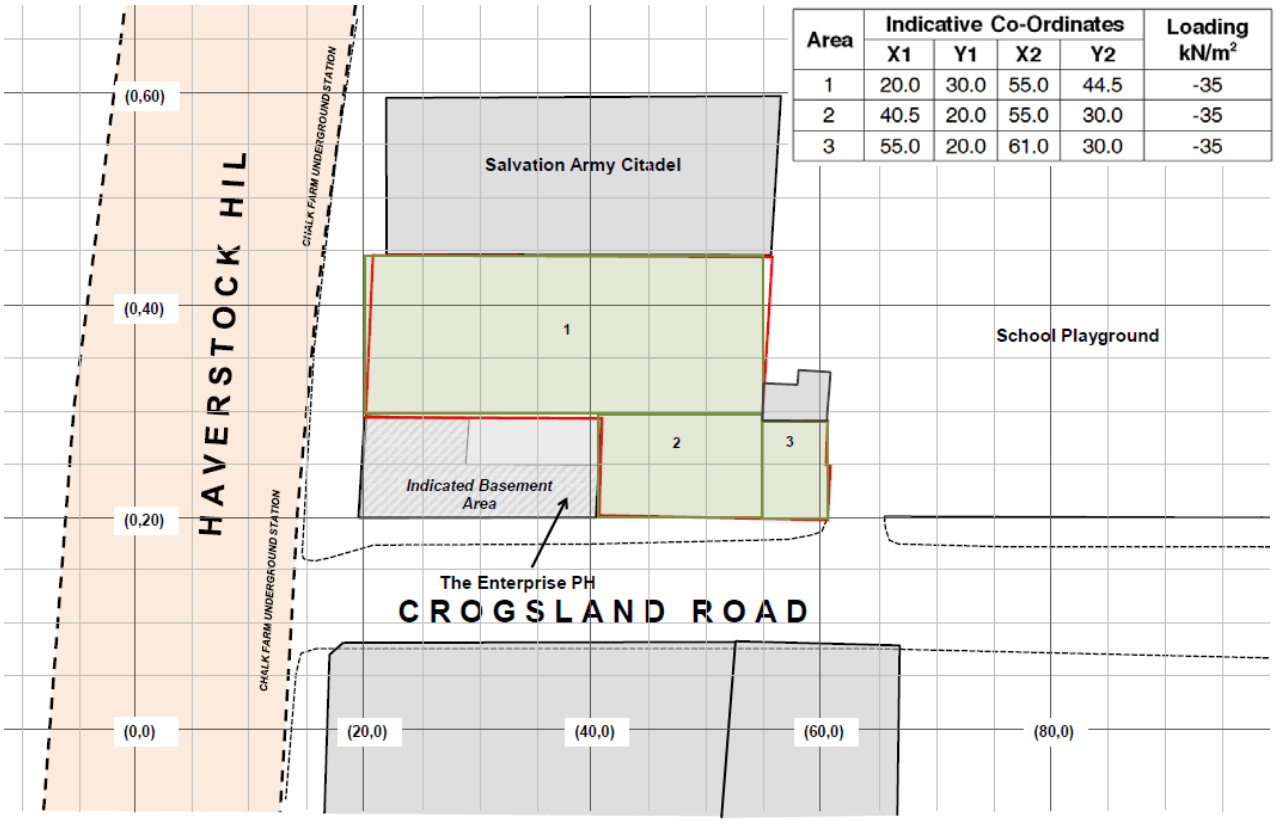
The ground surface movements arising from the installation of the bored pile retaining wall may be estimated using default values in CIRIA report C760.

It should be noted that the amount of predicted movement is related to the wall depth and that for the purposes of this assessment the predictions are made on the basis of a pile depth equivalent to 1.5 times the retained height.

The analysis suggests that as a result of pile installation, both the Salvation Army Citadel and The Enterprise Pub may experience up to 4mm of settlement each. The associated horizontal movement is predicted to be 4mm for each building.

7.4.3.2 Ground Surface Movements due to Demolition and Excavation

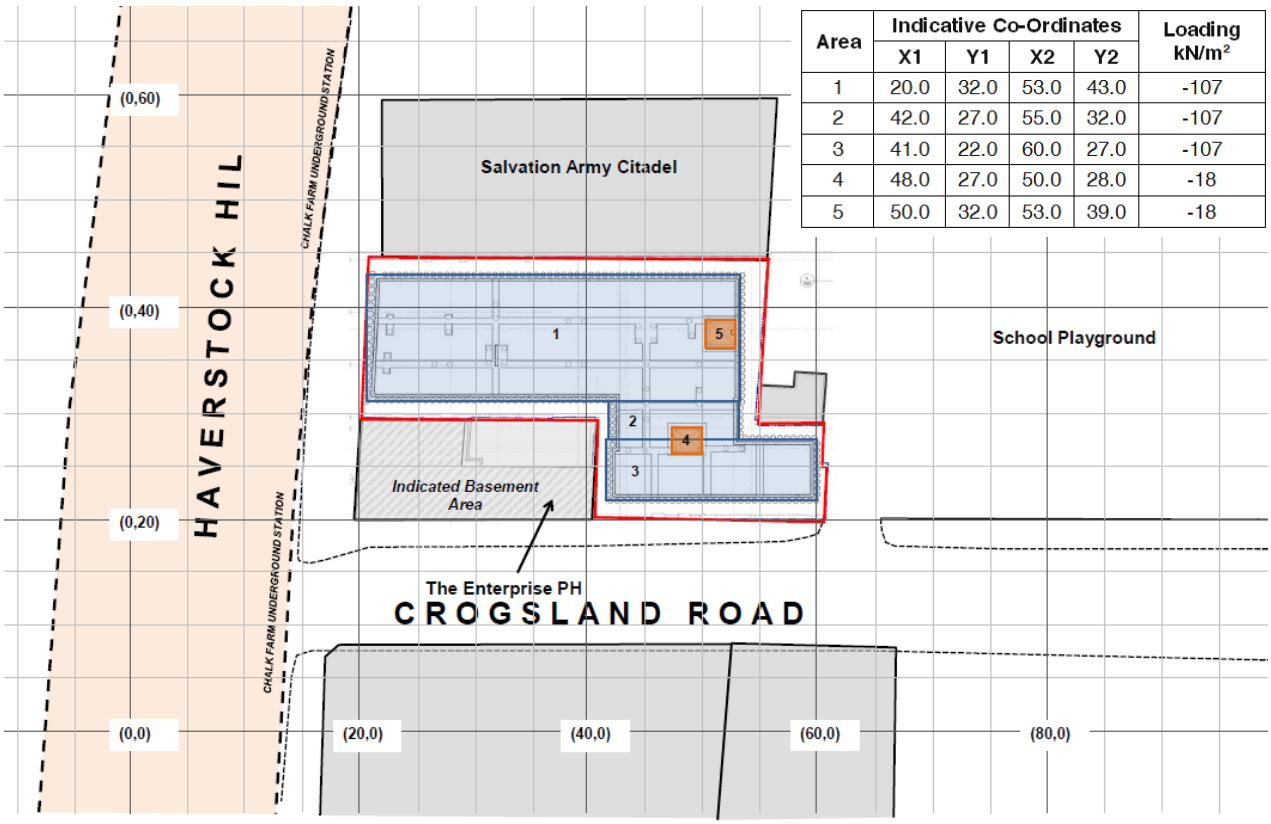
The potential effect of the planned basement excavations has been considered applying a net unloading of approximately -35kN/m^2 due to demolition of the existing building and -107kN/m^2 soil unloading in the basement area. This soil unloading increases to -125kN/m^2 in the area of the two deepened sections for the proposed lift shaft and sump.



Area	Indicative Co-Ordinates				Loading kN/m²
	X1	Y1	X2	Y2	
1	20.0	30.0	55.0	44.5	-35
2	40.5	20.0	55.0	30.0	-35
3	55.0	20.0	61.0	30.0	-35

Plan showing modelled unload areas due to demolition

Assumed Demolition Unload Area



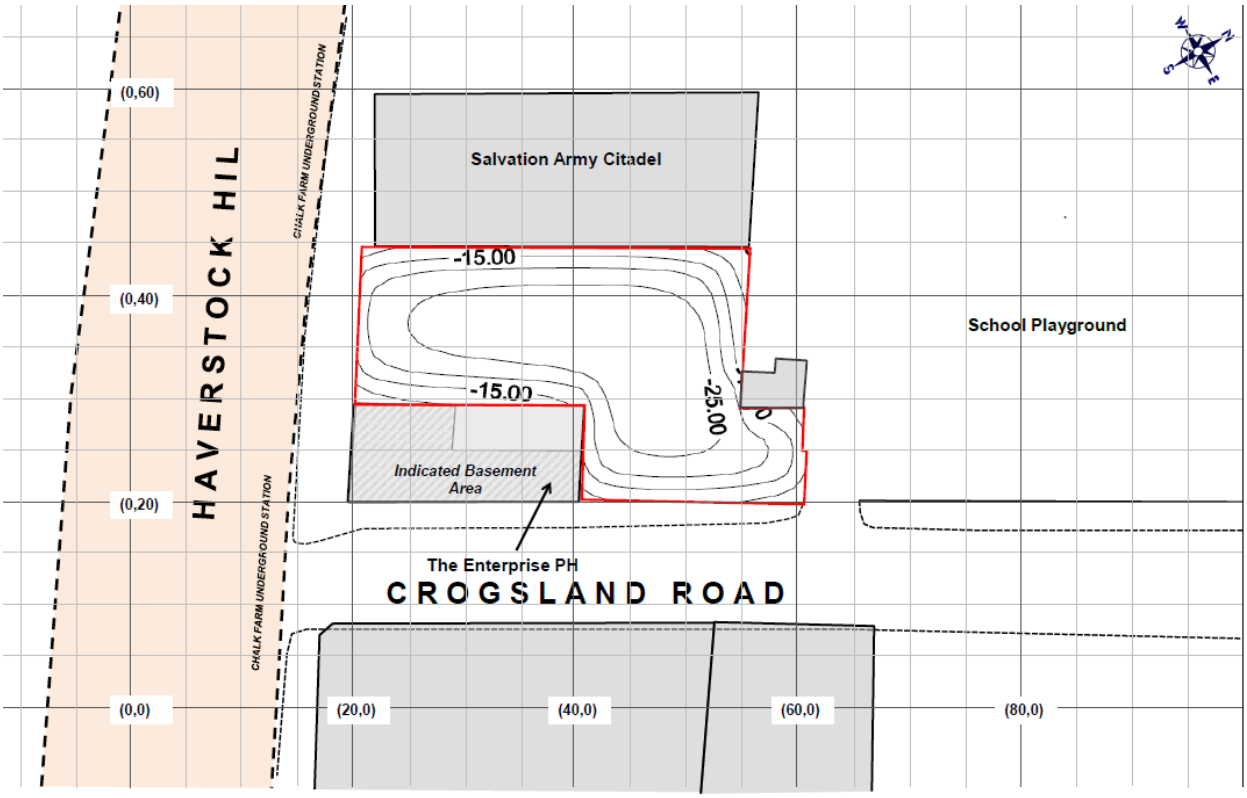
Area	Indicative Co-Ordinates				Loading kN/m²
	X1	Y1	X2	Y2	
1	20.0	32.0	53.0	43.0	-107
2	42.0	27.0	55.0	32.0	-107
3	41.0	22.0	60.0	27.0	-107
4	48.0	27.0	50.0	28.0	-18
5	50.0	32.0	53.0	39.0	-18

Plan showing modelled unload areas due to soil excavation

Assumed 6m Soil Unload Area

Assumed 7m Soil Unload Area

The analysis suggests that, by the time basement excavation is complete, up to 30mm of heave is likely to have taken place within the centre of the basement area.



Plan showing theoretical approximate short term heave (mm) due to demolition and soil excavation

7.4.3.3 Ground Surface Movements due to Pile Wall Yielding

The ground surface movements arising from excavation in front of the bored pile retaining wall and consequent yielding of the piled wall have been estimated using default values contained with CIRIA report C760.

The wall support has been assumed to be of moderate stiffness for the purpose of this assessment. With reference to Table 6.3 in C760, both the vertical and horizontal surface movements at the wall are assumed to be 0.3% of the maximum excavation depth. In addition, the curves present in Figure 6.13 allow for the profile of ground movements behind the wall to be estimated.

The analysis suggests that on the basis of a moderate stiffness wall, both the Salvation Army Citadel and The Enterprise Pub may experience up to 14mm of settlement each respectively. The associated horizontal movement is predicted to be up to 17mm for each structure.

7.4.4 Damage Assessment

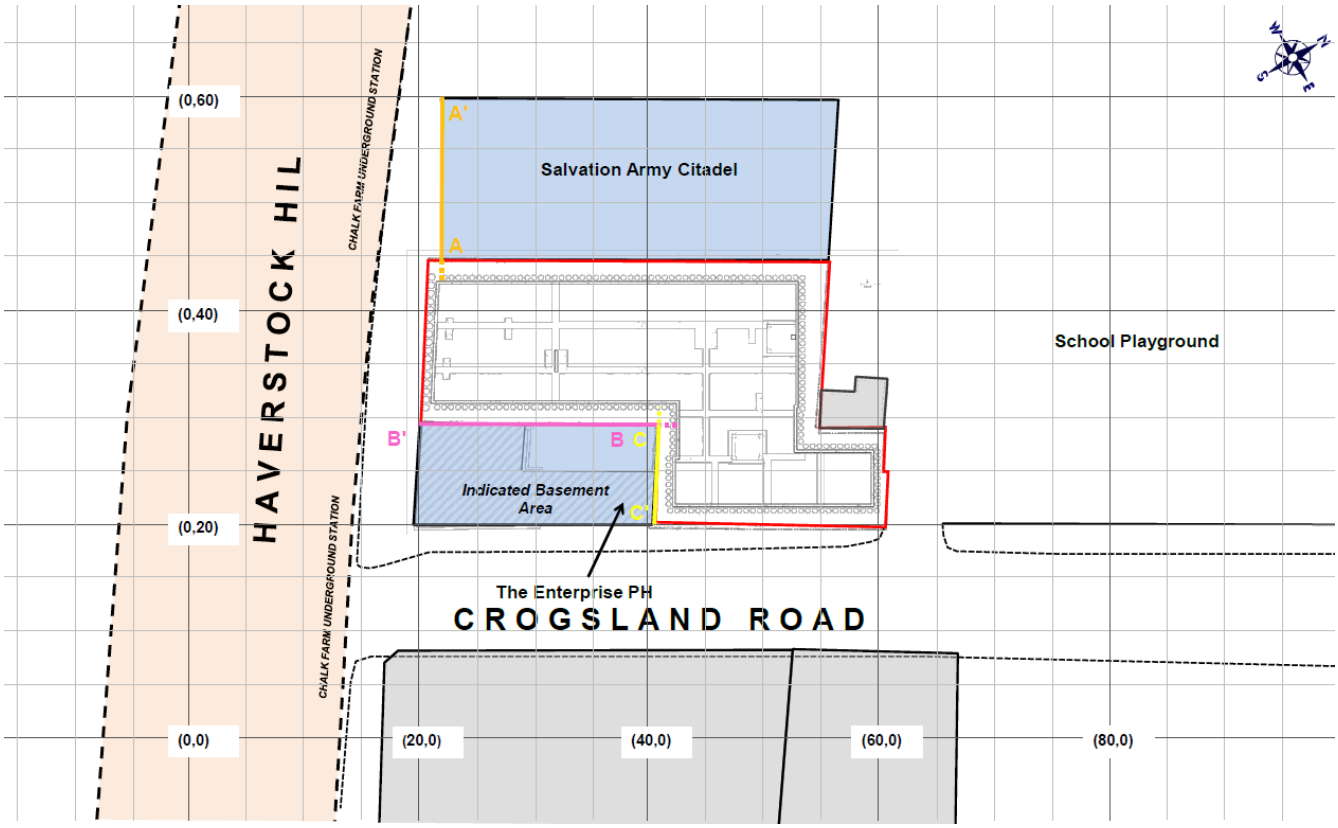
In view of the settlements and horizontal movements described above, an assessment of the potential damage to the neighbouring structures has been made. This has been achieved using the methodology proposed by Burland as described in CIRIA C760 for ground movements associated with a bored piled retaining wall.

The deflection ratio (Δ / L) has been calculated from the predicted net movements at either end of the section under assessment.

The length (L) of the Salvation Army Citadel is assumed to be 15m with an approximate wall height (H) of 7.5m. The strain has been assessed over the full length of the building.

Similarly, the longer party wall of the Enterprise Pub has an assumed length of 20m and an approximate height of 13.5m. The side section of the party wall to the Enterprise Pub, emerging on Crogsland Road, has been assumed as 10m in length and an approximate height of 13.5m.

The strain has been assessed over the full length of the walls.



Site plan showing line of sections used for damage category assessment

7.4.4.1 Salvation Army Cital (Section A – A')

The maximum horizontal strain, Ɛh (**δ**h / L) = 0.095%, and the maximum deflection ratio Δ / L = -0.006 have been calculated over the full length of the building.

Based upon Figure 6.25b for L / H = 2, the limiting strain to this structure is assessed as 0.105%, less than the upper bound of 'slight' (Burland Category 2).

7.4.4.2 The Enterprise Pub – Long Section (Section B – B')

The maximum horizontal strain, Ɛh (**δ**h / L) = 0.08%, and the maximum deflection ratio Δ / L = -0.05 have been calculated over the full length of the building.

Based upon Figure 6.25b for L / H = 1.48, the limiting strain to this structure is assessed as 0.08%, less than the upper bound of 'slight' (Burland Category 2).

7.4.4.3 The Enterprise Pub – Short Section (Section C – C')

The maximum horizontal strain, Ɛh (**δ**h / L) = 0.088%, and the maximum deflection ratio ∆ / L = -0.002 have been calculated over the full width of the building.

Based upon Figure 6.25b for L / H = 0.7, the limiting strain to this structure is assessed as 0.085%, less than the upper bound of 'slight' (Burland Category 2).

7.4.5 Conclusion

In line with DP27, Camden will ensure that harm is not caused to neighbouring properties by basement development. CPG4 guidance states that it is a major objective of design and construction to maintain a level of risk to buildings no higher than Burland Category 2 'slight'.

Given the construction of a moderate stiffness basement retaining wall via the use of an appropriate amount of propping, the above analysis suggests that the worst potential for damage to the neighbouring structures is expected to be limited to 'slight'.

Nevertheless, the piled basement retaining wall design should be designed and maintained in as rigid a state as is possible through the installation of appropriate propping prior to any excavation and the installation of additional propping as necessary as the excavation proceed, with the intention of allowing negligible deflection and yielding at any level.

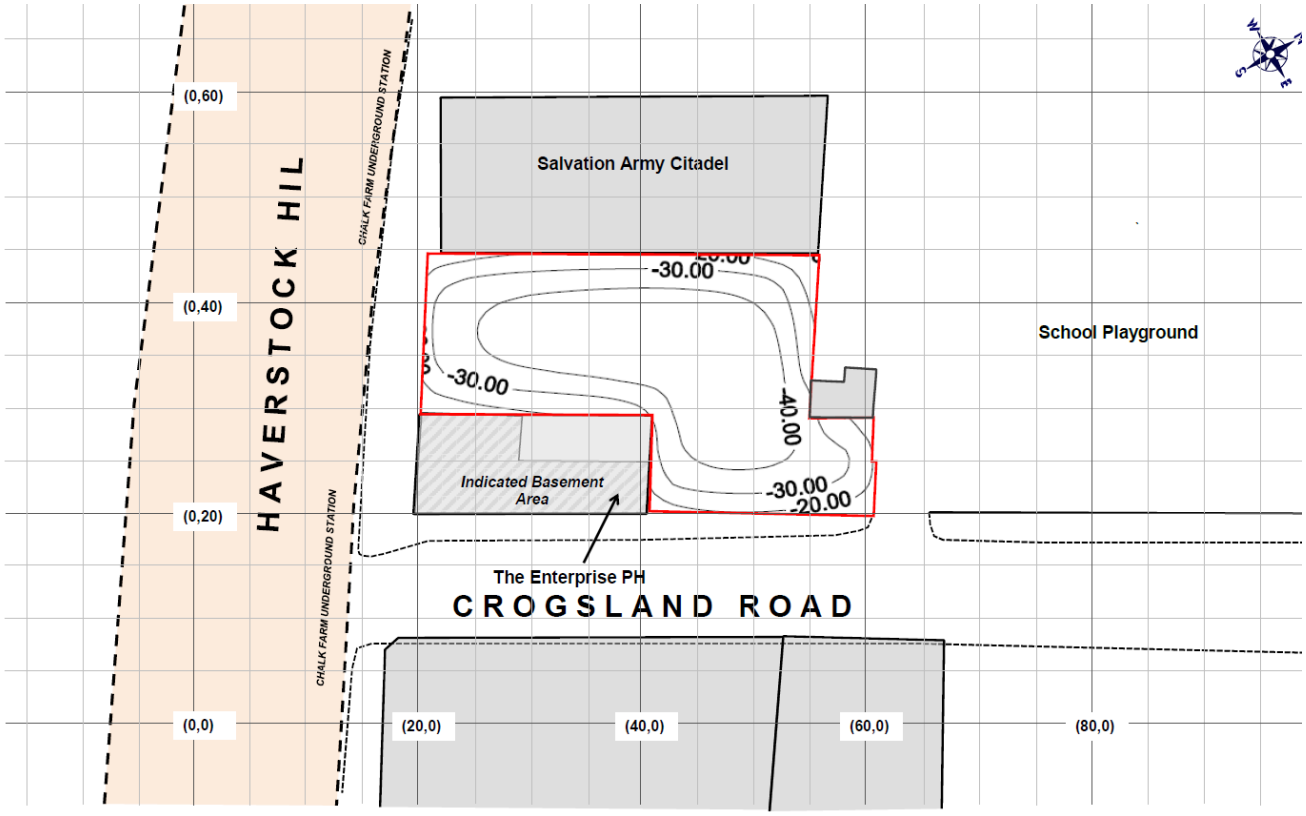
7.4.6 Long Term Movements

Following excavation of the new basement, loading will be reapplied to the soil as a result of the weight of the new structure. This will be transferred to the London Clay by means of the piles progressively as the structure is built.

However, it is evident that there is a mismatch between the weight of soil that is to be removed during the basement excavation and the weight of the new structure that is to replace this. In this situation there will inevitably be a component of long term heave movement that could proceed for several decades.

While there is some scope for this movement to be manifested into inside the basement excavation, it is not envisaged that there will be discernible on-going heave outside the new basement retaining walls.

The analysis suggests that owing to the net unloading in the permanent situation following construction, an additional 50mm of heave could occur beneath the building. In practice this figure will be significantly reduced by the effected of the re-loading at depth due to the new piled foundations.



Plan showing theoretical approximate post construction heave (mm) due to demolition and soil excavation

7.5 Monitoring

The monitoring plan is to be sufficiently robust to enable mitigation to be effectively implemented in the event of agreed trigger values for vertical and horizontal movement being exceeded at agreed monitoring positions. During the actual basement excavation stage both start of shift and end of shift measurements will be necessary in order for movements to be checked and, in the event of any adverse movement, for the contingency plan to be effected sufficiently quickly to prevent the excessive movement to either the neighbouring properties.

The plan will make it clear what emergency measures or mitigation may be required to be implemented in the event of an exceedance and will demonstrate the availability of the required resources. The plan will also identify exactly who will have the responsibility for implementing the plan.

It is anticipated that the piling and subsequent excavation will in practice be separated by a number of weeks. This period will provide an opportunity for the ground movements due to piling to be assessed and for the ground movement analysis to be reviewed prior to the main excavation taking place so that propping proposals can be adjusted if required

7.6 Residual Impacts

Given the mitigation measures afforded by the construction methodology that has been described, it is concluded that the proposed basement development will have no residual unacceptable impacts upon the surrounding structures, infrastructure and environment.

8. Conclusion

This BIA has demonstrated that each of the potential impact and issues can be satisfactorily addressed through the use of appropriate engineering design and construction measures, and that the proposed construction can be successfully completed without detriment to the environment, flooding or ground instability.

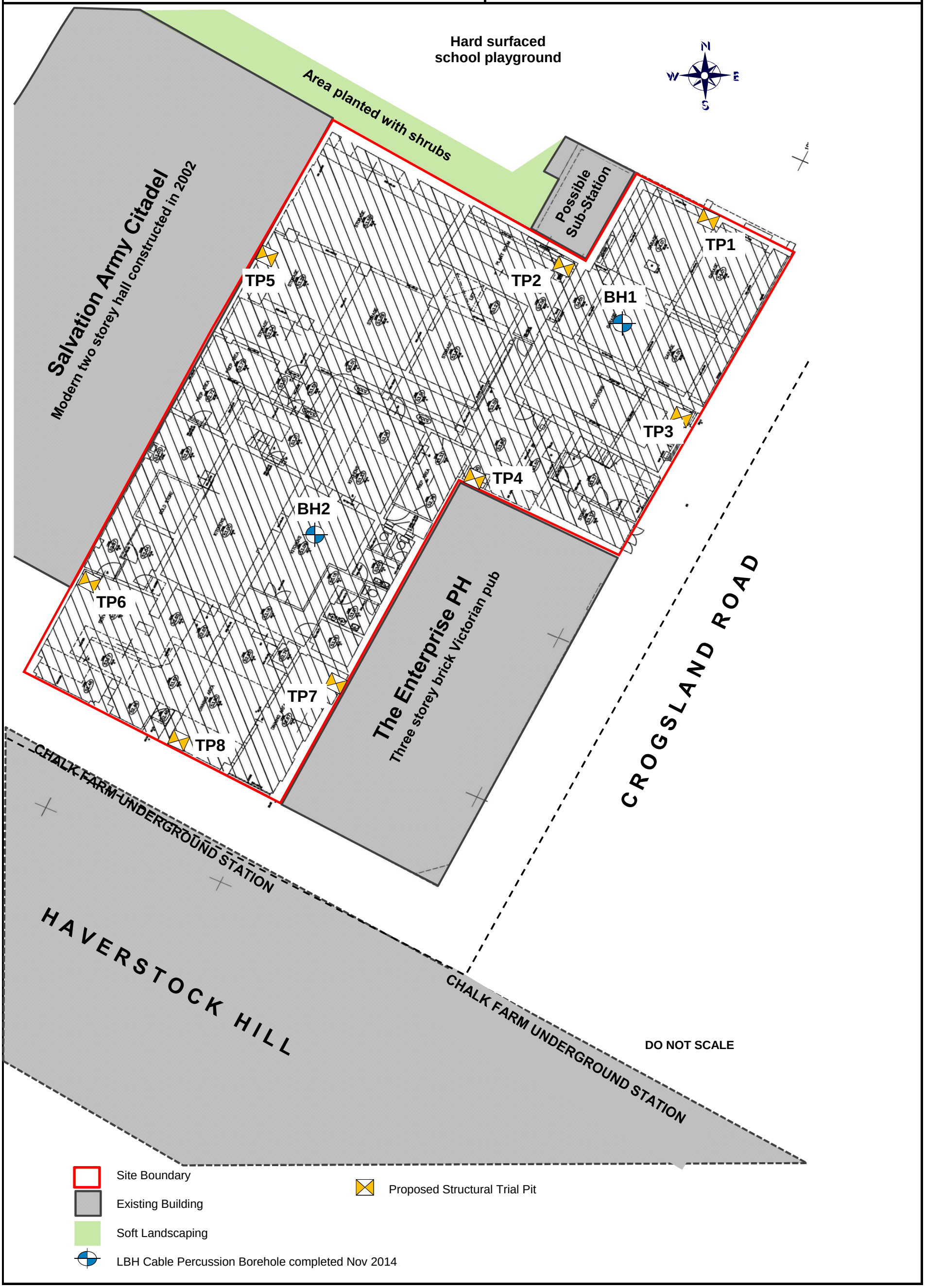
Having reviewed the adequate design and construction methodology, it is envisaged that the basement construction will have no significant detrimental impact on the stability of the neighbouring structures and can be achieved without any cumulative impact.

Appendix

Ground Investigation Factual Data

Burland Damage Assessment Diagrams

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL	LBH4278	**SITE PLAN SHOWING EXPLORATORY POSITIONS**
CLIENT: SRE Haverstock Hill Ltd		



PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH1

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 17/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 9.00m on completion. Top seal 0.2m to 2m. Bottom seal 10m to 9m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						MADE GROUND (Concrete)
					0.15	
1	D	0.30	c			MADE GROUND (Light brown clayey sand with gravel and scattered brick and concrete fragments)
2	D	0.50				
3	B	0.50-1.00				
4	D	1.50	c			
5	D	1.50			1.50	
6	U	1.50-1.95				Firm to stiff orange-brown and mottled grey silty CLAY
7	D	2.00				
8	D	2.50	c			
	SPT	2.80	N=9			
9	D	2.95				
10	U	3.50-3.95				
11	D	4.00				
	SPT	4.80	N=15			
12	D	4.95				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 1

LBH WEMBLEY **Geotechnical & Environmental**

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH1

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 17/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 9.00m on completion. Top seal 0.2m to 2m. Bottom seal 10m to 9m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Firm to stiff orange-brown and mottled grey silty CLAY
13	U	6.00-6.45				
14	D	6.50				
15	SPT D	7.50-7.95 7.95	N=23			- Becoming stiff
16	U	9.00-9.45				
17	D	9.50			9.50	
						Stiff grey silty CLAY

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 2

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH1

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 17/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 9.00m on completion. Top seal 0.2m to 2m. Bottom seal 10m to 9m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Stiff grey silty CLAY
18	SPT D	10.50-10.95 10.95	N=25			
19	U	12.00-12.45				
20	D	12.50				
21	SPT D	13.50-13.95 13.95	N=34			- Becoming very stiff
22	U	15.00-15.45				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH1

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 17/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 9.00m on completion. Top seal 0.2m to 2m. Bottom seal 10m to 9m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
23	D	15.50				Very stiff grey silty CLAY
24	SPT D	16.50-16.95 16.95	N=38			
25	U	18.00-18.45				
26	D	18.50				
27	SPT D	19.50-19.95 19.95	N=41			

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH1

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 17/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m

Standpipe installed to 9.00m on completion. Top seal 0.2m to 2m. Bottom seal 10m to 9m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Very stiff grey silty CLAY
28	U	21.00-21.45				
29	D	21.50				
	SPT	22.50-22.95	N=45			
30	D	22.95				
31	U	24.00-24.45				
32	D	24.50				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH1

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 17/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m

Standpipe installed to 9.00m on completion. Top seal 0.2m to 2m. Bottom seal 10m to 9m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Very stiff grey silty CLAY
33	SPT D	25.50-25.95 25.95	N=50			
34	U	27.00-27.45				
35	D	24.50				
36	SPT D	28.50-28.95 28.95	N=47			
37	U	30.00-30.45				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

LBH WEMBLEY Geotechnical & Environmental

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL

LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH1

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 17/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m

Standpipe installed to 9.00m on completion. Top seal 0.2m to 2m. Bottom seal 10m to 9m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples		Depth	Tests	Legend	Depth	Description
No	Type	m			m	
38	D	30.50			30.50	Very stiff grey silty CLAY

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 7

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH2

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 21/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 17.00m on completion. Top seal 0.2m to 2m. Bottom seal 18m to 17m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
1	D	0.25	c		0.15	MADE GROUND (Concrete)
2	D	0.50				MADE GROUND (Dirty brown clayey sand with gravel and brick and concrete fragments)
3	B	0.50				
4	D	1.50	c		1.50	
5	U	2.50-2.95				Firm to stiff orange-brown and mottled grey silty CLAY
6	D	3.00				
	SPT	3.50-3.80	N=13			
7	D	4.00				
8	U	4.50-4.95				
9	D	5.00				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 1

LBH WEMBLEY Geotechnical & Environmental

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH2

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 21/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 17.00m on completion. Top seal 0.2m to 2m. Bottom seal 18m to 17m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Firm to stiff orange-brown and mottled grey silty CLAY
10	SPT D	6.00-6.30 6.50	N=18			- Becoming stiff
11	U	7.50-7.95				
12	D	8.00				
13	SPT D	9.00-9.45 9.50	N=23			
					9.50	
						Stiff grey silty CLAY

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH2

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 21/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 17.00m on completion. Top seal 0.2m to 2m. Bottom seal 18m to 17m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Stiff grey silty CLAY
14	U	10.50-10.95				
15	D	11.00				
	SPT	12.00-12.45	N=30			
16	D	12.50				- Occasional layers of claystone
17	U	13.50-13.95				
18	D	14.00				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 3

LBH WEMBLEY Geotechnical & Environmental

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH2

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 21/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 17.00m on completion. Top seal 0.2m to 2m. Bottom seal 18m to 17m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Stiff grey silty CLAY
19	SPT D	15.00-15.45 15.50	N=34			- Becoming very stiff
20	U	16.50-16.95				
21	D	17.00				
22	SPT D	18.00-18.45 18.50	N=37			
23	U	19.50-19.45				
24	D	20.00				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

LBH WEMBLEY Geotechnical & Environmental

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH2

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 21/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 17.00m on completion. Top seal 0.2m to 2m. Bottom seal 18m to 17m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
						Very stiff grey silty CLAY
25	SPT D	21.00-21.45 21.50	N=41			
26	U	22.50-22.95				
27	D	23.00				
28	SPT D	24.00-24.45 24.50	N=45			

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 5

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH2

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 21/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 17.00m on completion. Top seal 0.2m to 2m. Bottom seal 18m to 17m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
29	U	25.50-25.95				Very stiff grey silty CLAY
30	D	26.00				
	SPT	27.00-27.45	N=54			
31	D	27.50				
32	U	28.50-28.95				
33	D	29.00				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 6

LBH WEMBLEY Geotechnical & Environmental

PROJECT: Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL LBH4278

CLIENT: SRE Haverstock Hill Ltd

BOREHOLE BH2

BORING METHOD: Low headroom cutdown cable percussion drilling rig

Date: 21/11/14

GROUND WATER: Borehole dry on completion

REMARKS: Hand-dug inspection pit to 1.2m
Standpipe installed to 17.00m on completion. Top seal 0.2m to 2m. Bottom seal 18m to 17m. Response zone 2m to 9m.

Ground level = +30.72mOD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
34	SPT D	30.00-30.45 30.50	N=50		30.50	Very stiff grey silty CLAY

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

Sheet No: 7

LBH WEMBLEY Geotechnical & Environmental

Project Name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	01/12/2014
Project No:	LBH4278	**Our job/report no:**	17891	**Date Reported:**	02/12/2014

K4 SOILS

Borehole No:	Sample No:	Depth (m)	Description	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425 mm (%)	Remarks
BH1	D	11.00	Dark grey silty CLAY	26	77	24	53	100	
BH2	D	2.00	Brown and dark brown slightly gravelly silty CLAY with traces of fine brick fragments (gravel is fine and sub-angular)	30	73	23	50	98	

UKAS TESTING 2519

Summary of Test Results

BS 1377 : Part 2 : Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method.
BS 1377 : Part 2 : Clause 5 : 1990 Determination of the plastic limit and plasticity index.
BS 1377 : Part 2 : Clause 3.2 : 1990 Determination of the moisture content by the oven-drying method.

Checked and Approved
Initials: K.P
Date: 01/12/2014

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

Test Results relate only to the sample numbers shown above. Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Project Name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL		K4 SOILS
Client:	LBH Wembley	Project no: LBH4278	
		Our job no: 17891	

Borehole No:	Sample No:	Depth m	Description	pH	Sulphate content (g/l)
BH1	D	0.50	Reddish brown sandy GRAVEL (gravel is fmc brick and concrete fragments)	8.4	3.05
BH1	D	12.50	Dark grey silty CLAY	8.2	0.97
BH2	D	2.00	Brown and dark brown slightly gravelly silty CLAY with traces of fine brick fragments (gravel is fine and sub-angular)	7.9	1.98
BH2	D	14.00	Dark grey silty CLAY	8.1	0.49

Date
01/12/2014

Summary of Test Results

BS 1377 : Part 3 :Clause 5 : 1990

Determination of sulphate content of soil and ground water : gravimetric method

Checked and Approved
Initials : kp

Client :	LBH Wembley	Our Job/report no:	17891	Samples Rec :	19/11/2014	Testing Started:	03/12/2014
Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL	Project No:	LBH4278	Project Started:	26/11/2014	Date reported:	05/12/2014

BH / TP No	Sample no / ref	Sample depth (m)	Description	Moisture content (%)	Bulk Density (Mg/m3)	Dry density (Mg/m3)	Cell Pressure (kPa)	Strain at failure (%)	Max Deviator Stress (kPa)	Mode of failure	Shear Strength (kPa)	Phi (deg)
BH1	U	1.50 - 1.95	Medium strength brown slightly blue grey mottled silty CLAY	31	1.99	1.52	30	5.1	98	Brittle	49	NA
BH1	U	3.50 - 3.95	Medium strength fissured brown slightly blue grey mottled silty CLAY	34	1.90	1.42	70	8.1	146	Brittle	73	NA
BH1	U	6.00 - 6.45	High strength slightly fissured brown silty CLAY with occasional selenite	32	1.91	1.45	120	5.1	169	Brittle	84	NA
BH1	U	9.00 - 9.45	Very high strength fissured dark grey brown silty CLAY	27	1.96	1.54	180	7.6	326	Brittle	163	NA
BH1	U	12.00 - 12.45	Very high strength fissured dark grey brown silty CLAY	28	2.01	1.57	17	5.1	546	Brittle	273	NA
BH1	U	15.00 - 15.45	Very high strength fissured dark grey silty CLAY	27	2.00	1.57	300	6.1	322	Brittle	161	NA
BH1	U	18.00 - 18.45	Extremely high strength fissured dark grey silty CLAY	27	1.95	1.53	360	6.6	643	Brittle	322	NA
BH1	U	21.00 - 21.45	Very high strength fissured dark grey silty CLAY - REMARKS - Sample was disturbed	26	1.94	1.54	420	13	308	Compound	154	NA
BH1	U	24.00 - 24.45	Very high strength fissured dark grey silty CLAY	25	2.02	1.62	480	6.0	343	Brittle	172	NA
BH1	U	27.00 - 27.45	Very high strength fissured dark grey silty CLAY	26	2.00	1.59	540	6.0	573	Brittle	287	NA
BH1	U	30.00 - 30.45	Extremely high strength fissured dark grey silty CLAY	25	2.02	1.61	600	9.0	990	Brittle	495	NA
BH2	U	2.50 - 2.95	High strength brown silty CLAY	31	1.94	1.48	50	7.5	163	Brittle	82	NA
BH2	U	4.50 - 4.95	Medium strength brown mottled blue grey silty CLAY	34	1.88	1.40	90	6.5	144	Brittle	72	NA

K4 SOILS

Summary of Undrained Triaxial Compression Testing

BS 1377 : Part 7 : Clause 8 : 1990

Checked and approved

Initials kp

Client :	LBH Wembley	Our Job/report no:	17891	Samples Rec :	19/11/2014	Testing Started:	03/12/2014
Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL	Project No:	LBH4278	Project Started:	26/11/2014	Date reported:	05/12/2014

BH / TP No	Sample no / ref	Sample depth (m)	Description	Moisture content (%)	Bulk Density (Mg/m3)	Dry density (Mg/m3)	Cell Pressure (kPa)	Strain at failure (%)	Max Deviator Stress (kPa)	Mode of failure	Shear Strength (kPa)	Phi (deg)
BH2	U	7.50 - 7.95	High strength fissured brown silty CLAY with occasional orange brown silt partings and occasional selenite crystals	31	1.89	1.45	150	5.5	191	Brittle	95	NA
BH2	U	10.50 - 10.95	High strength fissured dark grey silty CLAY	29	1.89	1.47	210	7.1	217	Brittle	109	NA
BH2	U	13.50 - 13.95	Very high strength fissured dark grey CLAY	28	1.97	1.54	270	4.5	417	Brittle	209	NA
BH2	U	16.50 - 16.95	High strength fissured dark grey silty CLAY - REMARKS - Sample was disturbed	28	1.98	1.55	330	6.1	189	Brittle	94	NA
BH2	U	19.50 - 19.95	Extremely high strength fissured dark grey silty CLAY	28	2.02	1.58	390	4.5	639	Brittle	319	NA
BH2	U	22.50 - 22.95	Extremely high strength fissured dark grey silty CLAY	26	1.91	1.52	450	9.6	683	Brittle	341	NA
BH2	U	25.50 - 25.95	High strength fissured dark grey silty CLAY	25	1.90	1.52	510	6.1	233	Brittle	116	NA
BH2	U	28.50 - 28.95	Very high strength fissured dark grey silty CLAY with light grey fine sand partings	24	1.99	1.61	570	9.6	555	Brittle	277	NA

K4 SOILS

Summary of Undrained Triaxial Compression Testing

BS 1377 : Part 7 : Clause 8 : 1990

Checked and approved

Initials kp

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	1.50

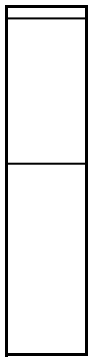
Soil Description: Medium strength brown slightly blue grey mottled silty CLAY

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	31
Bulk Density	Mg/m³	1.99
Dry Density	Mg/m³	1.52

Test Details

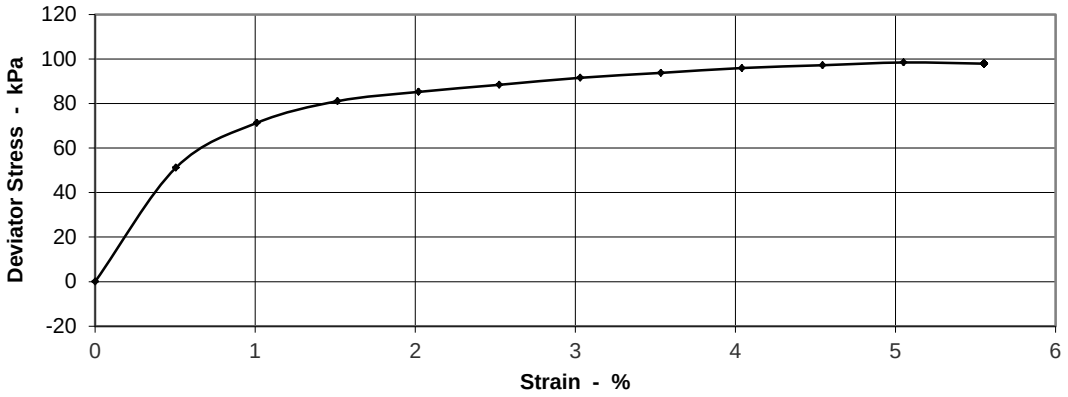
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.26
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	30
Strain at Failure	%	5.1
Maximum Deviator Stress	kPa	98
Shear Strength	kPa	49
Mode of Failure		Brittle

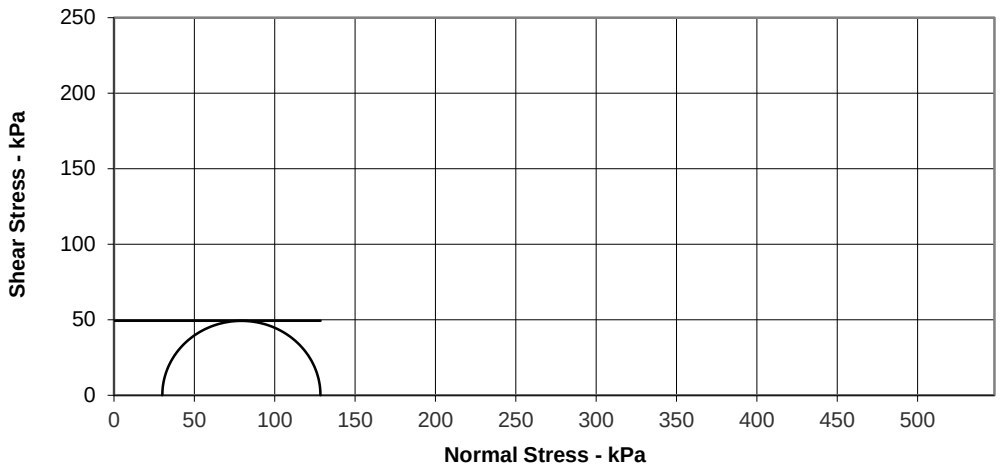
Position and orientation within the original sample



Shear Strength Parameters	
C	49 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	3.50

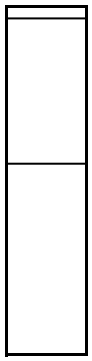
Soil Description: Medium strength fissured brown slightly blue grey mottled silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	34
Bulk Density	Mg/m³	1.90
Dry Density	Mg/m³	1.42

Test Details

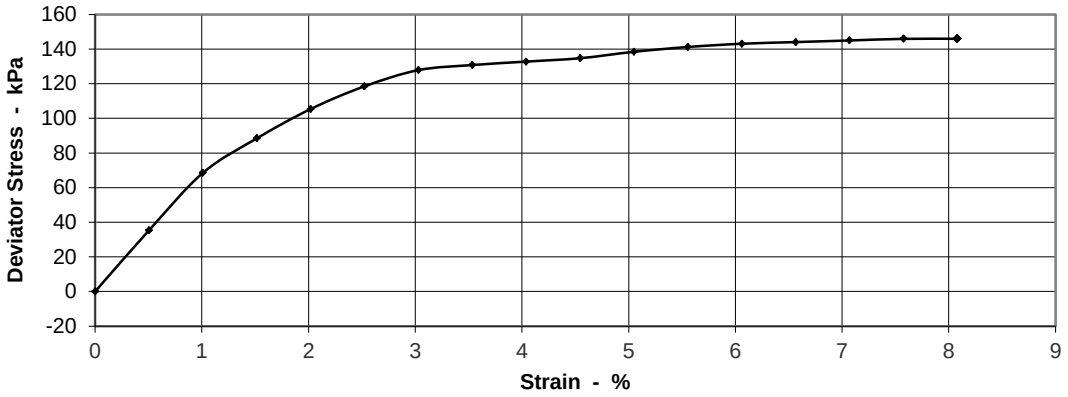
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.38
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	70
Strain at Failure	%	8.1
Maximum Deviator Stress	kPa	146
Shear Strength	kPa	73
Mode of Failure		Brittle

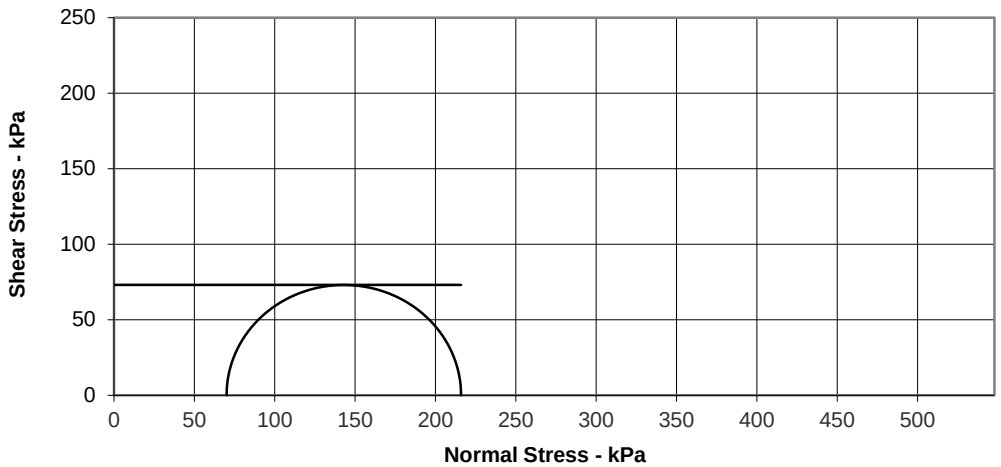
Position and orientation within the original sample



Shear Strength Parameters	
C	73 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	6.00

Soil Description: High strength slightly fissured brown silty CLAY with occasional selenite

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	32
Bulk Density	Mg/m³	1.91
Dry Density	Mg/m³	1.45

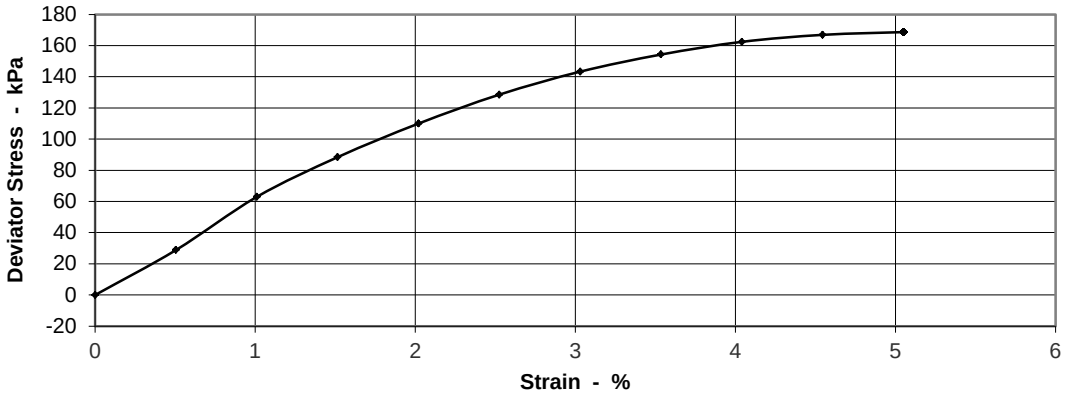
Position and orientation within the original sample

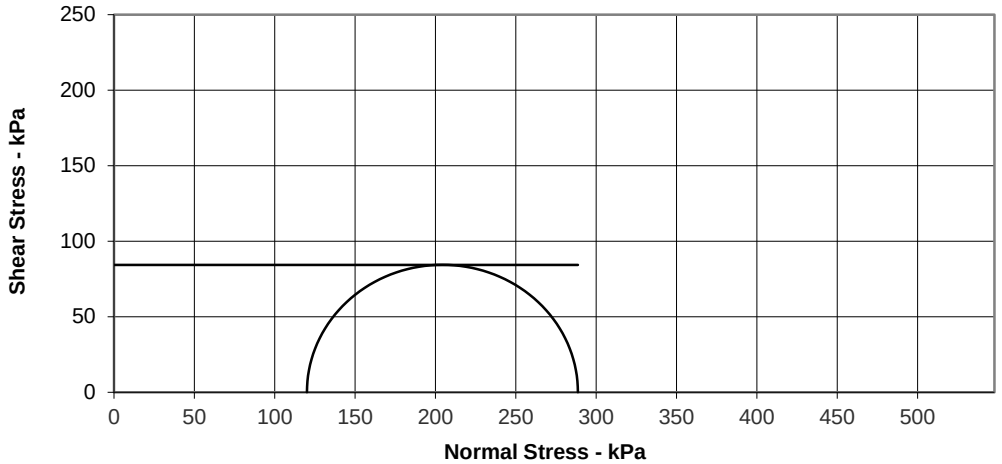
Test Details

Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.26
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	120
Strain at Failure	%	5.1
Maximum Deviator Stress	kPa	169
Shear Strength	kPa	84
Mode of Failure		Brittle

Shear Strength Parameters	
C	84 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

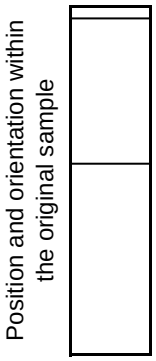
Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	9.00

Soil Description: Very high strength fissured dark grey brown silty CLAY

Sample Details		**Specimen 1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	27
Bulk Density	Mg/m³	1.96
Dry Density	Mg/m³	1.54

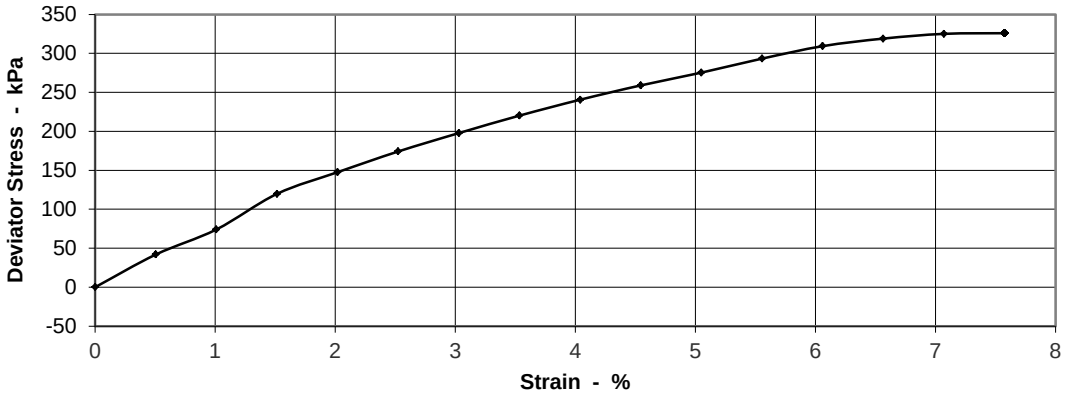
Test Details		
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.36
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	180
Strain at Failure	%	7.6
Maximum Deviator Stress	kPa	326
Shear Strength	kPa	163
Mode of Failure		Brittle

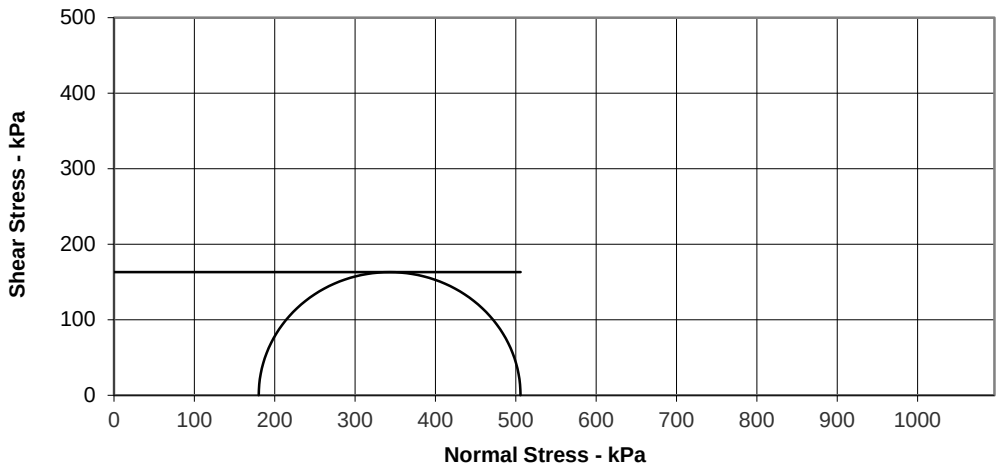
Position and orientation within the original sample



Shear Strength Parameters	
C	163 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	12.00

Soil Description: Very high strength fissured dark grey brown silty CLAY

Sample Details		**Specimen 1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	28
Bulk Density	Mg/m³	2.01
Dry Density	Mg/m³	1.57

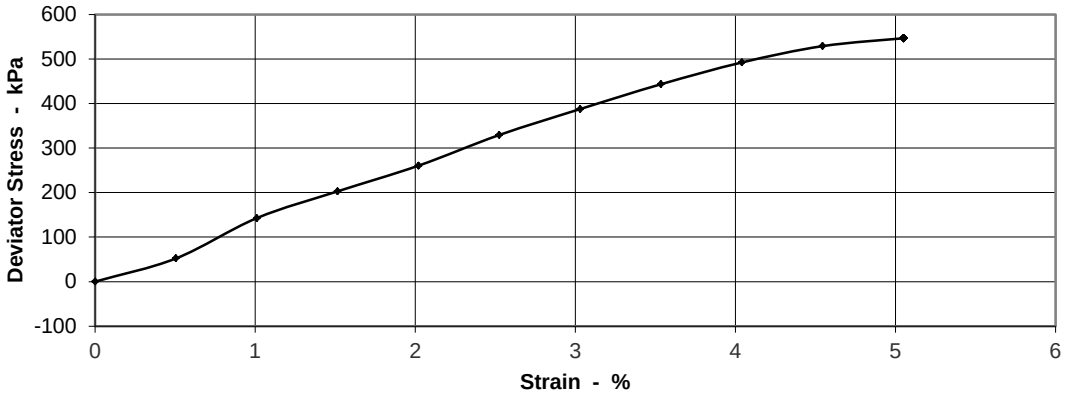
Position and orientation within the original sample

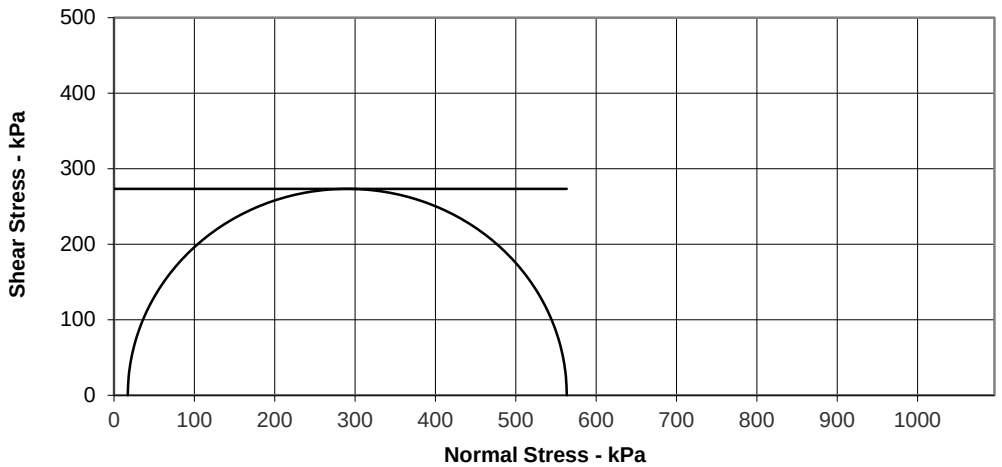
Test Details

Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.26
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	17
Strain at Failure	%	5.1
Maximum Deviator Stress	kPa	546
Shear Strength	kPa	273
Mode of Failure		Brittle

Shear Strength Parameters	
C	273 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	15.00

Soil Description: Very high strength fissured dark grey silty CLAY

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	27
Bulk Density	Mg/m³	2.00
Dry Density	Mg/m³	1.57

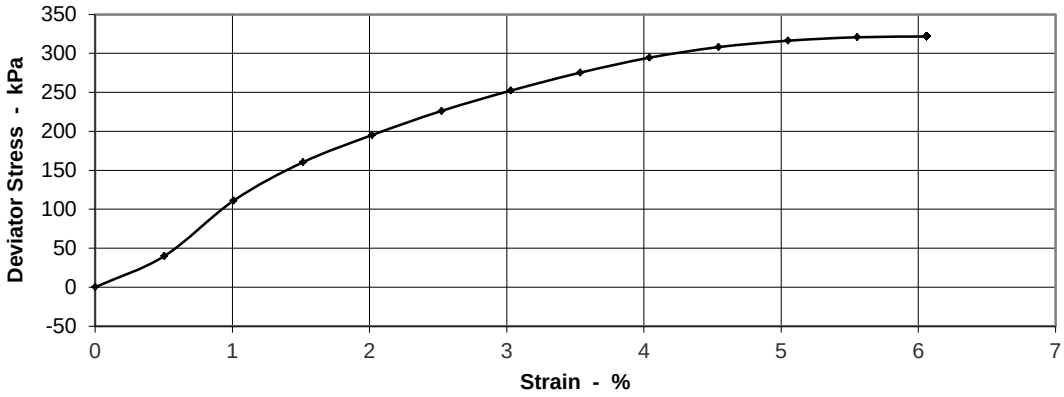
Position and orientation within the original sample

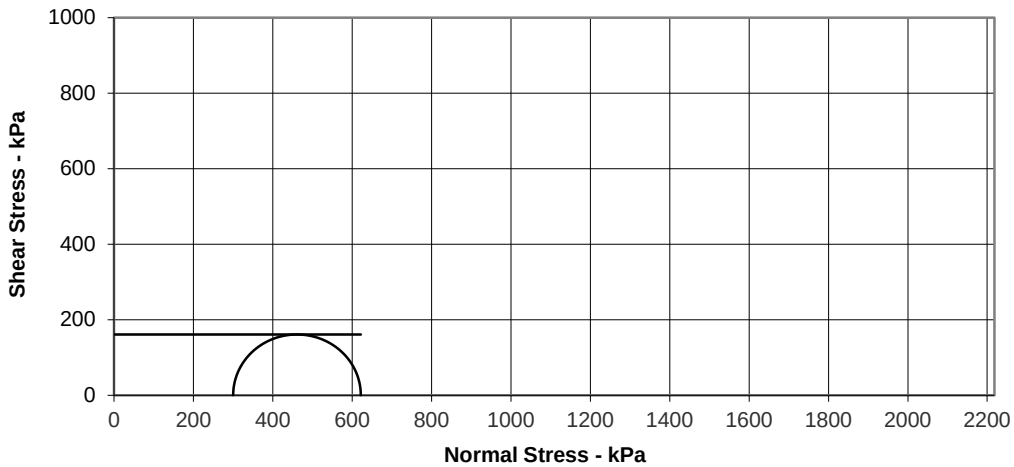
Test Details

Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.30
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	300
Strain at Failure	%	6.1
Maximum Deviator Stress	kPa	322
Shear Strength	kPa	161
Mode of Failure		Brittle

Shear Strength Parameters	
C	161 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

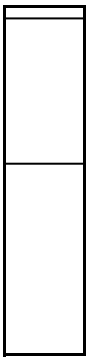
BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	18.00

Soil Description: Extremely high strength fissured dark grey silty CLAY

Sample Details		**Specimen 1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	27
Bulk Density	Mg/m³	1.95
Dry Density	Mg/m³	1.53

Position and orientation within the original sample

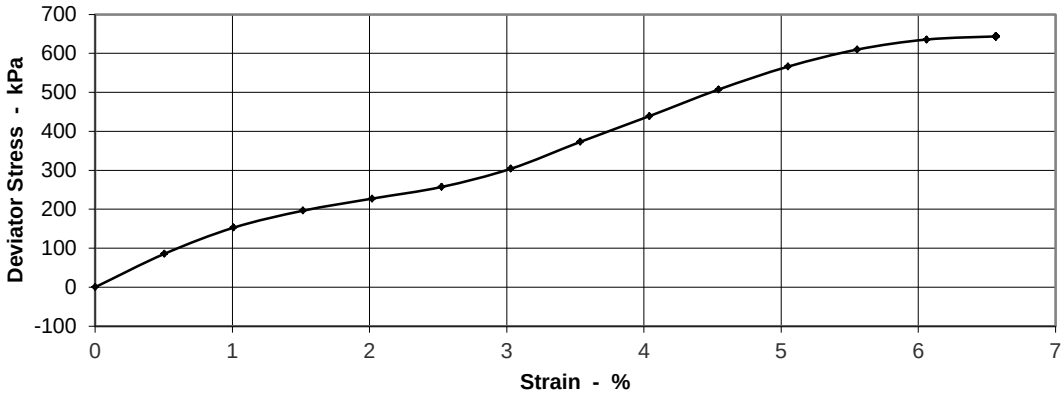


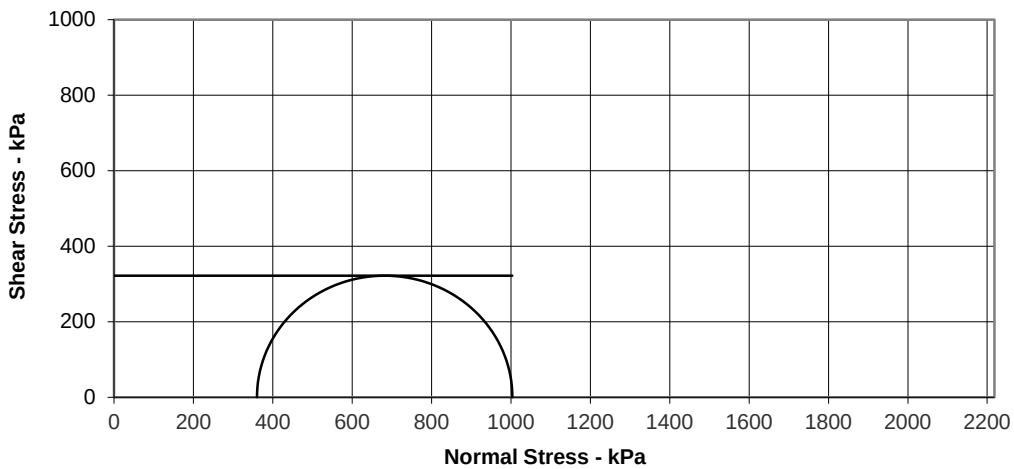
Test Details

Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.32
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	360
Strain at Failure	%	6.6
Maximum Deviator Stress	kPa	643
Shear Strength	kPa	322
Mode of Failure		Brittle

Shear Strength Parameters	
C	322 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	21.00

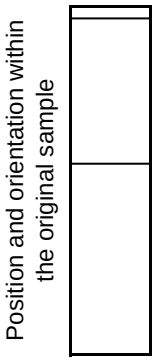
Soil Description: Very high strength fissured dark grey silty CLAY - REMARKS - Sample was disturbed

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	26
Bulk Density	Mg/m³	1.94
Dry Density	Mg/m³	1.54

Test Details

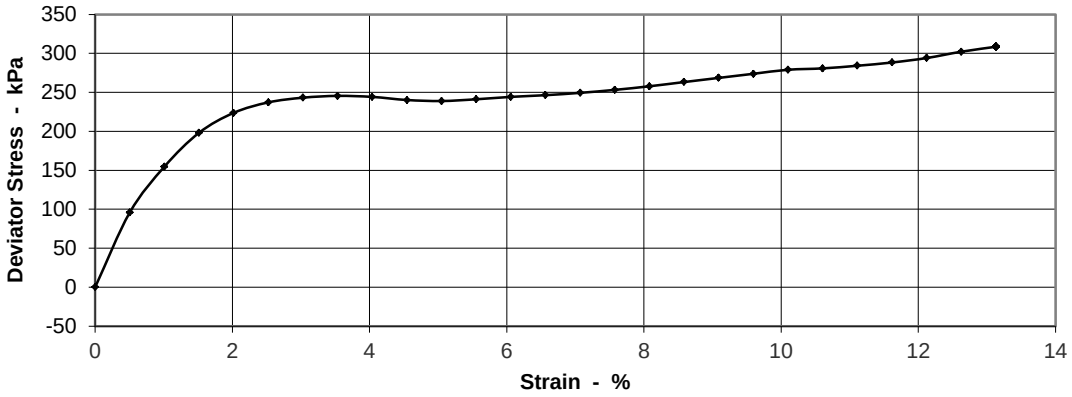
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.55
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	420
Strain at Failure	%	13.1
Maximum Deviator Stress	kPa	308
Shear Strength	kPa	154
Mode of Failure		Compound

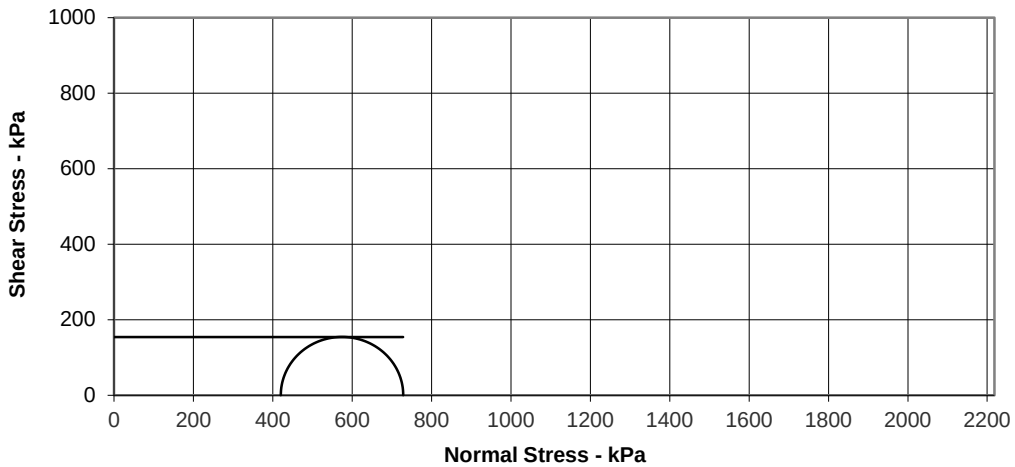
Position and orientation within the original sample



Shear Strength Parameters	
C	154 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

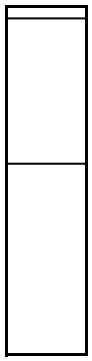
Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	24.00

Soil Description: Very high strength fissured dark grey silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	201.0
Diameter	mm	102.0
Moisture Content	%	25
Bulk Density	Mg/m³	2.02
Dry Density	Mg/m³	1.62

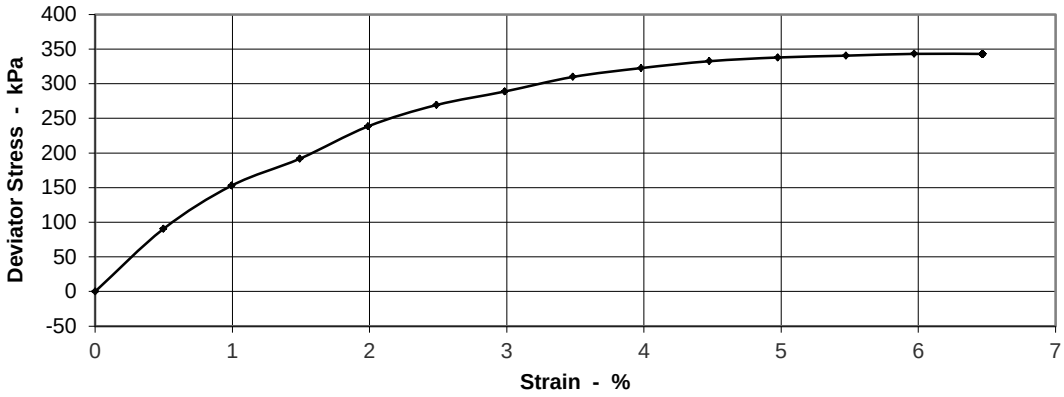
Test Details		
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.29
Rate of Axial Displacement	%/min	1.99
Cell Pressure	kPa	480
Strain at Failure	%	6.0
Maximum Deviator Stress	kPa	343
Shear Strength	kPa	172
Mode of Failure		Brittle

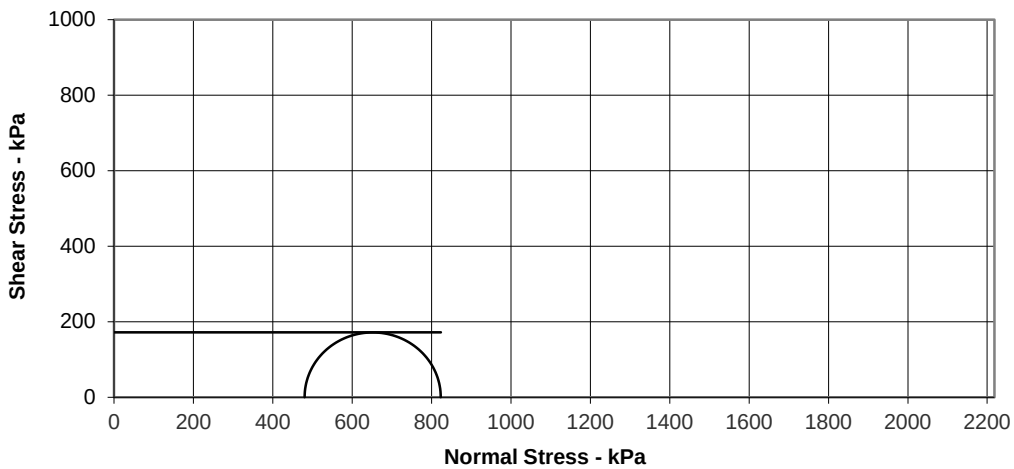
Position and orientation within the original sample



Shear Strength Parameters	
C	172 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

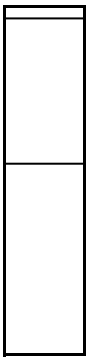
Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	27.00

Soil Description: Very high strength fissured dark grey silty CLAY

Sample Details		**Specimen 1**
Sample Condition		Undisturbed
Height	mm	201.0
Diameter	mm	102.0
Moisture Content	%	26
Bulk Density	Mg/m³	2.00
Dry Density	Mg/m³	1.59

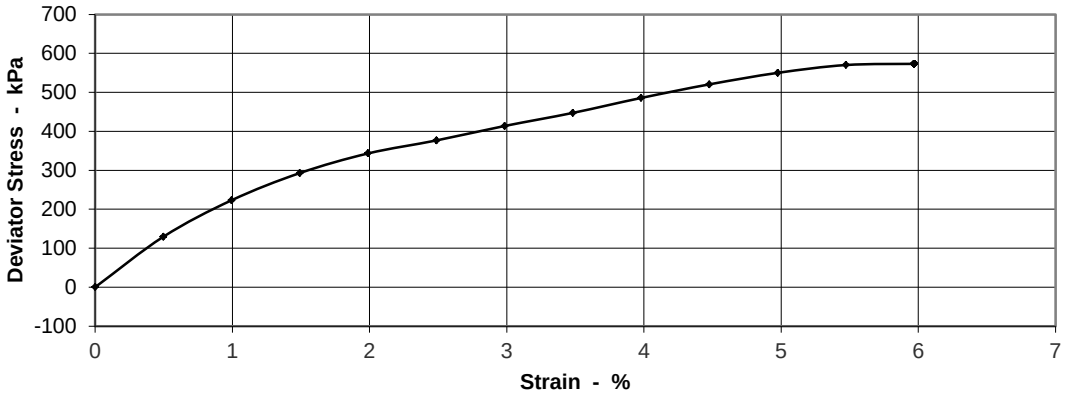
Test Details		
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.29
Rate of Axial Displacement	%/min	1.99
Cell Pressure	kPa	540
Strain at Failure	%	6.0
Maximum Deviator Stress	kPa	573
Shear Strength	kPa	287
Mode of Failure		Brittle

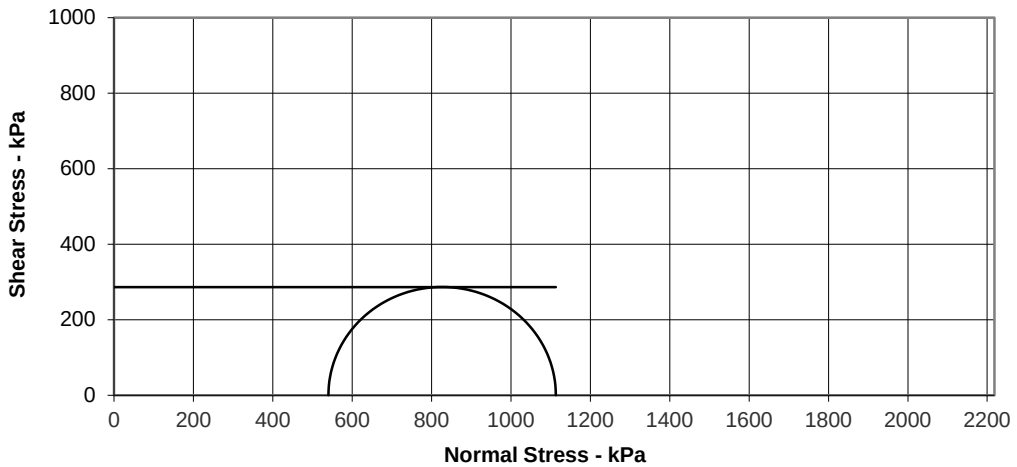
Position and orientation within the original sample



Shear Strength Parameters	
C	287 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH1	**Sample no:**	U	**Depth (m):**	30.00

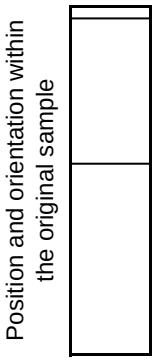
Soil Description: Extremely high strength fissured dark grey silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	201.0
Diameter	mm	102.0
Moisture Content	%	25
Bulk Density	Mg/m³	2.02
Dry Density	Mg/m³	1.61

Test Details

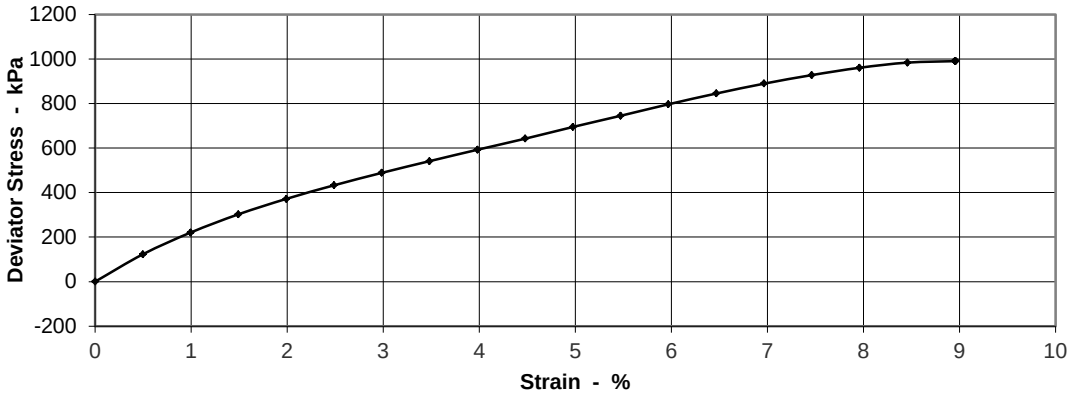
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.41
Rate of Axial Displacement	%/min	1.99
Cell Pressure	kPa	600
Strain at Failure	%	9.0
Maximum Deviator Stress	kPa	990
Shear Strength	kPa	495
Mode of Failure		Brittle

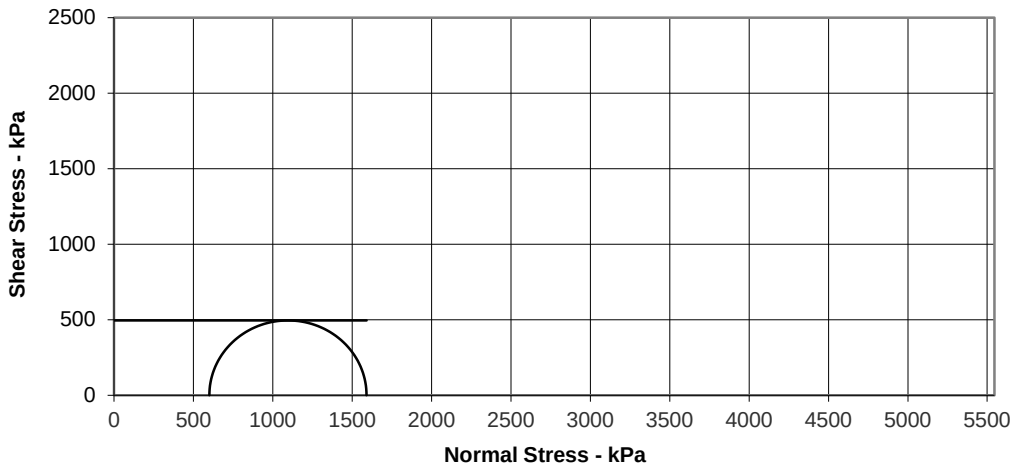
Position and orientation within the original sample



Shear Strength Parameters	
C	495 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	2.50

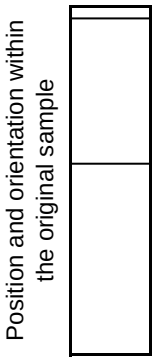
Soil Description: High strength brown silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	201.0
Diameter	mm	102.0
Moisture Content	%	31
Bulk Density	Mg/m³	1.94
Dry Density	Mg/m³	1.48

Test Details

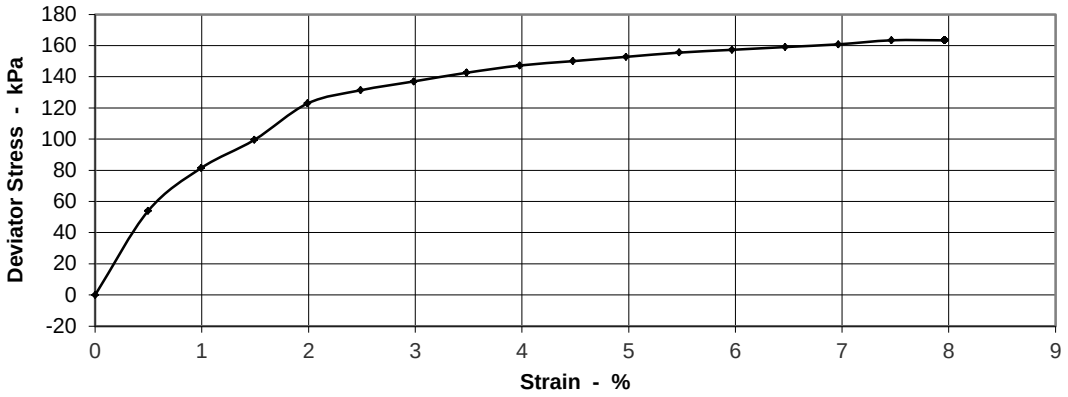
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.35
Rate of Axial Displacement	%/min	1.99
Cell Pressure	kPa	50
Strain at Failure	%	7.5
Maximum Deviator Stress	kPa	163
Shear Strength	kPa	82
Mode of Failure		Brittle

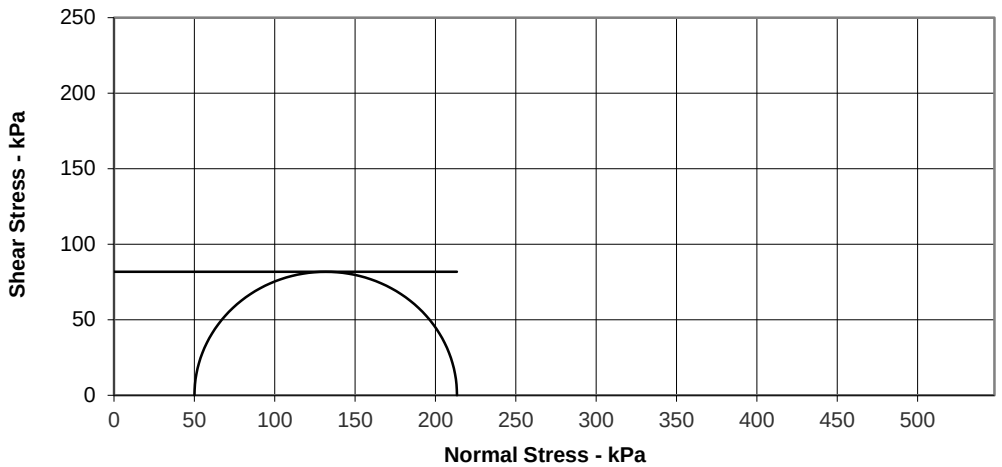
Position and orientation within the original sample



Shear Strength Parameters	
C	82 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	4.50

Soil Description: Medium strength brown mottled blue grey silty CLAY

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	201.0
Diameter	mm	102.0
Moisture Content	%	34
Bulk Density	Mg/m³	1.88
Dry Density	Mg/m³	1.40

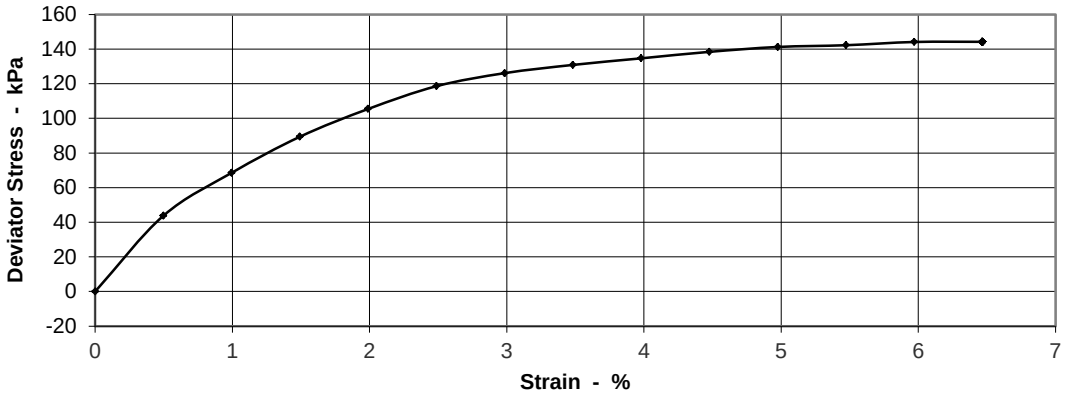
Position and orientation within the original sample

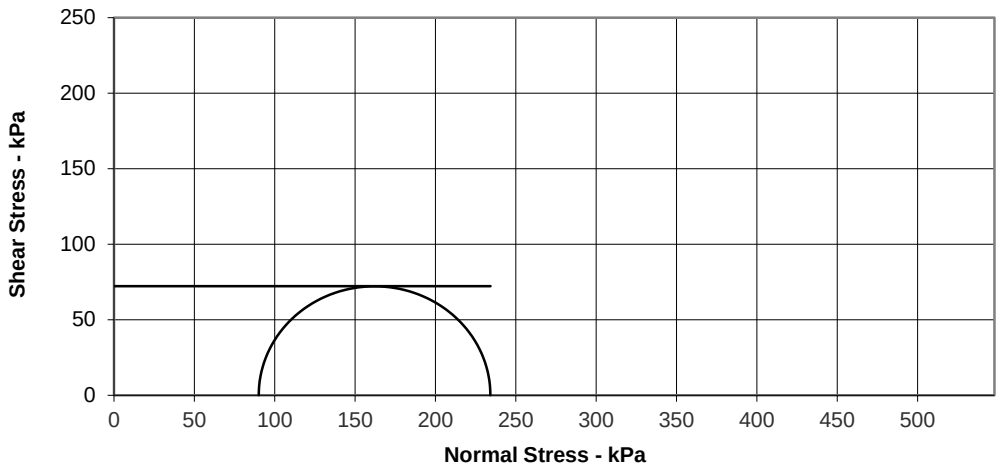
Test Details

Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.31
Rate of Axial Displacement	%/min	1.99
Cell Pressure	kPa	90
Strain at Failure	%	6.5
Maximum Deviator Stress	kPa	144
Shear Strength	kPa	72
Mode of Failure		Brittle

Shear Strength Parameters	
C	72 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	7.50

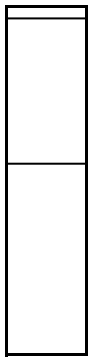
Soil Description: High strength fissured brown silty CLAY with occasional orange brown silt partings and occasional selenite crystals

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	201.0
Diameter	mm	102.0
Moisture Content	%	31
Bulk Density	Mg/m³	1.89
Dry Density	Mg/m³	1.45

Test Details

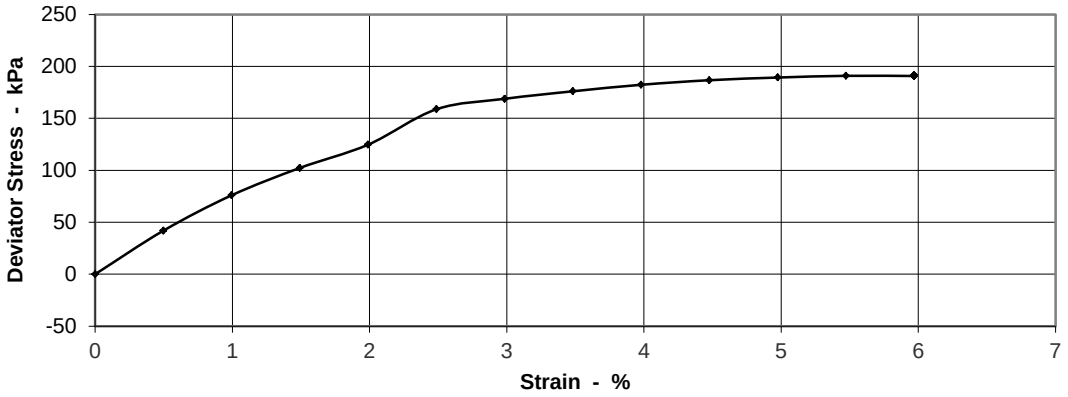
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.27
Rate of Axial Displacement	%/min	1.99
Cell Pressure	kPa	150
Strain at Failure	%	5.5
Maximum Deviator Stress	kPa	191
Shear Strength	kPa	95
Mode of Failure		Brittle

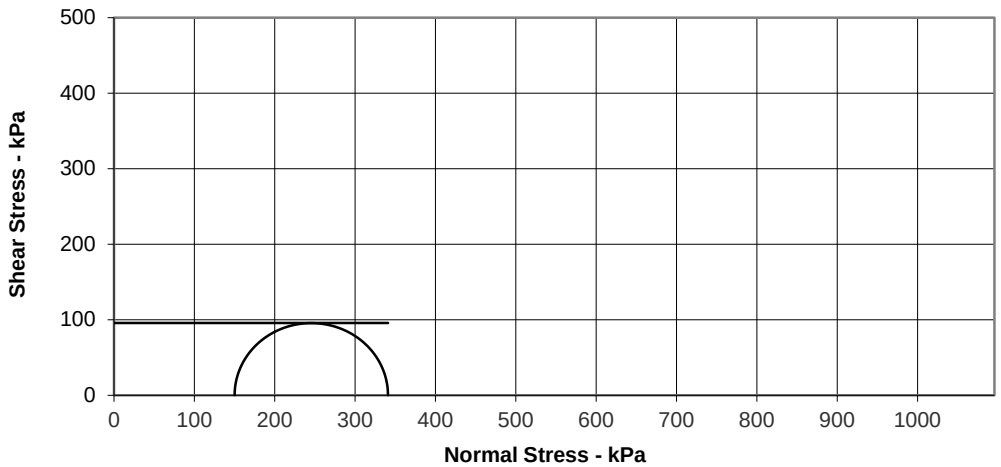
Position and orientation within the original sample



Shear Strength Parameters	
C	95 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

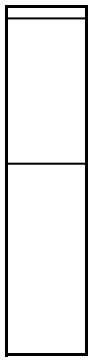
Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	04/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	10.50

Soil Description: High strength fissured dark grey silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	29
Bulk Density	Mg/m³	1.89
Dry Density	Mg/m³	1.47

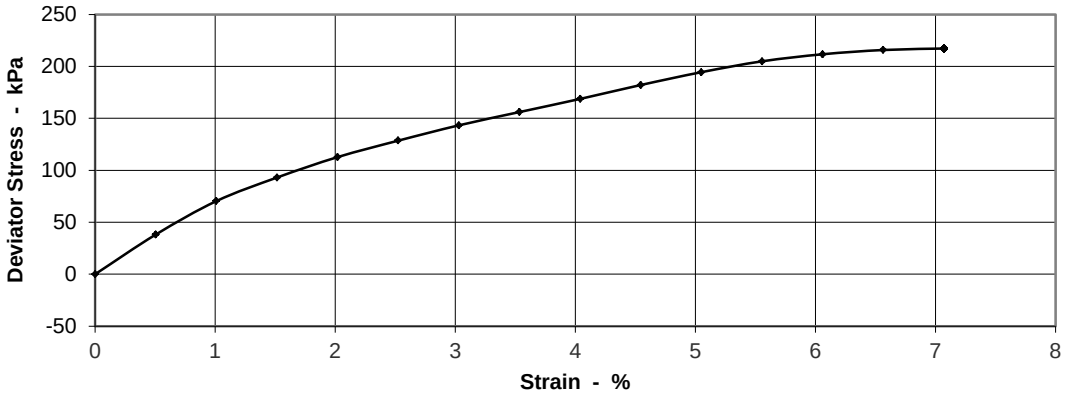
Test Details		
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.34
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	210
Strain at Failure	%	7.1
Maximum Deviator Stress	kPa	217
Shear Strength	kPa	109
Mode of Failure		Brittle

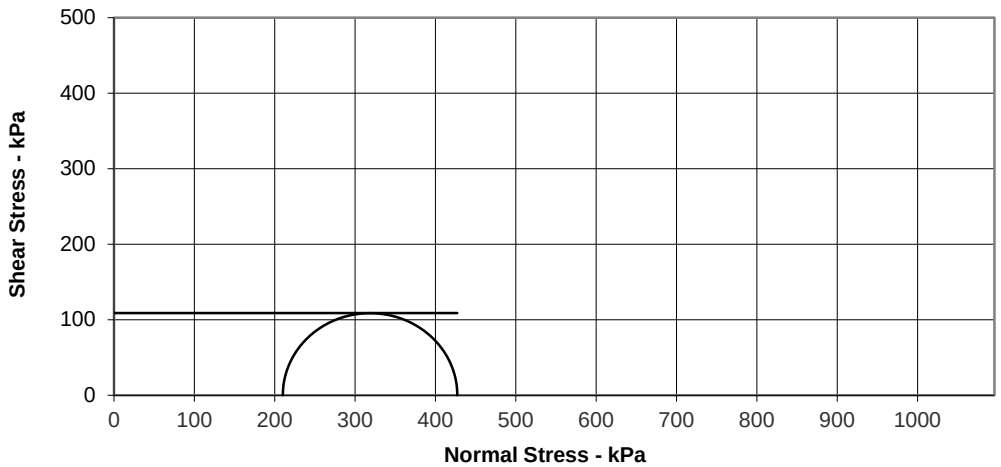
Position and orientation within the original sample



Shear Strength Parameters	
C	109 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	04/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	13.50

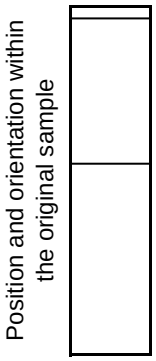
Soil Description: Very high strength fissured dark grey CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	28
Bulk Density	Mg/m³	1.97
Dry Density	Mg/m³	1.54

Test Details

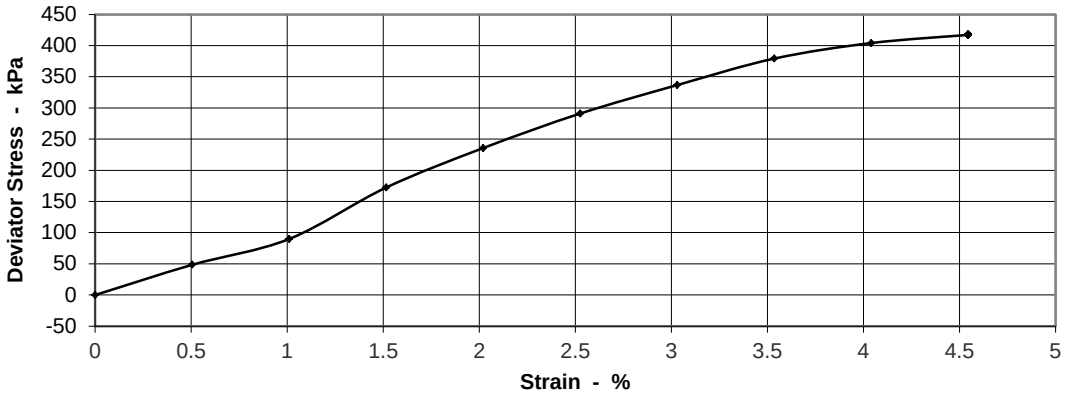
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.23
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	270
Strain at Failure	%	4.5
Maximum Deviator Stress	kPa	417
Shear Strength	kPa	209
Mode of Failure		Brittle

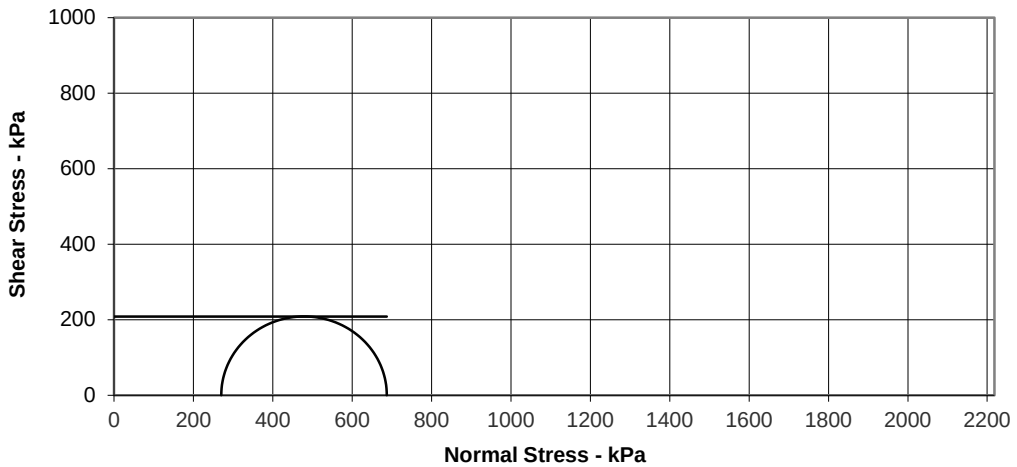
Position and orientation within the original sample



Shear Strength Parameters	
C	209 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	03/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	16.50

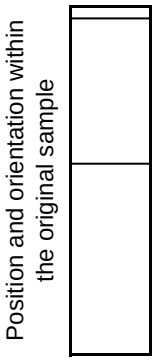
Soil Description: High strength fissured dark grey silty CLAY - REMARKS - Sample was disturbed

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	28
Bulk Density	Mg/m³	1.98
Dry Density	Mg/m³	1.55

Test Details

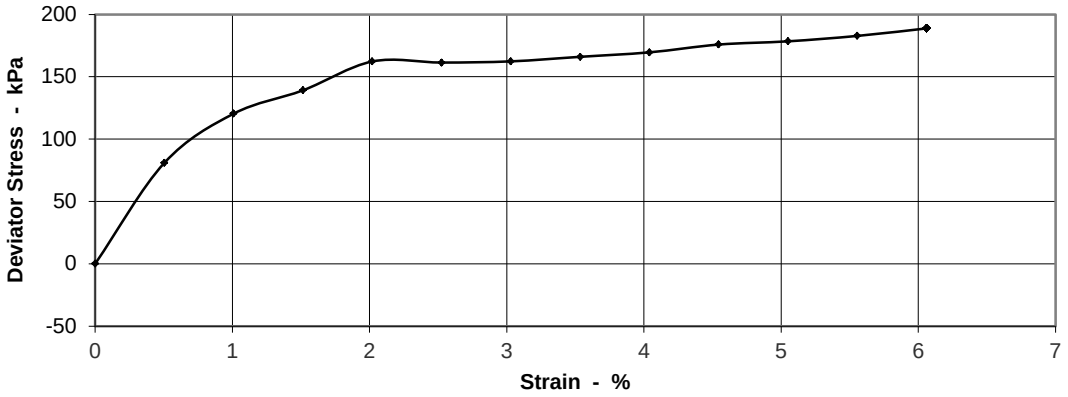
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.30
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	330
Strain at Failure	%	6.1
Maximum Deviator Stress	kPa	189
Shear Strength	kPa	94
Mode of Failure		Brittle

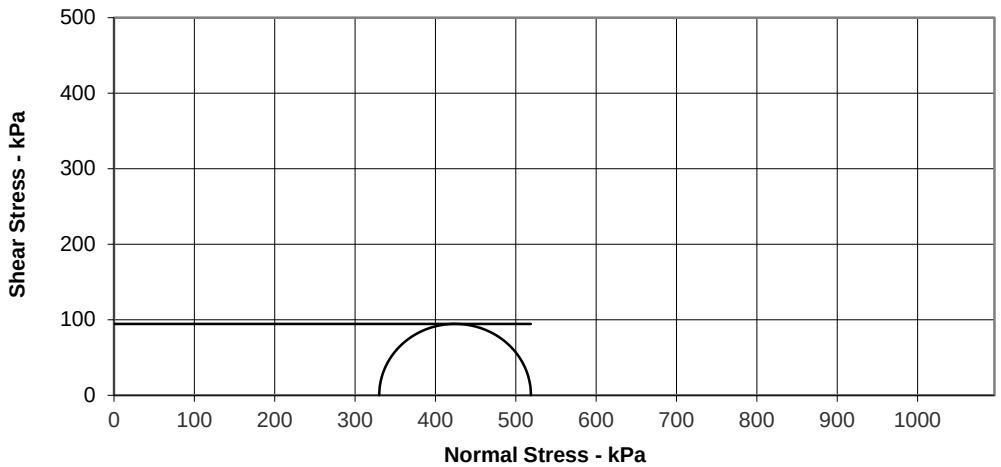
Position and orientation within the original sample



Shear Strength Parameters	
C	94 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

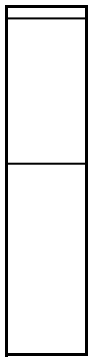
Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	04/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	19.50

Soil Description: Extremely high strength fissured dark grey silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	28
Bulk Density	Mg/m³	2.02
Dry Density	Mg/m³	1.58

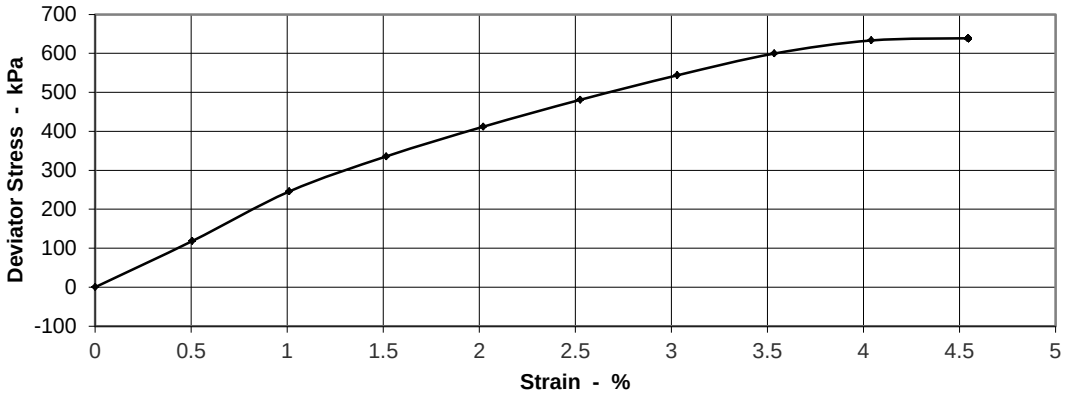
Test Details		
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.23
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	390
Strain at Failure	%	4.5
Maximum Deviator Stress	kPa	639
Shear Strength	kPa	319
Mode of Failure		Brittle

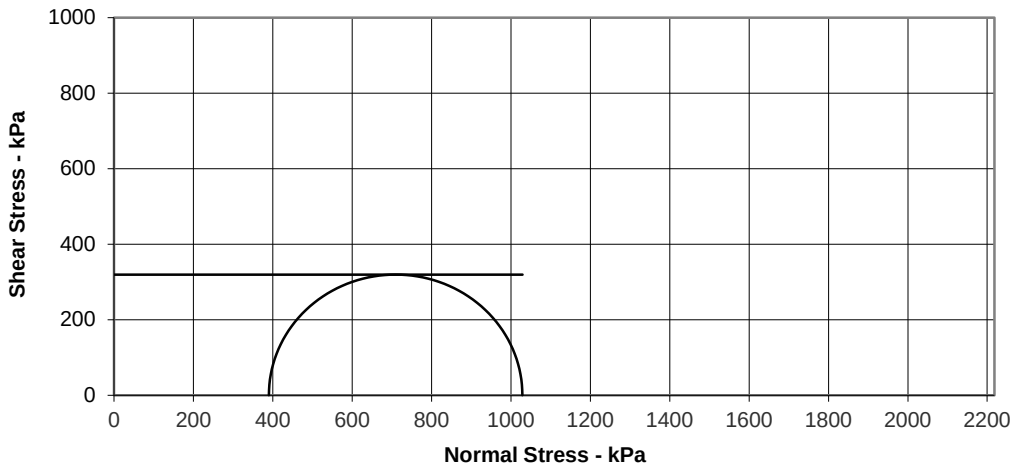
Position and orientation within the original sample



Shear Strength Parameters	
C	319 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	04/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	22.50

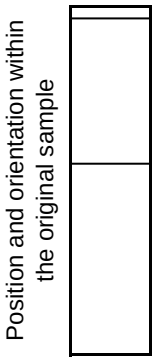
Soil Description: Extremely high strength fissured dark grey silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	26
Bulk Density	Mg/m³	1.91
Dry Density	Mg/m³	1.52

Test Details

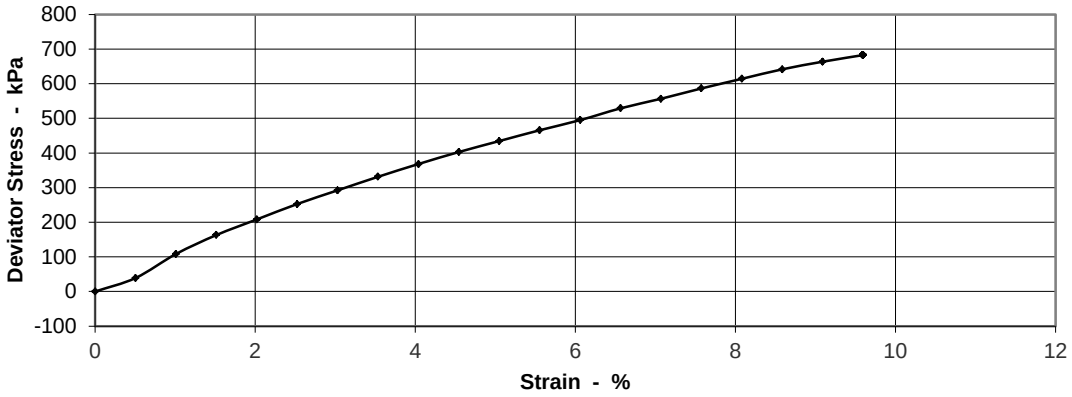
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.43
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	450
Strain at Failure	%	9.6
Maximum Deviator Stress	kPa	683
Shear Strength	kPa	341
Mode of Failure		Brittle

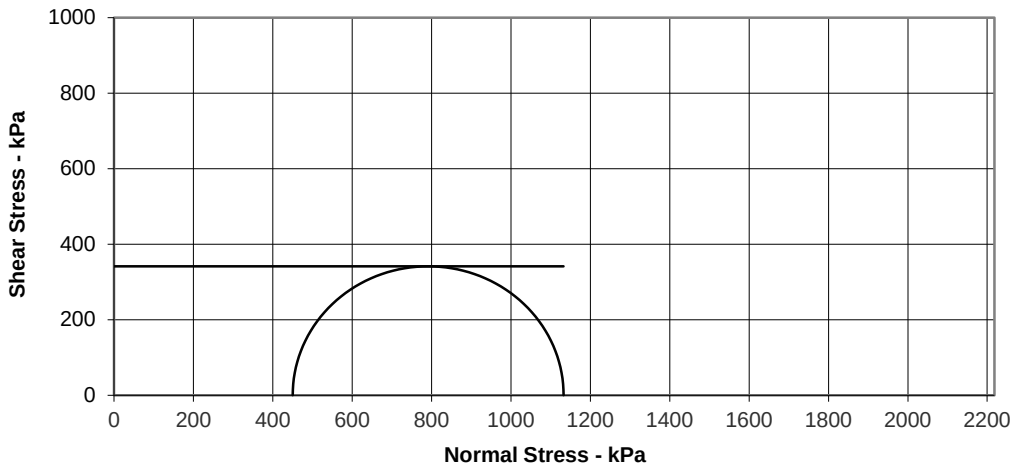
Position and orientation within the original sample



Shear Strength Parameters	
C	341 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	04/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	25.50

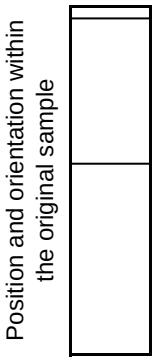
Soil Description: High strength fissured dark grey silty CLAY

Sample Details		**Specimen** 1
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	25
Bulk Density	Mg/m³	1.90
Dry Density	Mg/m³	1.52

Test Details

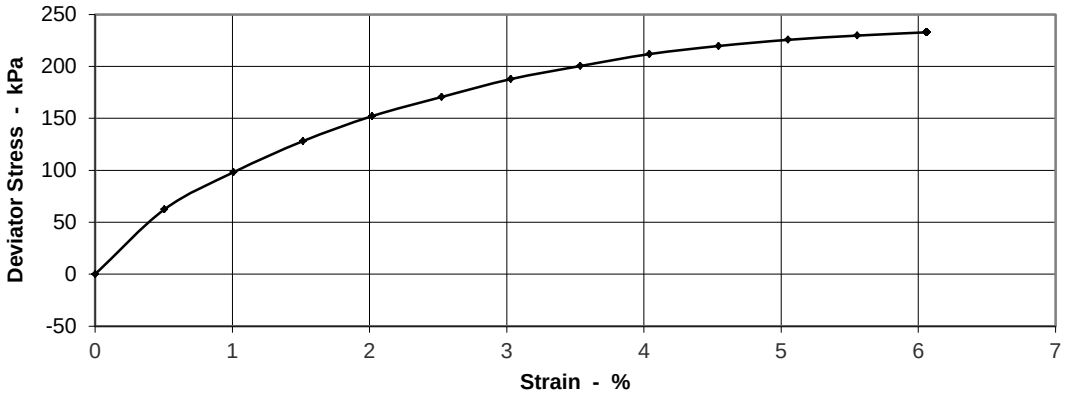
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.30
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	510
Strain at Failure	%	6.1
Maximum Deviator Stress	kPa	233
Shear Strength	kPa	116
Mode of Failure		Brittle

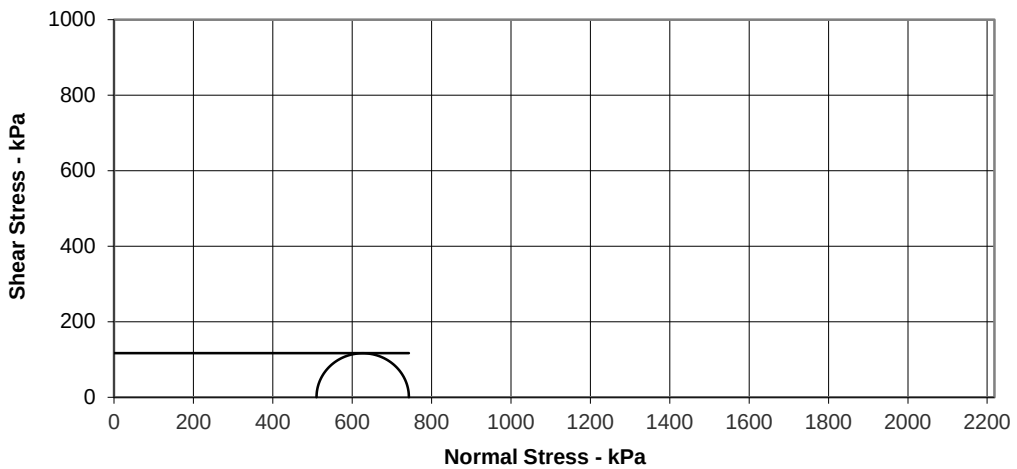
Position and orientation within the original sample



Shear Strength Parameters	
C	116 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

2519

K4 SOILS

Report of Undrained Triaxial Compression Test

BS 1377 : Part 7 : 1990 Clause 8.0

Project name:	Marine Ices, 4-8 Haverstock Hill, Camden, NW3 2BL			**Samples Received:**	19/11/2014
				Project Started:	26/11/2014
Client:	LBH Wembley			**Testing Started:**	04/12/2014
Project no:	LBH4278	**Our job /report no:**	17891	**Date Reported:**	05/12/2014
BH / TP no:	BH2	**Sample no:**	U	**Depth (m):**	28.50

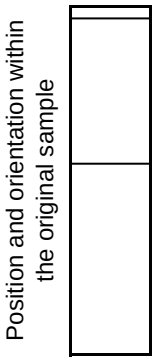
Soil Description: Very high strength fissured dark grey silty CLAY with light grey fine sand partings

Sample Details	**Specimen**	**1**
Sample Condition		Undisturbed
Height	mm	198.0
Diameter	mm	102.0
Moisture Content	%	24
Bulk Density	Mg/m³	1.99
Dry Density	Mg/m³	1.61

Test Details

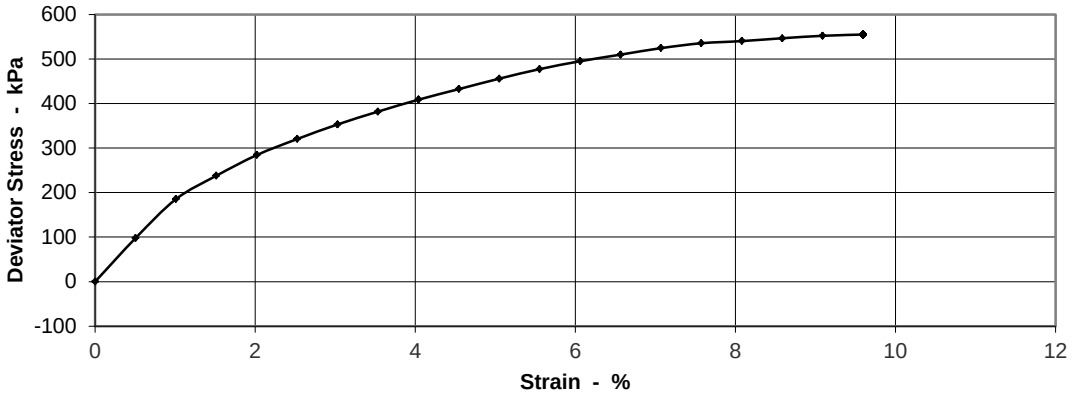
Membrane Thickness	mm	0.2
Membrane Correction	kPa	0.43
Rate of Axial Displacement	%/min	2.02
Cell Pressure	kPa	570
Strain at Failure	%	9.6
Maximum Deviator Stress	kPa	555
Shear Strength	kPa	277
Mode of Failure		Brittle

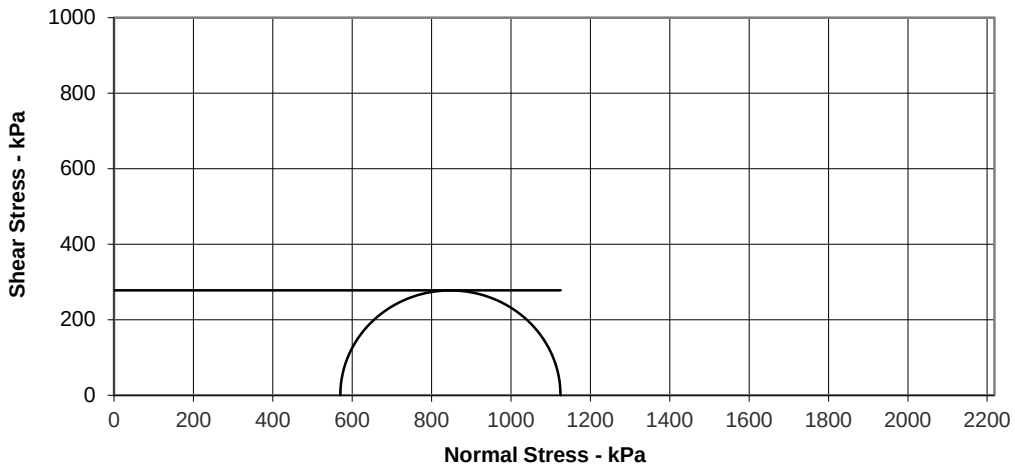
Position and orientation within the original sample



Shear Strength Parameters	
C	277 kPa
Phi	0.0 °

Specimen 1





K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Herts, WD18 9RU.
Tel:01923711288 Fax:01923711311
E-mail: k4soils@aol.com

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

Test results relate only to the sample numbers shown above

Checked and Approved
Initials: kp
Date: 05/12/2014

UKAS TESTING

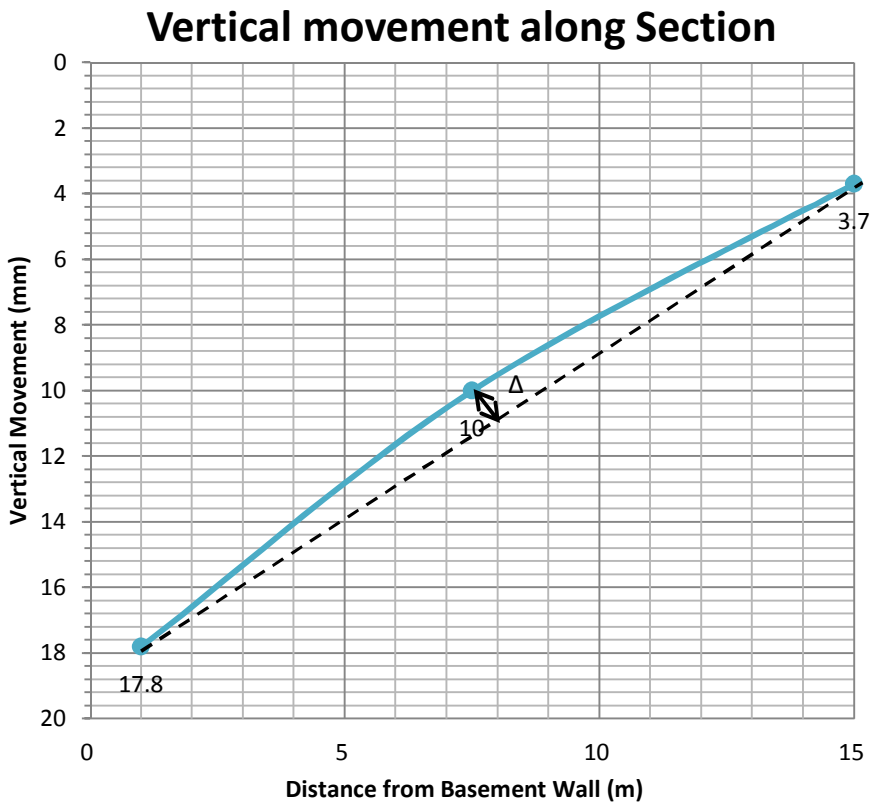
2519

Reference: **LBH 4278**
Site: **Marine Ices**
Section: **Salvation Army**
Date of analysis: **19th May 2017**
Project Engineer: **RL**

The damage category can be assessed from the calculated horizontal strain and deflection ratio of a "beam" under hogging or sagging.

Length of wall	**L =**	**15**	**m**
Height of wall	**H =**	**7.5**	**m**
Horiz. deflection	**Δ_{horiz} =**	**14.2**	**mm**
Vert. deflection	**Δ =**	**1**	**mm**

x	y	distance from wall	Vert. mov'nt	Horiz. mov'nt
m	m	m	mm	mm
22.5	45	1	17.8	20.2
22.5	52.5	7.5	10	13.3
22.5	60	15	3.7	6



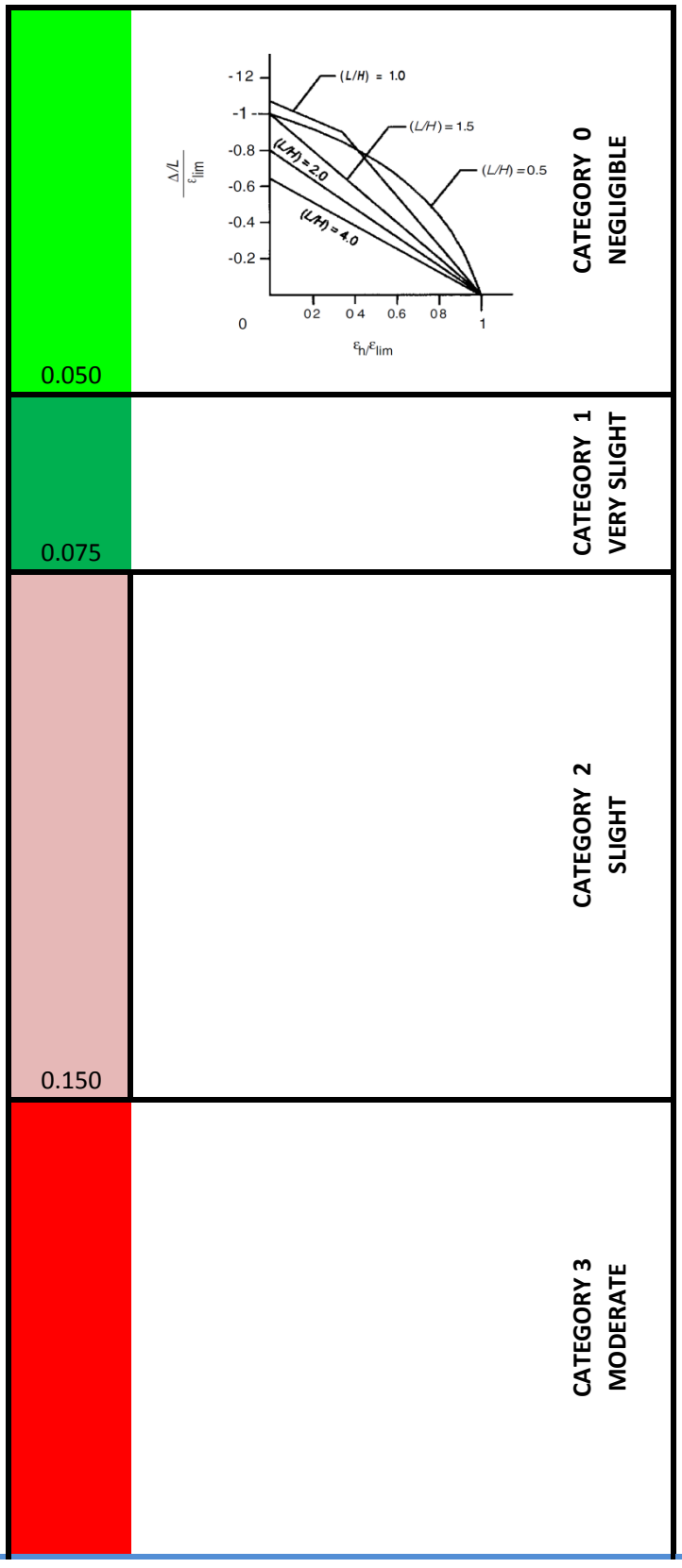
Reference: **LBH 4278** Section: **Salvation Army**

L/H = 2.0

Horiz. Strain ε_h = 0.094667 % ε_{lim} = 0.105 %

Deflection ratio Δ/L = -0.00667

DAMAGE LEVEL -->

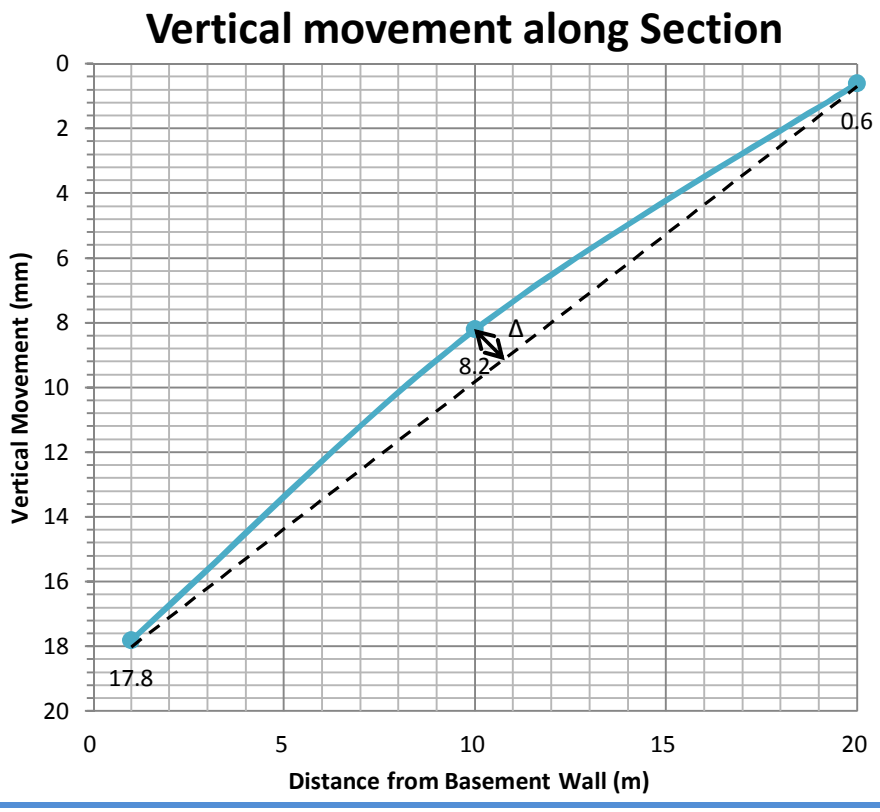


Reference: **LBH 4278**
Site: **Marine Ices**
Section: **Enterprise Pub (Haverstock Frontage)**
Date of analysis: **19th May 2017**
Project Engineer: **RL**

The damage category can be assessed from the calculated horizontal strain and deflection ratio of a "beam" under hogging or sagging.

Length of wall	**L =**	**20**	**m**
Height of wall	**H =**	**13.5**	**m**
Horiz. deflection	**Δ_{horiz} =**	**16**	**mm**
Vert. deflection	**Δ =**	**1**	**mm**

x	y	distance from wall	Vert. mov'nt	Horiz. mov'nt
m	m	m	mm	mm
40	20	1	17.8	20.2
30	20	10	8.2	11.4
20	20	20	0.6	4.2



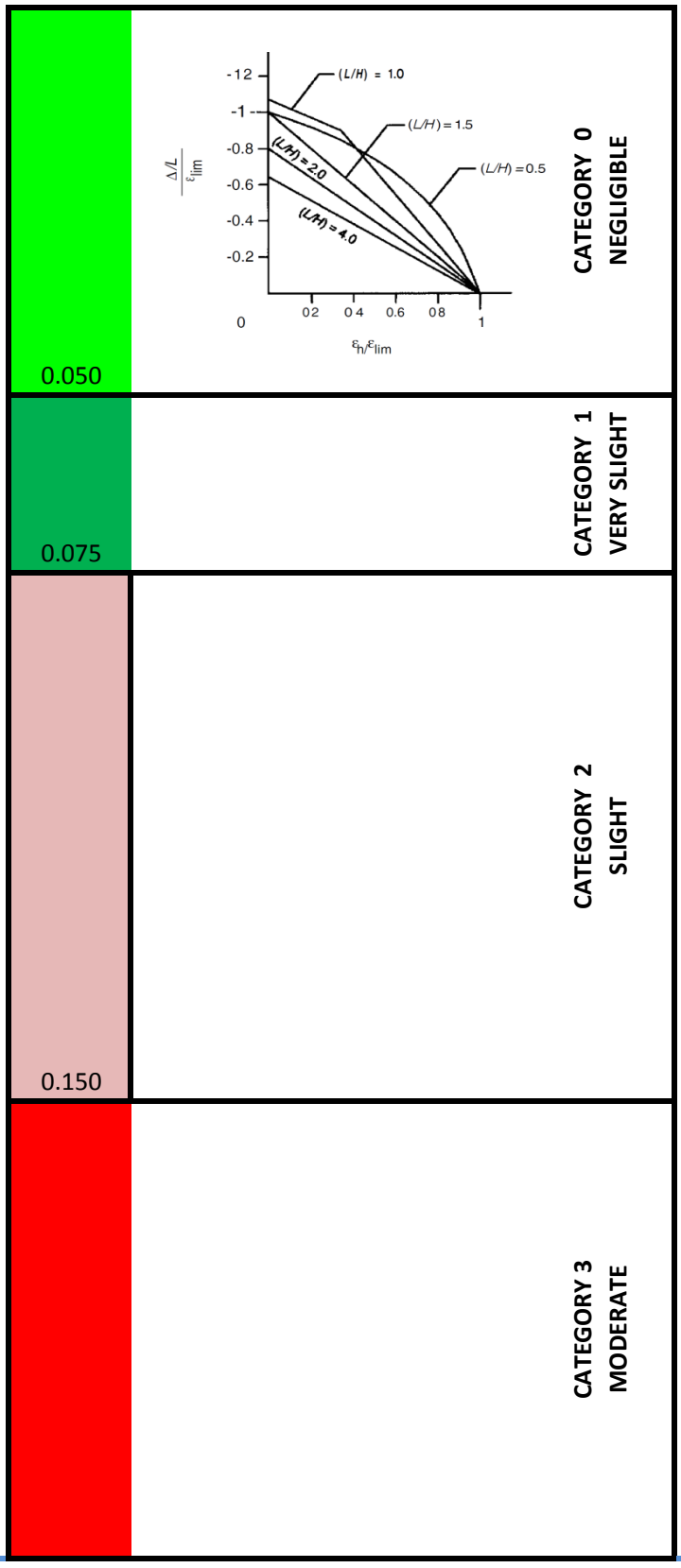
Reference: **LBH 4278** Section: **Enterprise Pub (Haverstock Frontage)**

L/H = 1.4815

Horiz. Strain ε_h = 0.08 % ε_{lim} = 0.085 %

Deflection ratio Δ/L = -0.005

DAMAGE LEVEL -->

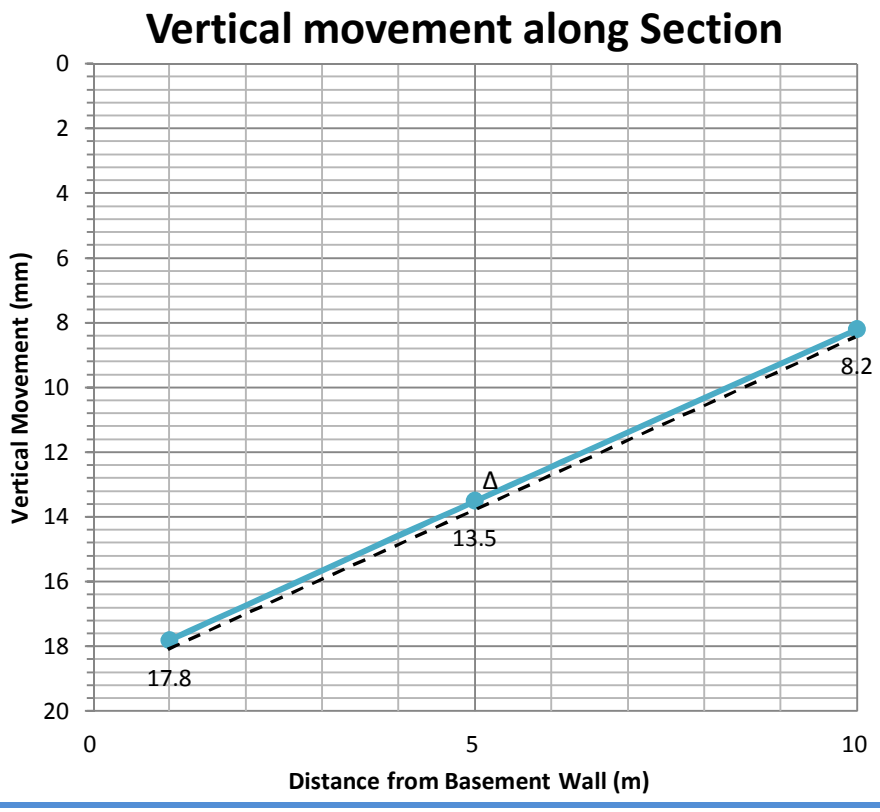


Reference: **LBH 4278**
Site: **Marine Ices**
Section: **Enterprise Pub (Crogsland Frontage)**
Date of analysis: **19th May 2017**
Project Engineer: **RL**

The damage category can be assessed from the calculated horizontal strain and deflection ratio of a "beam" under hogging or sagging.

Length of wall	**L =**	**10**	**m**
Height of wall	**H =**	**13.5**	**m**
Horiz. deflection	**Δ_{horiz} =**	**8.8**	**mm**
Vert. deflection	**Δ =**	**0.2**	**mm**

x	y	distance from wall	Vert. mov'nt	Horiz. mov'nt
m	m	m	mm	mm
40	30	1	17.8	20.2
40	25	5	13.5	16.3
40	20	10	8.2	11.4

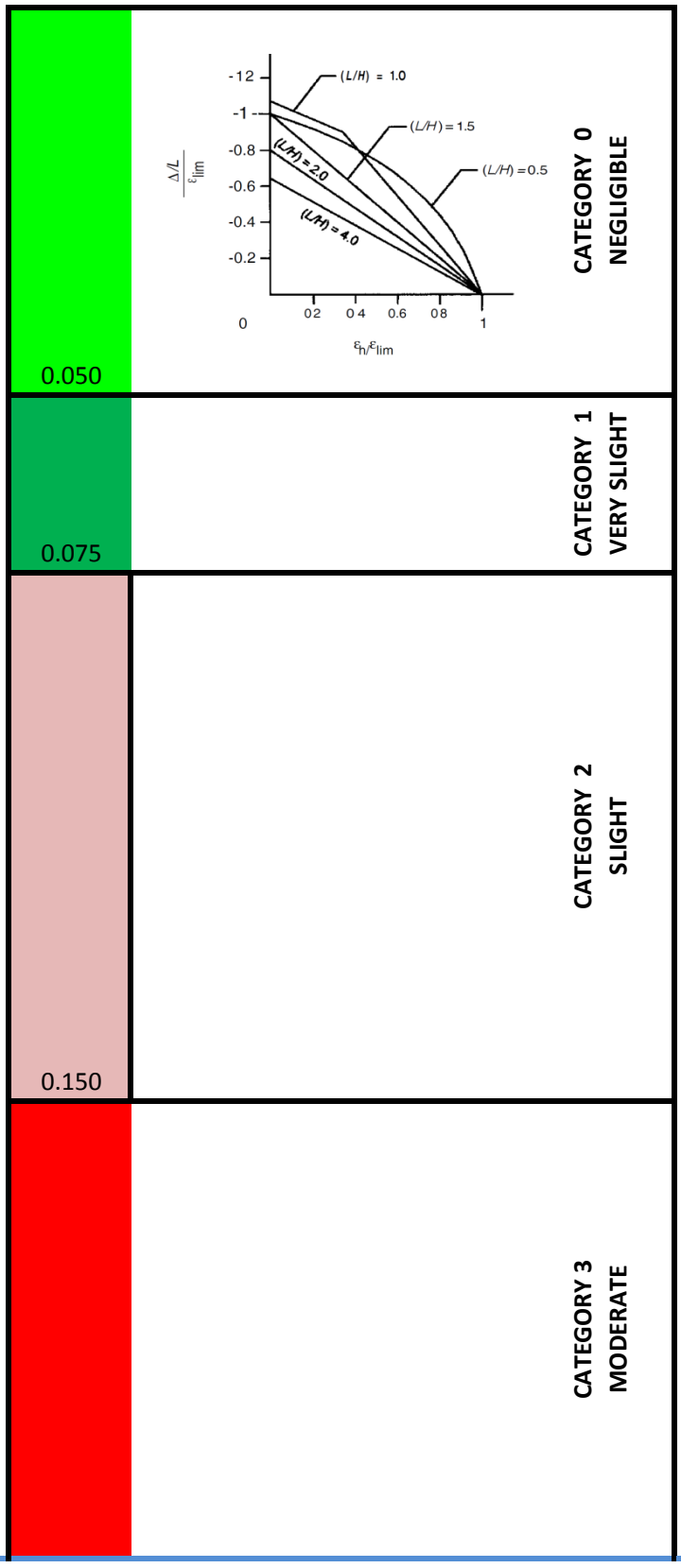


Reference: **LBH 4278** Section: **Enterprise Pub (Crogsland Frontage)**

L/H = 0.7

Horiz. Strain ε_h = 0.088 % ε_{lim} = 0.085 %

Deflection ratio Δ/L = -0.002



DAMAGE LEVEL -->