Richard Tant Associates
Consulting Civil & Structural Engineers

March 2023

RT/SMS/5295

Appendix 4
Programme

Broxwood View
(Previously 29 Barrie House)

Appendix 4
Programme

For

Attanasio d'Aponte
Arbitrage Broxwood Ltd

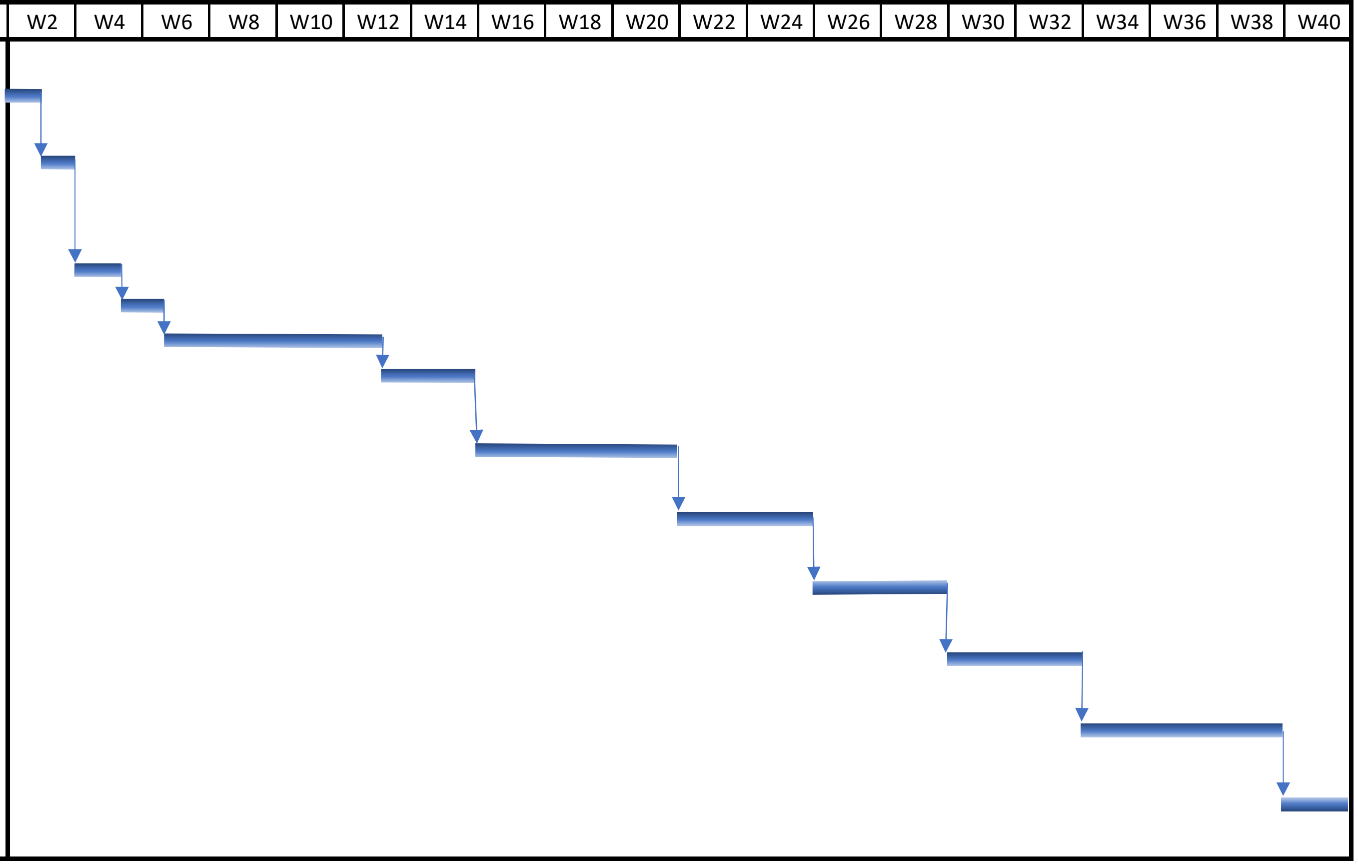
5295

March 2023

CONTENTS

PROGRAM OF WORK
Broxwood

ID	Task Name	Duration
	Site seting out	7 days
	Demolition	7 days
	Piling	
	preparation	10 days
	mobilisation	7 days
	piling works	42 days
	capping beam	21 days
	Excavation incl. underpinning	42 days
	Ground works basement slab	28 days
	RC Walls	28 days
	GF Slab	28 days
	Waterproofing	
	Site cleanning	



Appendix 5
Site Investigation Data

Broxwood View
(Previously 29 Barrie House)

Appendix 5
Site Investigation Data

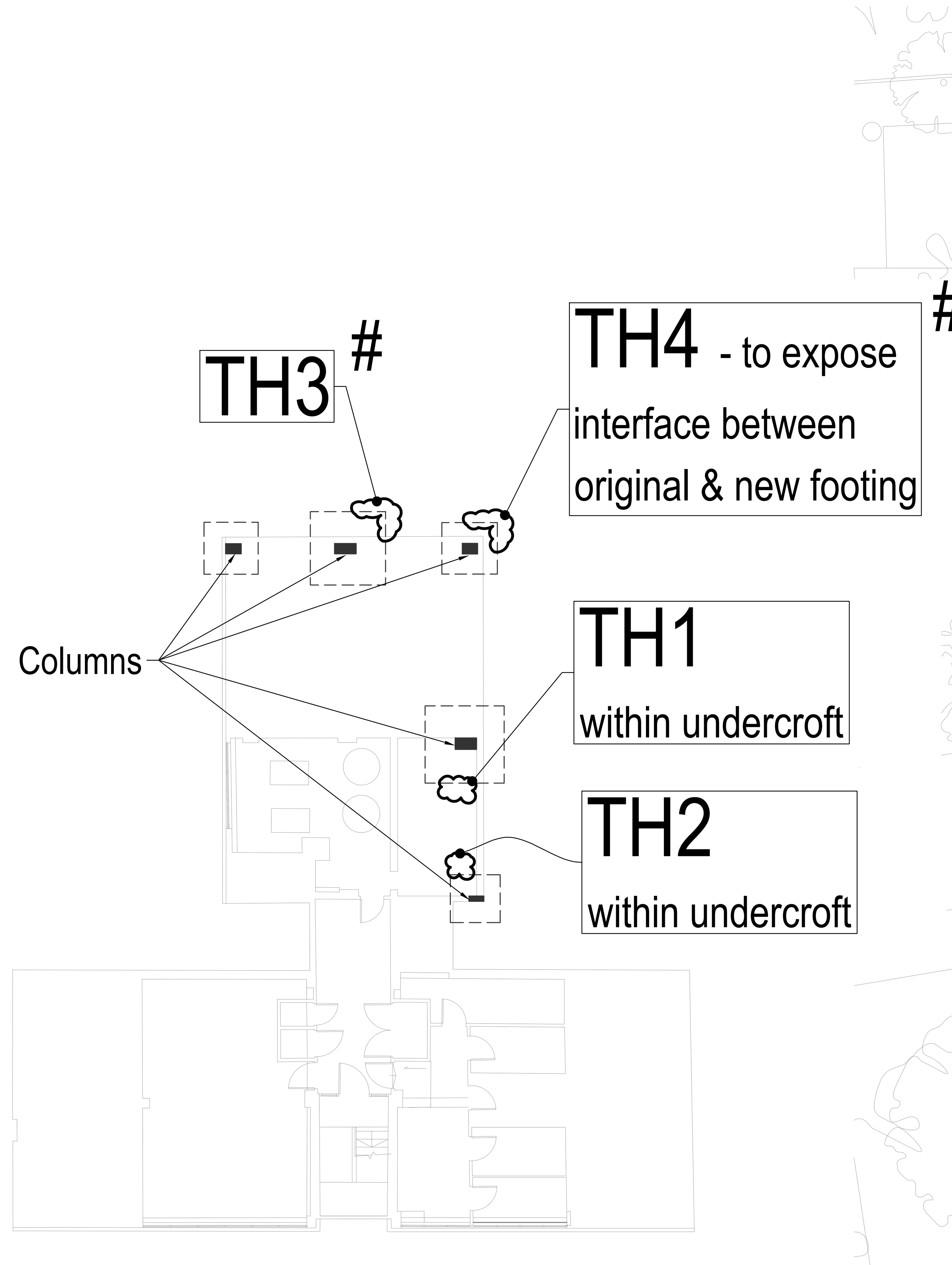
For

Attanasio d'Aponte
Arbitrage Broxwood Ltd

5296

March 2023

CONTENTS

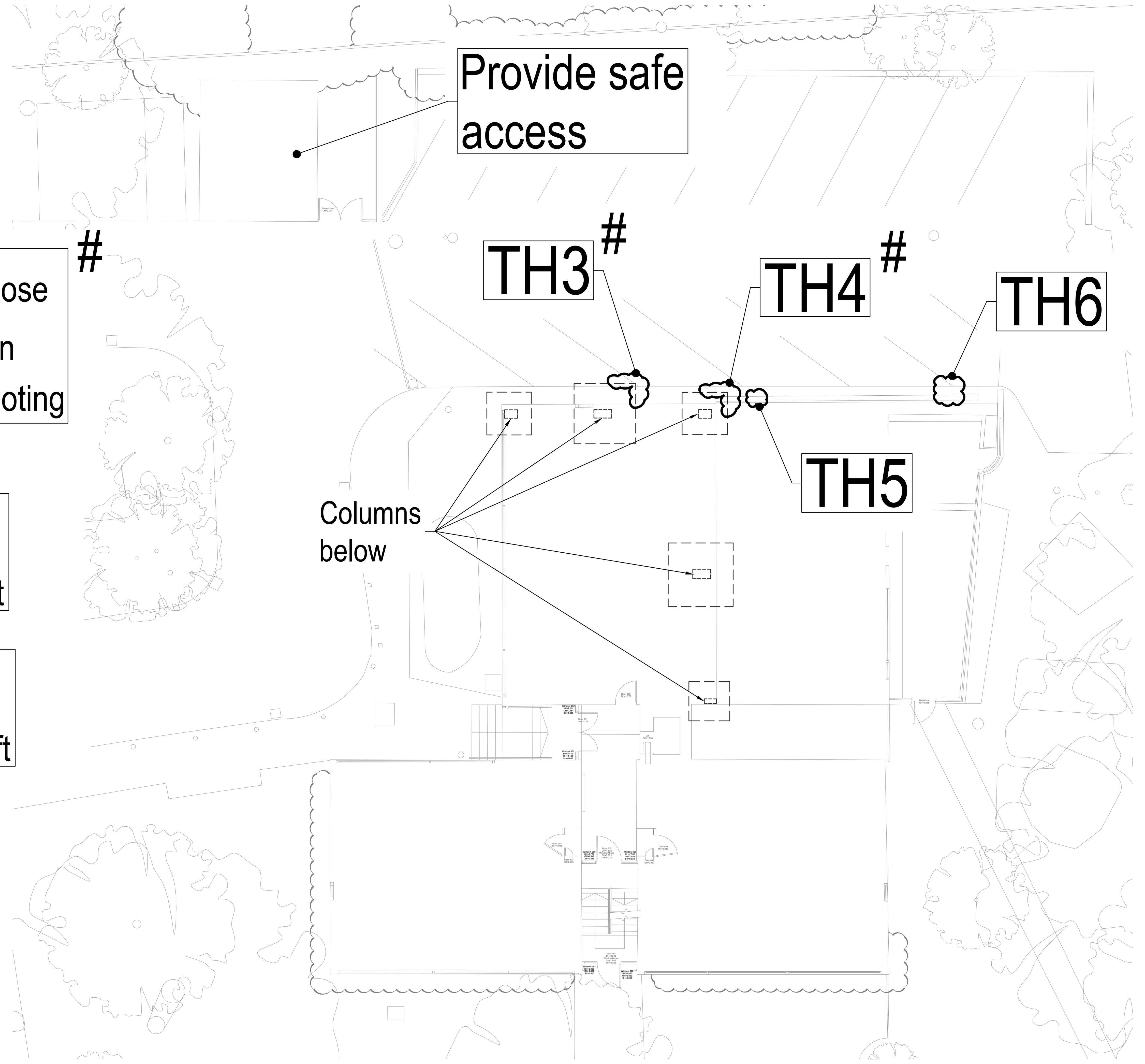


Size of THs to be such to enable structure to be measured.

: To expose corner of existing pad.

Existing Lower Ground Floor

Not to Scale

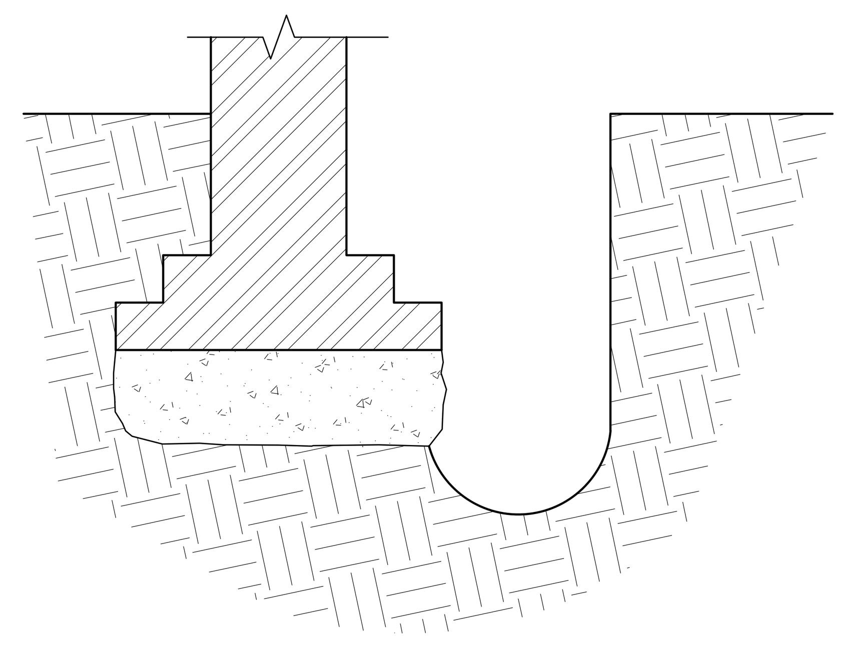


Size of THs to be such to enable structure to be measured.

: To expose corner of existing pad.

Existing Ground Floor

Not to Scale



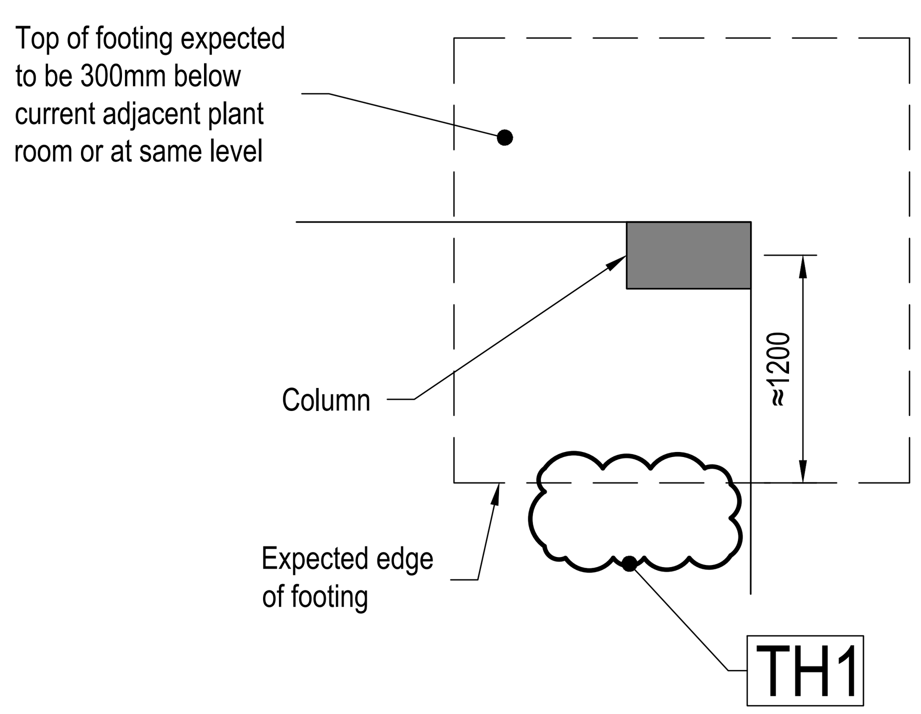
Typical Trial Hole (T.H.) - Except TH1, 2, 3 & 4

Trial hole to be dug to expose bottom of existing footing. Do not undermine existing footing. After inspection by Richard Tant Associates back fill with granular compacted material. Minimum depth to be 750mm.

Richard Tant Associates assume asbestos survey has been carried out at all trial hole & opening up locations.

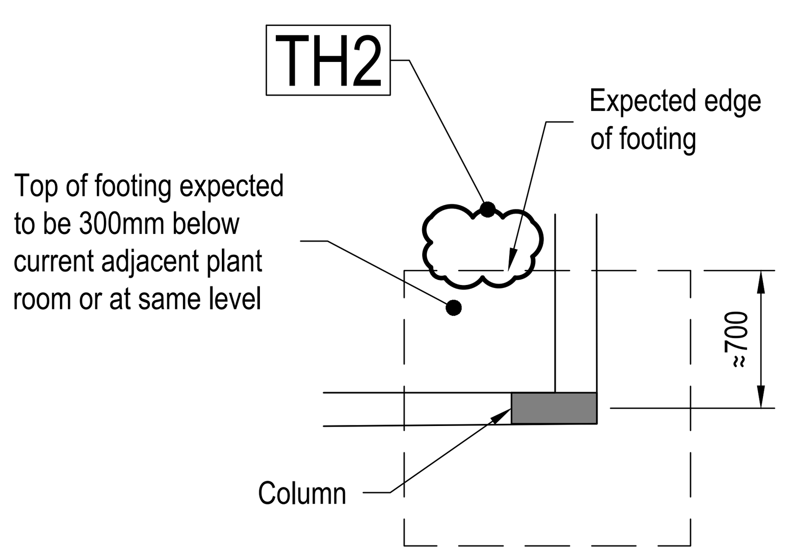
Contractor to confirm with client if opening up is to be made good after inspection by Richard Tant Associates.

Note: Location of existing services not known. Care to be taken and prior to digging, sampling or opening up, areas are to be scanned.



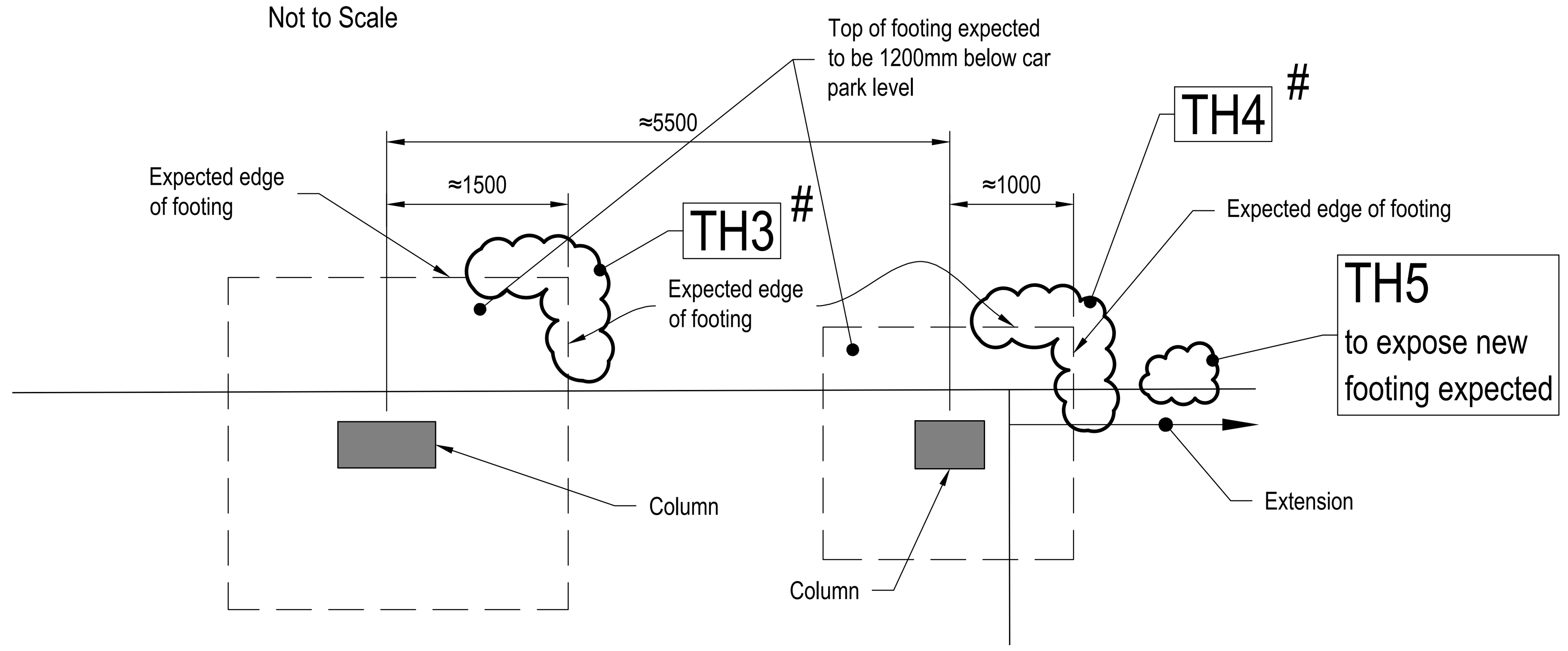
TH1

Not to Scale



TH2

Not to Scale



: To expose corner of existing pad.

TH3, TH4 & TH5

Not to Scale

Notes.

REV.	AMENDMENTS	BY	DATE	CHECKED
A	TH3 & TH4 amended.	AR	6.5.22	DK

PROJECT
Broxwood View
Barrie House

TITLE
Trial Hole Locations

ARCHITECT
Carbogno Ceneda Architects

DRAWING No.
5295-SK01A

DATE	12.4.2022
SCALE	As shown @ A1
DRAWN	AR
CHECKED	RT
REVIEWED	-

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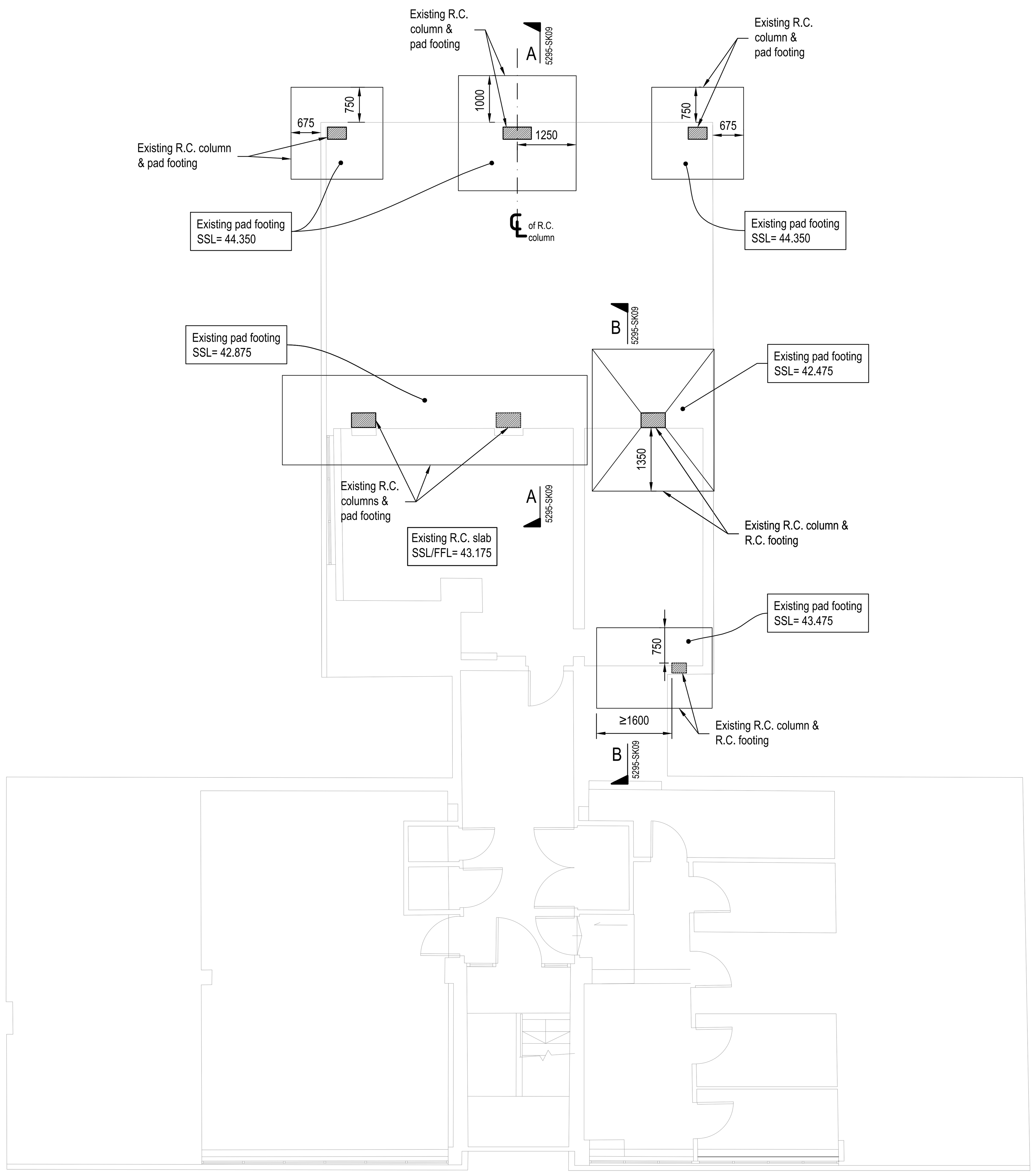
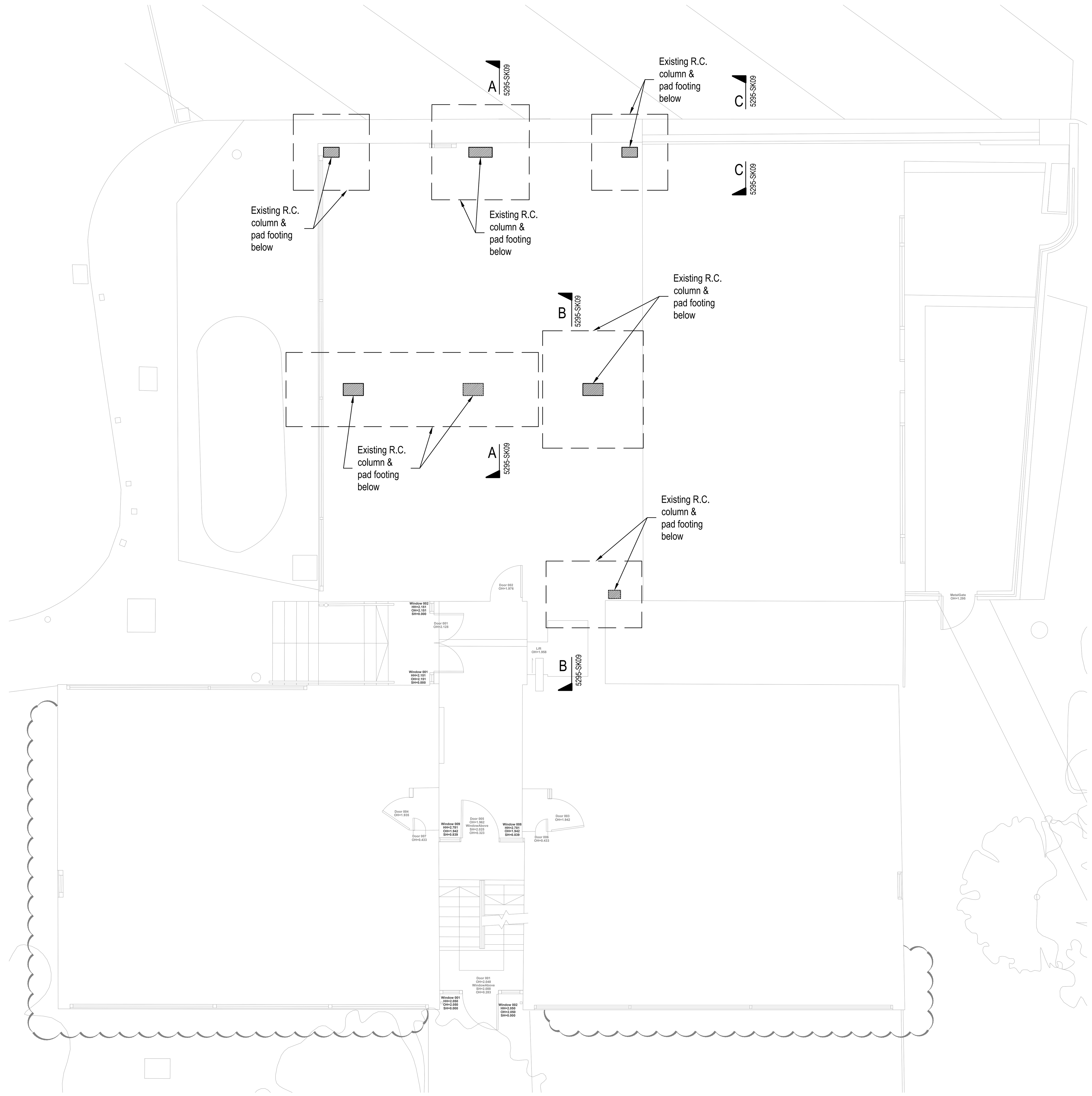


Existing Lower Ground Floor

Scale 1:75



Existing Ground Floor

Scale 1:75

Notes.

REV	AMENDMENTS	BY	DATE	CHECKED

PROJECT
Broxwood View
Barrie House

TITLE
Trial Hole Information 1

ARCHITECT
Carbogno Ceneda Architects

DRAWING No.
5295-SK08

DATE	10.8.2022
SCALE	As shown @ A1
DRAWN	AR
CHECKED	RT
REVIEWED	-

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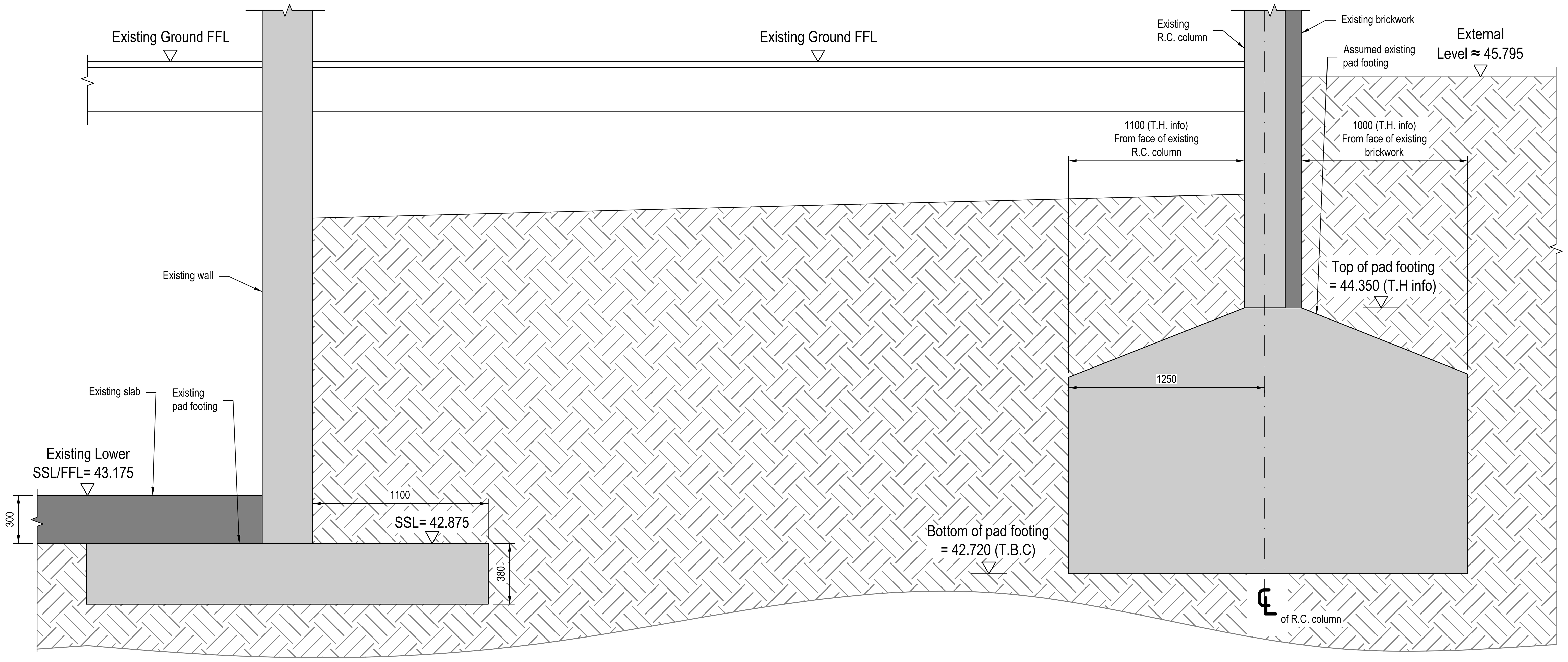
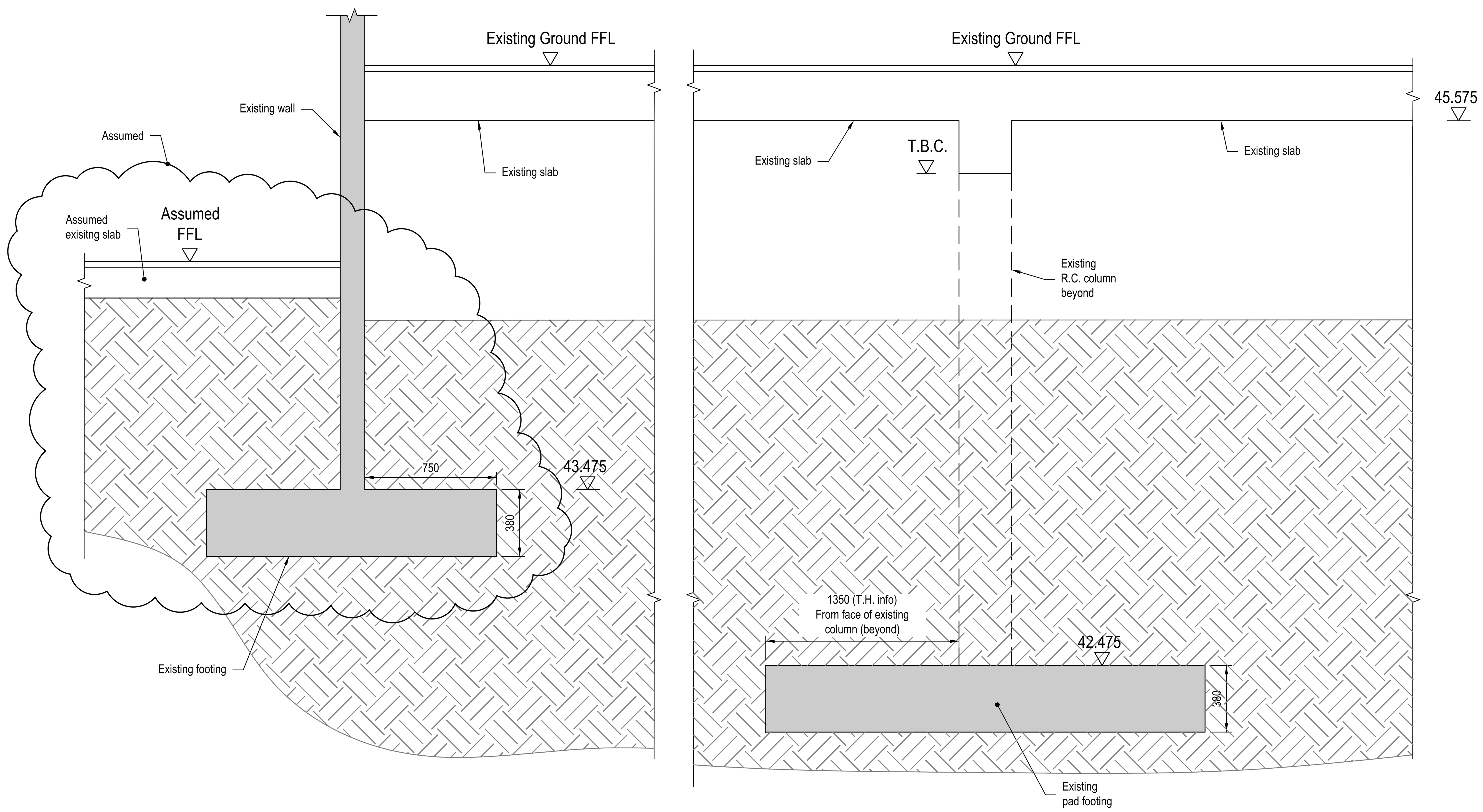
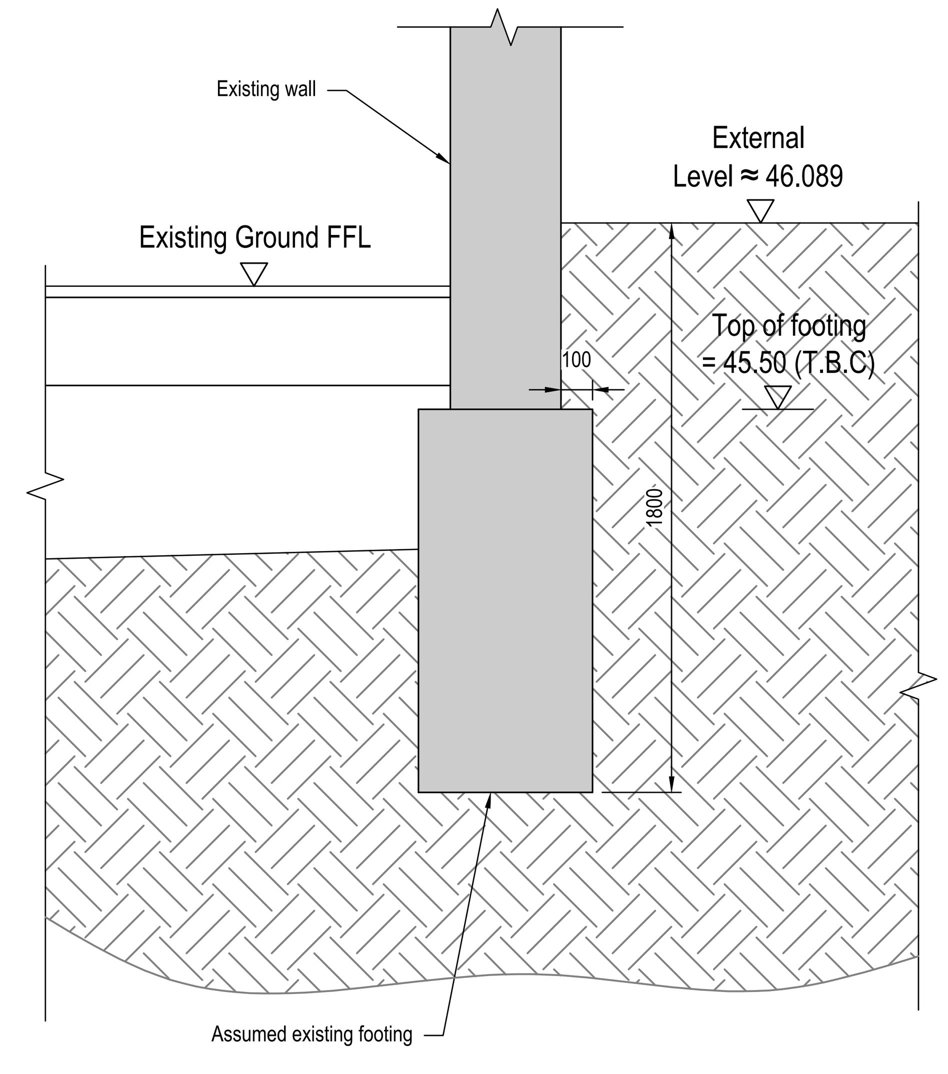


Section A-A
Scale 1 : 20



Section B -B
Scale 1 : 20



Section C-C
Scale 1 : 20

Notes.

REV	AMENDMENTS	BY	DATE	CHECKED

PROJECT
Broxwood View
Barrie House

TITLE
Trial Hole Information 2

ARCHITECT
Carbogno Ceneda Architects

DRAWING No.
5295-SK09

DATE	10.8.2022
SCALE	As shown @ A1
DRAWN	AR
CHECKED	RT
REVIEWED	-

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GROUND INVESTIGATION REPORT

Proposed construction at:

BARRIE HOUSE, 29 ST EDMUND'S TERRACE, LONDON NW8 7QH

Client -	**Robert Morley, Kaleminster Ltd** **The Old Barn, Ox Lane, Tenterden, Kent TN30 6NG**
Engineer -	**Structure Mode Ltd** **8a Peacock Yard, Iliffe Street, London SE17 3LH**
Report Ref -	**9241/OT/JRCB**
Date -	**07 November 2012**

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APPENDIX –

Historical information

- Ove Arup & Partners, Trial Pit Report Ref. G.M.M./TJS/11166
- John Burland [Imperial College], 15 April 1982
- Trial pit information, March 2011

Fieldwork and in situ testing

- Foreword to cable percussion boring
- Cable percussion borehole record
- Foreword to window sample boring
- Window sample borehole records
- Standard Penetration Test results
- Hand vane test results
- Pocket penetrometer test results

Laboratory testing

- Moisture content and Atterberg limit test results
- Plasticity Charts
- Undrained triaxial test results
- Consolidated undrained triaxial test with pore water measurement results [K4 soils]
- p-q plot

Plans & drawings

- Site plan
- Location map

1.0 INTRODUCTION

A ground investigation has been carried out by Soil Consultants Ltd in connection with the proposed construction of a penthouse on the roof of Barrie House, London.

The investigation, undertaken in September 2012, aimed to establish the underlying geology and ground/groundwater conditions, in order to provide an assessment on the performance of the foundations under both the existing and proposed increased loadings associated with the proposed construction.

This report presents the results of the ground investigation. The ground conditions encountered are then described and our assessment of the performance of the foundations is provided.

This Report has been prepared for the benefit of the Client and associated parties directly involved with the design and construction of the project under direction of the Client. No reliance can be assumed by others without written agreement from Soil Consultants Limited.

2.0 SITE DESCRIPTION AND BACKGROUND

Barrie House is an 8-storey detached residential block located in north London at approximate National Grid Reference 527495E, 183575N.

The appended Site Plan shows the main site features. The current building was constructed in the 1950s and contains a single-storey basement beneath part of its footprint. Vehicular access is from St Edmund's Terrace [west of the building] leading to a paved parking area to the north of the building.

The building is located in a central position within the grounds and is surrounded by landscaped gardens containing a large number of deciduous trees, mainly within a wooded area to the east of the building, along with several trees to the south and west of the building. Several large stumps were noted south of the building indicating the presence of former trees in close proximity to the building. Grassed areas and shrubs/flower beds are also present to the south and west of the building.

The ground generally slopes from east to west and north to south. The highest point is in the in the north-eastern corner [about +48.6m OD] and the lowest is in the south-west corner [about +42.0m OD].

The proposals are to construct a new penthouse on the roof of the building which will increase loads on the existing [pad] foundations by around 9%. In 1982, when a similar scheme was proposed, John Burland of Imperial College issued a letter [appended] providing advice on the foundation performance, based on information obtained from short report by Ove Arup [only partial records available] and on several assumptions as to the clay properties. Burland assessed the performance of one strip footing at basement level and concluded that the available bearing capacity factor of safety may be too low to allow the proposed construction to proceed. He also concluded that a drained bearing capacity analysis would be the most appropriate in order to assess the existing factor of safety of the foundations, as the building was constructed in the 1950s and consolidation [and hence strength increase] of the clay will have taken place. Burland attributed the observed increased basement settlement, to a large extent, on the high bearing pressures and low factors of safety in this area. However, he stated that if a detailed soils investigation were carried out to provide additional effective stress parameters, it is possible that the assumed drained strength parameters [and the factor of safety] could be upgraded.

We understand that following Burland's report, and potential evidence of foundation cracks revealed by Ove Arup, the local authority did not approve the proposed scheme until such time that further information was obtained to allay their concerns that the foundations could accommodate the increased stresses due to construction.

A further trial pit investigation was undertaken [by others] in 2011 to determine foundation dimensions in several areas [see Appendix].

3.0 GROUND INVESTIGATION

The exploratory work by Soil Consultants Ltd was undertaken on 13 & 17 September 2012. The investigation comprised the elements detailed below and exploratory records/laboratory test results are included in the Appendix. A Site Plan which shows the exploratory locations is also appended.

Trial pitting and coring

In consultation with the Engineers, 3no pad foundation positions were identified for exposure by hand pitting. This was followed by formation of a 75mm diameter hole through each pad to allow a measurement of the depth of the foundations and to facilitate sampling and testing of the underlying soils by means of window sampling. These positions are identified as TP1 to TP3 on the Site Plan.

Window sample boreholes

3no window sample boreholes [WS1 to WS3] were constructed, either through the cored hole [WS1 & WS3] or, where not possible, from the edge of the pad [WS2], terminating within the competent natural strata at a maximum depth of 5.0m. These boreholes were constructed by driving in 1m or 2m long steel sample tubes containing cut out [windows] that enabled the soil to be examined, tested and sub-sampled. The boreholes commenced using 60mm diameter tube with succeeding tubes reducing usually by about 10mm in diameter to assist the extraction of the tube from the ground. A near-continuous soil profile was provided by this system, which was logged by our senior geotechnical engineer and sub-sampled for laboratory testing.

Cable percussion borehole

A 150mm diameter cable percussion borehole [BH1] was constructed in the car park area to 7.5m depth, terminating within the natural clay strata. In situ Standard Penetration Tests were undertaken at regular intervals and representative disturbed and undisturbed samples collected for description and laboratory testing.

Field testing

Standard Penetration Tests [SPT] were undertaken at 1m intervals in BH1 and both Hand Shear Vane and Pocket Penetrometer tests were undertaken in the window samples to provide information on the shear strength of the soils. In addition, we attempted to undertake U38 samples at each pad location but this was not impossible due to the presence of water in the coreholes and the relatively high clay strength.

Installations

19mm ID standpipes were installed in Boreholes WS1 & WS2 to 5.0m depth in order to facilitate groundwater monitoring in the period following the investigation.

Laboratory testing

All samples collected from the boreholes and trial pits were taken to our laboratory for Index Property [moisture content and Atterberg limit] testing.

In addition, 3no 'undisturbed' soil samples were tested by a specialist laboratory [K4 Soils] for effective stress parameters [using consolidated undrained triaxial testing with pore water pressure measurement].

4.0 GROUND CONDITIONS

Published BGS information indicates that the site is underlain by the London Clay Formation, which is shown to extend to >50m depth in the general area.

Our interpretation of the strata encountered in our investigation is summarised below:

4.1 Made Ground

Made ground was present above all foundation pads, generally comprising a topsoil layer followed by brown clay with occasional to some building rubble [mostly concrete and brick]. Borehole WS2, constructed immediately in front of a foundation pad, encountered [from the level of the top of the pad at 1.1m depth] a 1m thick layer of soft to firm brown clay with occasional flint gravel and dark brown sand and silt lenses. Borehole BH1, constructed in the car park area, encountered a 0.5m thick layer of made ground initially comprising asphalt surfacing followed by grey/black mixture of ashy sand with asphalt, clinker and flint gravel; below about 0.35m becoming grey/brown clay with some ash and clinker. Occasional roots were also present.

4.2 London Clay

The London Clay was encountered beneath the made ground [in BH1 & WS2] or directly below the foundation concrete [in WS1 to WS3], to the full depth of the investigation [7.5m maximum in BH1]. The stratum generally comprised brown [weathered] mottled orange clay with occasional grey gleying and scattered selenite crystals. With depth the clay gradually became more uniformly brown with occasional grey gleying and fissuring. Occasional silty clay zones and silt partings were also present. Roots were not observed beneath the foundation pads.

The vast majority of Atterberg limit test results [see Appendix] classify the London Clay as a very high plasticity material, which is typical of this stratum. A high volume change potential is applicable to the London Clay with reference to NHBC Standards, Chapter 4.2 'Building near trees'.

Undrained shear strength results obtained in the field using hand shear vane apparatus [see plot in Appendix] show a gradual increase in strength with depth. Initially, in the top section of clay below the footings, WS3 had the highest strengths recorded and WS2 generally the lowest [bearing in mind this window sample was drilled from the edge rather than beneath the footing]. Below about 3.0m to 3.5m the strengths generally converge in all window sample boreholes. Within the range of 2B/3, usually taken as the depth for bearing capacity calculations, the mean shear strength obtained [at about 3.0m to 3.5m] is of the order of 80kN/m^2 to 85kN/m^2.

Pocket penetrometer testing showed a generally similar strength profile to that obtained by the hand vane. At 3.0m to 3.5m depth [after applying a typical London Clay factor of 35] the estimated clay undrained shear strength is about 80kN/m^2.

Although the clay in WS3 had the highest shear strengths initially [to about 3.0m depth], which is often associated with clay desiccation, moisture content profiling shows very uniform results in all three window sample boreholes, which, together with the lack of obvious roots, indicate that the clay in WS3 is naturally stiffer initially, but this is probably not caused by desiccation. Based on the shear strength and moisture content results from our investigation, clay desiccation does not appear to be present at the investigated locations/depths and the current foundation depths [about 1.6m to 2.1m at the investigated locations] provide sufficient protection against desiccation for the current size/species of trees currently present at the site. However, there are many large trees present and clay desiccation issues may be present elsewhere, particularly if shallower footings are present.

Future tree growth should also be considered and the various trees should be identified by an arboriculturalist to determine potential future growth and potential root penetration. If the combination of tree species, distance from the foundations and foundation depths indicate that clay desiccation may be issue [with reference to NHBC Chapter 4.2 'Building near trees'] then remedial measures [such as underpinning or tree pruning] may be warranted.

SPT results and an undrained triaxial test in BH1 indicate a 'soft' consistency initially, becoming firm and then stiff with depth.

Effective stress shear strength tests were undertaken by a specialist laboratory [K4 Soils] on 'undisturbed' U100 samples collected from BH1. 3no samples were tested [depth range 3.0m to 7.0m depth] to determine the effective stress parameters [c' - cohesion and φ' - angle of friction]. Multistage consolidated undrained triaxial tests with measurement of pore water pressure were undertaken and the test results are appended. The results for the sample at 4.0m depth were abnormally low compared to the anticipated peak values [as obtained in the other two tests]. This is likely to be explained by the fissured nature of this sample [the laboratory indicated that the fissures at an angle of 45°, and the fissures are highly stained with blue grey mottling, with some indication of slight polishing (slickenside), which would result in near residual/residual shear strengths]. Consequently, the results from this sample were ignored when deriving the 'typical value' used for the analysis work and the parameters used in our analysis were based on a summary 'p-q' plot using a 'best fit' line which gave c'=10.5kN/m^2 and φ'=23.5°.

4.3 Groundwater

With the exception of standing water at 1.4m depth in WS1, groundwater was not observed in the boreholes during our investigation. Standpipes were installed in WS1 and WS2 to allow for subsequent monitoring which was undertaken on 15 October 2012. Water was measured in both installations, at 0.95m depth in WS1 and at 3.50m depth in WS2, which compares with end of drilling depths of 1.40m depth in WS1 and a dry installation [ie >5.0m depth] in WS2.

5.0 DISCUSSION

The proposals are to construct a new 2-storey penthouse on the roof of the existing 8-storey block of flats. The building is supported by pad foundations bearing on the London Clay stratum. Information from the structural engineers indicates associated increased foundation loads of about 9%.

In 1982, John Burland of Imperial College provided advice with respect to the foundation performance at Barrie House, based on information provided by Ove Arup [not currently available]. His estimate of the short term [undrained] factor of safety of one of the basement strip foundations he had analysed ranged between 1.7 [for a mean clay shear strength (c_u) of 60kN/m^2] and 2.2 [for c_u=80kN/m^2], indicating that the foundations are "highly stressed". However, as the building was constructed in the 1950s and consolidation [and hence strength increase] of the clay will have taken place, a long-term drained analysis [based on assumed parameters c'=10kN/m^2, φ'=22°] was considered applicable, which resulted in a higher calculated factor of safety of 2.45. This suggested a slight improvement in stability of the foundations due to consolidation of the clay. Burland concluded that if a detailed soils investigation were carried out, it is possible that the assumed drained strength parameters [and the factor of safety] could be upgraded. Reported increased basement foundation settlement was attributed [by John Burland] to a large extent on the high bearing pressures and low factors of safety in this area.

Our investigation aimed to provide representative soil samples from the site [including directly beneath the existing foundations] to establish more clearly the strength parameters of the clay so that both drained and undrained analyses could be undertaken to enable a more thorough estimate of the foundation stability.

5.1 Undrained Analysis

As discussed above in Section 4.2, our investigation provided detailed undrained strength information for the London Clay within the zone of influence from three of the existing corner pad foundations. We concur with John Burland's assessment that the applicable depth for bearing capacity calculation would be 2B/3, equating to about 3m depth. Based on our test results we consider that the applicable c_u value at this depth for analysis should be taken as 80kN/m^2.

Based on this result, and information provided by StructureMode, we have assessed the undrained bearing capacity and factor of safety of the foundation locations detailed in Table 1 below. The bearing capacity factors of safety were assessed both for the existing situation. It is noted that there is some ambiguity as to some of the foundation pad sizes, with the reported sizes not always in agreement with the as-built drawings. It is also noteworthy that the structural engineers have calculated the pressure for the foundation analysed by Burland as 232kN/m^2, which is some 14% lower than the pressure he used for the analysis in 1982.

Table 1 – Undrained analysis for selected stip/pad foundations [existing situation]

Location	***Foundation dimensions [m]***	***Current foundation pressure [kN/m^2]***	***Calculated FoS for current pressures***	***Comments***
Strip foundation for basement wall [analysed by Burland, 1982]	1.73 x 9.35 [1.80m depth]	232	2.60	Original Burland calculation was for foundation pressure of 270kN/m^2 which gave FoS=2.20
WS1 [TH2 in Mar 2011 report]	1.60 x 1.86 [1.75m depth]	212	3.30	
WS2 [TH1 in Mar 2011 report]	1.85 x 2.40 [2.1m depth]	184	4.10	
WS2 [TH1 in Mar 2011 report]	1.40 x 1.40 [2.1m depth]	323	2.30	
WS3 [TH3 in Mar 2011 report]	1.60 x 1.86 [1.62m depth]	212	3.30	

The new construction will impose foundation loads more quickly than the rate of consolidation and thus the undrained situation will apply again in the short-term. Table 2 below presents the reduction in the factor of safety for each case based on the increased foundation pressures, and the final predicted factor of safety at the end of construction.

Table 2 – Effect of increased foundation pressures due to construction on selected strip/pad foundations [undrained case]

Location	Foundation dimensions [m]	Increase in foundation pressure due to proposed construction [kN/m^2]	Predicted end of construction FoS	Reduction in FoS due to construction [compared with Table 1]
Strip foundation for basement wall [analysed by Burland, 1982]	1.73 x 9.35 [1.80m depth]	20	2.3	0.3
WS1 [TH2 in Mar 2011 report]	1.60 x 1.86 [1.75m depth]	20	3.0	0.3
WS2 [TH1 in Mar 2011 report]	1.85 x 2.40 [2.1m depth]	16	3.7	0.4
WS2 [TH1 in Mar 2011 report]	1.40 x 1.40 [2.1m depth]	30	2.1	0.2
WS3 [TH3 in Mar 2011 report]	1.60 x 1.86 [1.62m depth]	20	3.0	0.3

Note: c' is in kN/m^2

From Table 2 it is apparent that the majority of assessed factors of safety following construction range between about 2.3 and 3.7 for the various footings, although the 1.4m square footing provides a lower factor of safety of 2.1.

5.2 Drained Analysis

Drained analysis is applicable to the long-term scenario, where the clay skeleton has adjusted to the imposed loads due to construction by a process of consolidation. This is a process by which soils decrease in volume due to expulsion of water under long term static loads. It occurs when stress is applied to a soil that causes the soil particles to pack together more tightly, therefore reducing its bulk volume, and increasing in strength.

Given the time that has passed since the original construction of Barrie House [about 54 years] it is reasonable to assume that the clay has undergone full consolidation and these calculations are therefore considered to represent more accurately the current state. The results, using the industry standard Meyerhof equation, are presented in Table 3 below. Information on the foundation sizes and pressures was provided by StructureMode and the angle of friction [φ'=23°] and cohesion [c'=10kN/m^2] were based on our assessment of the laboratory test results we have obtained on samples from BH1.

Table 3 – Drained analysis for selected strip/pad foundations [existing situation]					
Location	***Foundation dimensions [m]***	***Current foundation pressure [kN/m²]***	***Calculated FoS for current pressures***	***Difference in FoS compared with undrained FoS***	***Comments***
Strip foundation for basement wall [analysed by Burland, 1982]	1.73 x 9.35 [1.80m depth]	232	3.15 [c'=10] 2.60 [c'=5]	+0.55 [c'=10] 0.0 [c'=5]	Original Burland calculation was for foundation pressure of 270kN/m² and c'=10kN/m², φ'=22° which gave FoS=2.45 0° ground inclination
WS1 [TH2 in Mar 2011 report]	1.60 x 1.86 [1.75m depth]	212	3.10 [c'=10] 2.40 [c'=5]	-0.20 [c'=10] -0.90 [c'=5]	Water level taken at 1.0m depth 5° ground inclination
WS2 [TH1 in Mar 2011 report]	1.85 x 2.40 [2.1m depth]	184	4.10 [c'=10] 3.30 [c'=5]	+0.00 [c'=10] -0.80 [c'=5]	7.5° ground inclination
WS2 [TH1 in Mar 2011 report]	1.40 x 1.40 [2.1m depth]	323	2.55 [c'=10] 2.00 [c'=5]	+0.25 [c'=10] -0.30 [c'=5]	7.5° ground inclination
WS3 [TH3 in Mar 2011 report]	1.60 x 1.86 [1.62m depth]	212	3.90 [c'=10] 3.10 [c'=5]	+0.60 [c'=10] -0.20 [c'=5]	0° ground inclination [ground slopes towards the building]

Note: φ'=23° was used in our calculations; c' is in kN/m²

The above results include a sensitivity analysis using a reduced c'=5kN/m², and the resulting reduction in factor of safety was between about 18% and 23% [compared with the same analysis using c'=10kN/m²]. In all cases the lower c' resulted in a factor of safety equal to or below that obtained in the undrained analysis.

Based on the Table 3 results it is apparent that in most cases, when using the results from our effective stress triaxial tests [c'=10kN/m² φ'=23°] the drained analysis shows a small increase in the bearing pressure factors of safety compared with the undrained case. The ground inclination, which is not a factor considered in the undrained analysis, has a major influence in reducing the factors of safety obtained, particularly in the area of WS2. Nevertheless, all results with c'=10kN/m² are in excess of 2.5 [reducing to a minimum of 2.0 when using c'=5kN/m²].

In the long-term following construction, the drained situation will again apply, and the factors of safety obtained with the increased construction loads are shown in Table 4 below:

Table 4 – Effect of increased foundation pressures due to construction on selected strip/pad foundations [drained case]				
Location	***Foundation dimensions [m]***	***Increase in foundation pressure due to proposed construction [kN/m^2]***	***Predicted end of construction FoS***	***Reduction in FoS due to construction [compared with Table 3]***
Strip foundation for basement wall [analysed by Burland, 1982]	1.73 x 9.35 [1.80m depth]	20	2.90 [c'=10] 2.40 [c'=5]	0.25 0.40
WS1 [TH2 in Mar 2011 report]	1.60 x 1.86 [1.75m depth]	20	2.85 [c'=10] 2.15 [c'=5]	0.25 0.25
WS2 [TH1 in Mar 2011 report]	1.85 x 2.40 [2.1m depth]	16	3.80 [c'=10] 3.05 [c'=5]	0.30 0.25
WS2 [TH1 in Mar 2011 report]	1.40 x 1.40 [2.1m depth]	30	2.35 [c'=10] 1.85 [c'=5]	0.20 0.15
WS3 [TH3 in Mar 2011 report]	1.60 x 1.86 [1.62m depth]	20	3.55 [c'=10] 2.85 [c'=5]	0.35 0.25

Note: c' is in kN/m^2

From Table 4 it is apparent that the long-term factors of safety following construction range between about 2.3 and 3.8 for the various footings. With a lower assumed c' of 5kN/m^2 the factors of safety fall to range between about 2.1 and 2.8 [with the 1.4m square footing giving a factor of safety of about 1.8].

5.3 Predicted Settlements

The predicted settlements under the additional imposed structural loads associated with the new penthouse construction are shown in Table 5 below. These have been calculated to be less than 5mm for all the foundation/load cases analysed, without exception.

Table 5 – Predicted settlements for selected strip/pad foundations			
Location	***Foundation dimensions [m]***	***Increase in foundation pressure [kN/m^2]***	***Predicted settlements [mm]***
Burland analysis of strip foundation for basement wall	1.73 x 9.35 [1.80m depth]	20	<5mm
WS1 [TH2 in Mar 2011 report]	1.60 x 1.86 [1.75m depth]	20	<5mm
WS2 [TH1 in Mar 2011 report]	1.85 x 2.40 [2.1m depth]	16	<5mm
WS2 [TH1 in Mar 2011 report]	1.40 x 1.40 [2.1m depth]	30	<5mm
WS3 [TH3 in Mar 2011 report]	1.60 x 1.86 [1.62m depth]	20	<5mm

5.4 Slope stability

The site slopes down from the north-east to the south-west, with the slope steepest [about 1v:5h or 11.3°] to the west/south-west of the apartment block. Using the Bishop & Morgenstern stability charts with c'=0kN/m^2 and φ'=23° and a water pressure coefficient r_u of 0.3 [considered a conservative value] results in a factor of safety of 1.45, indicating that the overall stability of the slope should be acceptable. During our fieldwork we have observed some cracking in the pavement and some uneven ground in this part of the site, however, these are consistent with shallow soil creep and movement due to tree roots. We have not observed any indicators of significant deep-seated failure that may have an adverse impact on the performance of the foundations.

5.5 Summary and recommendations

Overall, we consider that the calculations undertaken demonstrate that in all but one of the cases, the soils beneath the site are sufficiently competent to allow for the proposed construction stresses to be safely accommodated by the existing foundations without the general need for modification. Based on our investigation and analysis, the end of construction factors of safety were found to be in all but one of the cases, in excess of 2.1. Although it is normal to use factors of safety of about 2.5 to 3.0 in bearing capacity cases, we consider that sufficient confidence in the soil sequence and properties has been obtained by our investigation to allow a lower factor of safety of 2.0 to be used.

A sensitivity analysis, with a reduced c', however, decreases the factors of safety to 1.85 for the 1.4m square footing in the area of WS1. This footing is the most highly stressed element that we have analysed with an applied pressure of 350kN/m^2. We consider that this foundation and any others that are similarly loaded should be underpinned or modified to provide additional capacity.

The proposed construction should result in a small amount of foundation settlement [<5mm], which is likely to be acceptable.

We have not observed any signs of clay desiccation in our boreholes, however, a full tree survey should be undertaken following which the potential impact on the foundations due to desiccation should be assessed and remedial action undertaken if necessary. Future tree planting must also be carefully planned with reference to NHBC Chapter 4.2 'Building near trees' to ensure that potential clay desiccation issues are avoided.

We have not observed obvious signs of slope instability at this site and from a preliminary visual assessment we consider that some superficial creep/root disturbance is apparent in the area to the west of Barrie House. Given the depths of foundations in this area of the site we do not consider that slope movement is a significant factor affecting foundation performance. Furthermore, the high groundwater in WS1, indicative of a possible leaking drain/pipe, does not appear to have softened the clay beneath the pad foundation in this area.

Our analysis of the foundation stability is based on industry-standard bearing capacity theory. It should be noted that the calculated stability can be very sensitive to foundation geometry, slope geometry and soil parameters. We assume that the most critical combinations of load/foundation geometry have been assessed, and no structural defects or any other issues not covered in this report, that have a significant bearing on foundation performance, are present. On this basis we consider that the proposed construction should be acceptable. It will, however, be of critical importance to devise a monitoring schedule during and following construction to ensure that any movements are within an acceptable range. If any further information comes to light on foundation sizes/depths this should be assessed to ensure that a sufficient factor of safety exists.

APPENDIX –

Historical information

- Ove Arup & Partners, Trial Pit Report Ref. G.M.M./TJS/11166
- John Burland [Imperial College], 15 April 1982
- Trial pit information, March 2011

Fieldwork and in situ testing

- Foreword to cable percussion boring
- Cable percussion borehole record
- Foreword to window sample boring
- Window sample borehole records
- Standard Penetration Test results
- Hand vane test results
- Pocket penetrometer test results

Laboratory testing

- Moisture content and Atterberg limit test results
- Plasticity Charts
- Undrained triaxial test results
- Consolidated undrained triaxial test with pore water measurement results [K4 soils]
- p-q plot

Plans & drawings

- Site plan
- Location map

OVE ARUP & PARTNERS

BARRIE HOUSE

29 ST. EDMUNDS TERRACE, N.W.5

TRIAL PIT REPORT

OVE ARUP AND PARTNERS

G.M.M./TJS/11166

1. General

Barrie House is an eight storey block of flats constructed in 1958. It is a brick clad insitu concrete framed building constructed on strip and pad foundations.

The original calculations and structural drawings by Felix J. Samuelly are available and at present in our possession.

In order to comment on the feasibility of constructing a penthouse on the existing roof, the district surveyor insisted that Ove Arup arrange for a trial pit to be dug, in order that the "As built" foundations could be compared to the "As drawn" foundations.

This Trial pit was completed and inspected on August 26th by Ove Arup and Partners and Mr. Baines of the district surveyors office.

2. TRIAL PIT RECORD

The trial pit was dug adjacent to column No. 16. See 629/1 for location.

The concrete base measured 8'- 0" in one direction by 7'- 8" in the opposite direction. Dimensions and levels etc. we recorded on 11166 TP 01.

There were many fibrous free roots in the top 900mm of the trial pit but none below that level.

The trial pit instantly filled with water to the level shown on 11166 TP 01 and prevented the contractor from determining the underside level of the foundation.

The soil at the level of the water table was Brown London Clay.

3. <u>Original Foundation Specification</u>

Drawing 629/5 details the foundation to col. 16 as 7'- 3" square but does not specify the underside level.

This is compared to 8'- 0" by 7'- 8" as constructed.

There is on calculation page D.3 an assumed ground bearing pressure of 2 ton per sq. ft.

It was not possible to check this because the base level was under water.

4. District Surveyors Comments

The district surveyor pointed out two minor cracks in the ground beam at columns 11 and 23. This is a point at which the building basement line ends.

He stated that in view of the following points:-

a) The cracks mentioned above.

b) The prolific tree roots in the trial pit.

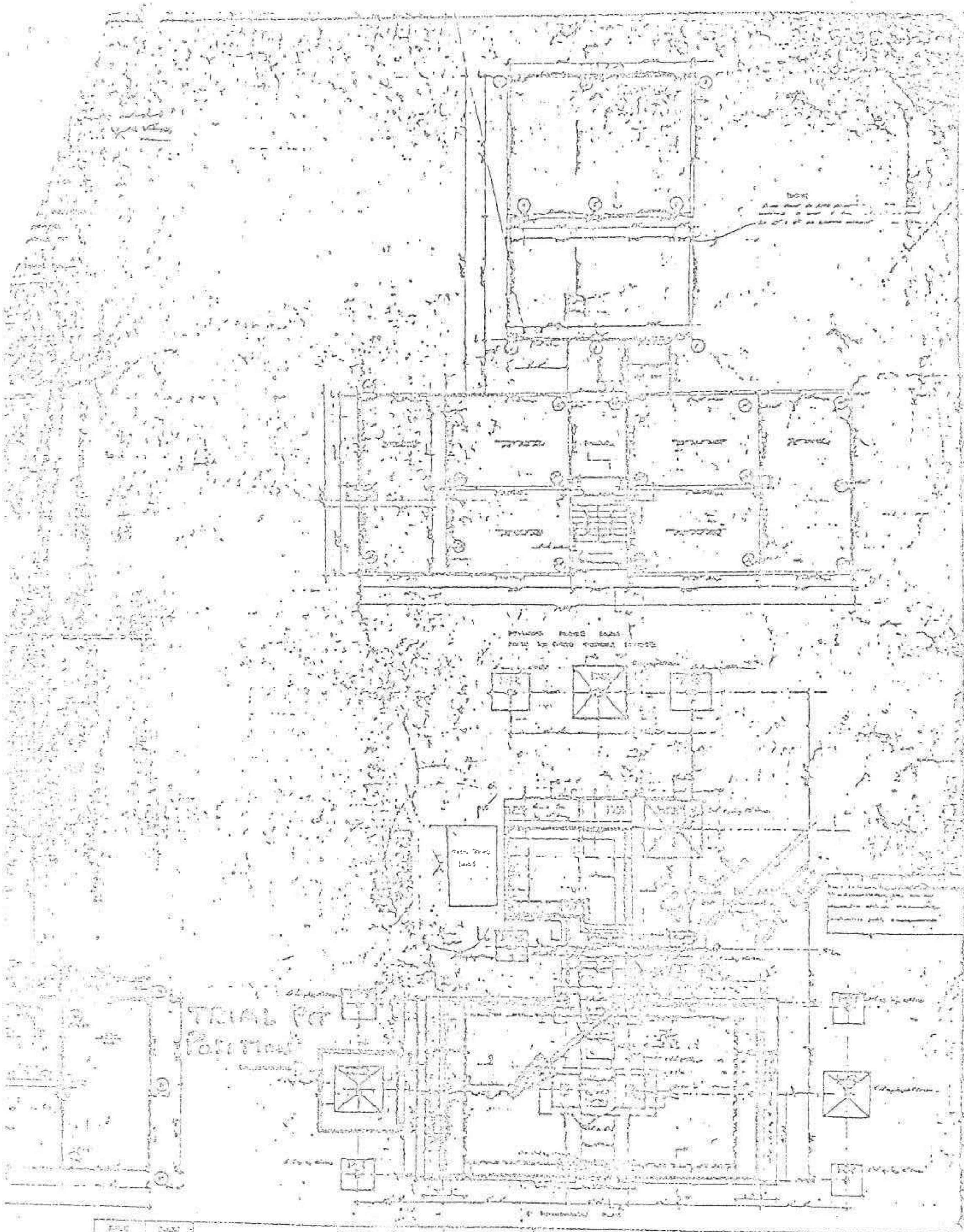
c) The water in the trial pit.

d) The slope of the site.

he would not permit extra load to be added to the building unless the following points were settled:-

a) The cause of the cracking in the ground beam. ← ELE

b) That the clay slope was stable. ← Soils



9, ST EDMUNDS TERRACE N.W. 8.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

J. B. Burland, MSc(Eng), Ph D,
C Eng, MICE, MIStructE, MSAICE
Professor of Soil Mechanics
Head of Soil Mechanics Section

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London SW7 2BU.
Telephone 01-589 5111 Ext 1305
Telex 261503

April 15th. 1982

Mr. S. Jeffryes,
Walter F. Parker and Associates,
27, Marylebone Road,
London NW1 5JS.

Dear Mr. Jeffryes,

Barrie House

I have now studied the report by Ove Arup and Partners dealing with the foundations of Barrie House. In the report it is stated that the factor of safety for the most critical footings is in the range 1.55 to 2.5. This calculation is based on the undrained strength of the soil. I have carried out an independant calculation (see attached sheet 1) and using the strengths given in Figure 11 of the report I find that the undrained short term factor of safety lies between 1.7 and 2.2. Normally one would not design to a factor of safety on bearing capacity less than 2 to 2.5 for footings. Hence I agree with conclusion 4 that the foundations are highly stressed.

Since the flats were built in 1958 the soil beneath the footings will have become fully consolidated under the foundation loads. It occurred to me that this could lead to a considerable improvement in stability and accordingly I have carried out a drained bearing capacity calculation (sheet 2). In doing this calculation I have had to make a number of assumptions the two most important ones being (i) that the effective strength parameters are $\phi' = 22^{\circ}$, $c' = 10 kN/m^2$ and (ii) that the footing is buried to a depth of 1.8 metres. Without obtaining undisturbed samples, soils and doing drained triaxial tests it is not possible to assess the accuracy of assumption (i) but it probably represents a lower limit to likely values of strength for London Clay. Assumption (ii) is almost certainly optomistic since there is a basement on one side of the footings.

The calculations on sheet 2 lead to a drained factor of safety of 2.45 which suggests a slight improvement in stability due to consolidation. However it should be noted that the surcharge term $P_o.N_q$ contributes more than half the bearing capacity and in view of the optomistic assumption about P_o the Factor of Safety may well be somewhat less. Hence I conclude that any increase in stability with time is unlikely to be significant andin present circumstances should not be relied upon. If a detailed soils investigation were carried out it is possible that the assumed drained strength parameters could be upgraded. However such an investigation would be expensive and there is no guarantee that it would yield improved strength parameters. No doubt Ove Arup and Partners could advise you on the costs and likely outcome of a further soils investigation.

In the light of information contained in the Ove Arup report and the calculations that I have carried out I agree with conclusions 4 to 6 in the report. No doubt the main reason why the basement area appears to have settled more than the surrounding area is due to the high bearing pressures and low factors of safety in that area.

Please do not hesitate to contact me if you would like to discuss the matter further. As requested in your letter of 5th. April 1982 I attach a statement of my fee.

Yours sincerely,

J. B. Burland

Short term stability – most critical case is footings for columns 11, 17, 23 and 14, 20 and 26.

Dimensions: 1.73×9.35 m

Depth of founding: 1.8 m – optimistic since basement on one side

Density of soil (say): 18 kN/m³

Working pressure: 270 kN/m²

Undrained strength c_u: Take value at a depth below founding of 2/3 breadth i.e. 3 metres below G.L.

From Fig 11 c_u is 60 to 80 kN/m².

Failure pressure $q_f = c_u \times N_c + p_o$

N_c for strip footing at $D/B = 1$ is 6.4

N_c for rectangular footing $= 6.4(1 + 0.2B/L)$

$= 6.4(1 + 0.2 \times 1.73/9.35)$

$= 6.64$

$p_o = 18 \times \text{depth} = 18 \times 1.8 = 32.4$ kN/m²

For $c_u = 60$ kN/m²

$q_f = 60 \times 6.64 + 32.4$

$= 431$ kN/m²

For $c_u = 80$ kN/m²

$q_f = 80 \times 6.64 + 32.4$

$= 564$ kN/m²

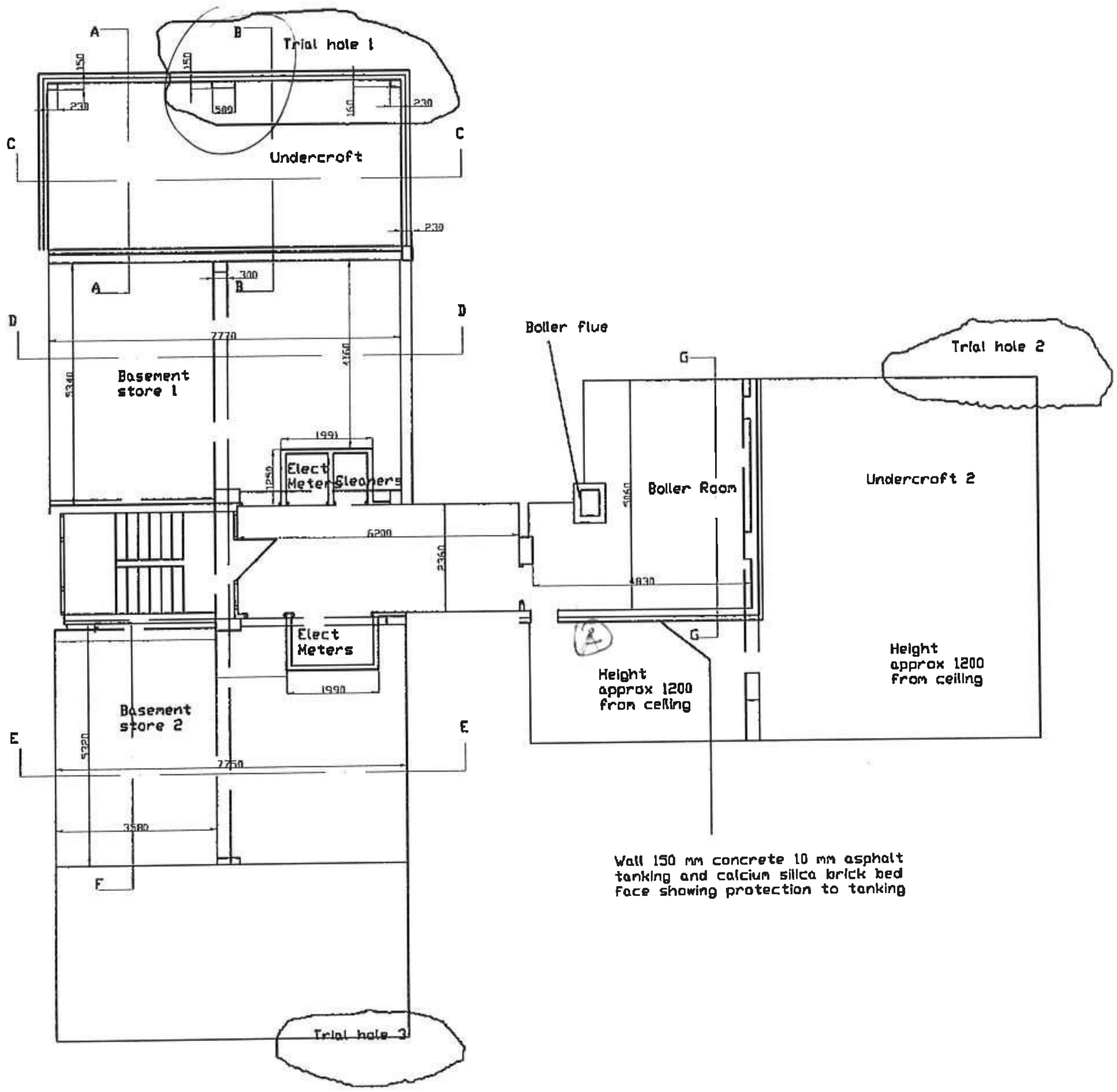
$\therefore$ F. of S. $= \dfrac{q_{f\,net}}{q_{w\,net}} = \dfrac{431-32}{270-32}$

$= \underline{1.68}$

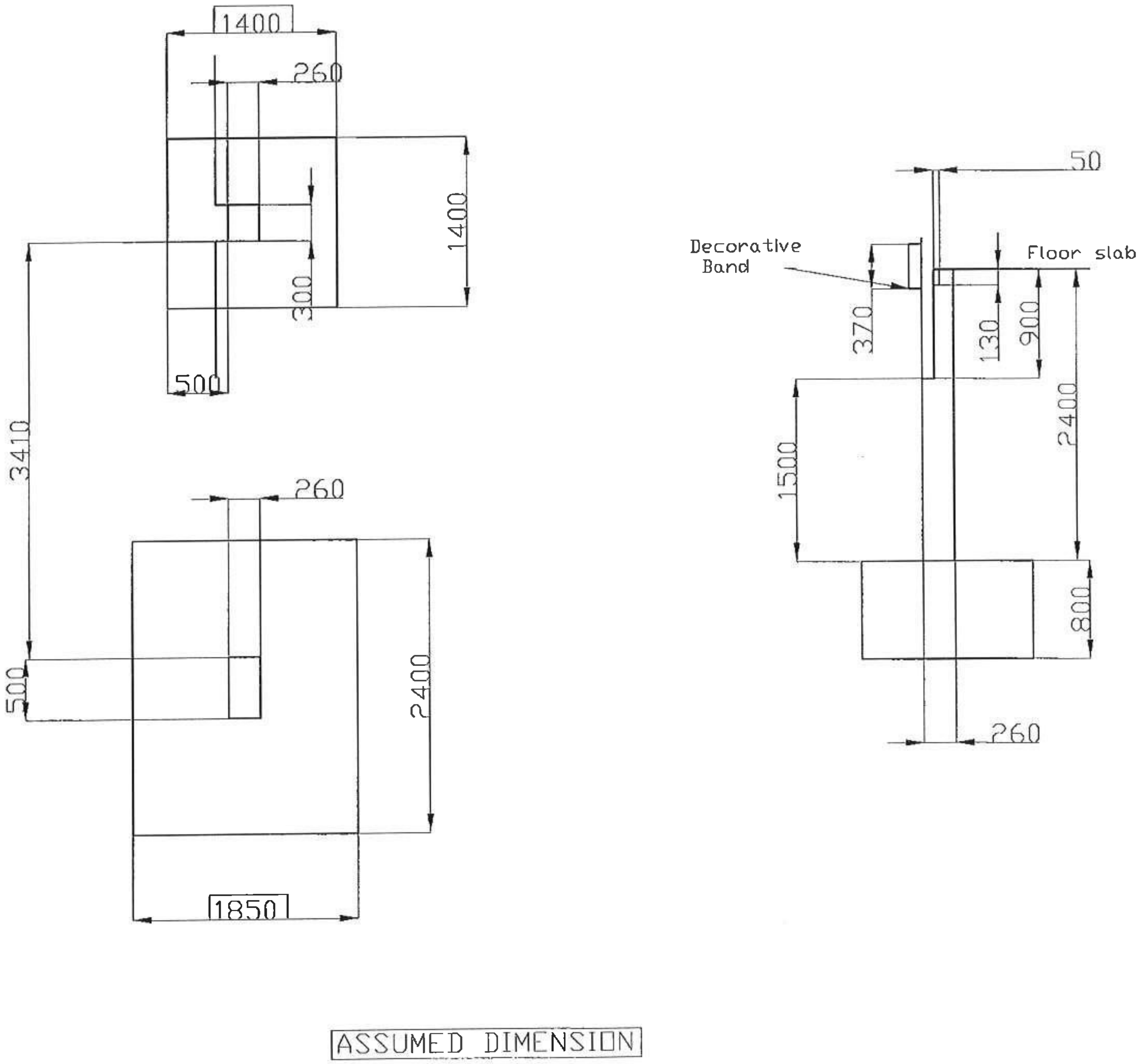
F of S $= \dfrac{564-32}{270-32}$

$= \underline{2.24}$

i.e. Factor of safety against short term bearing capacity failure is between 1.7 and 2.2

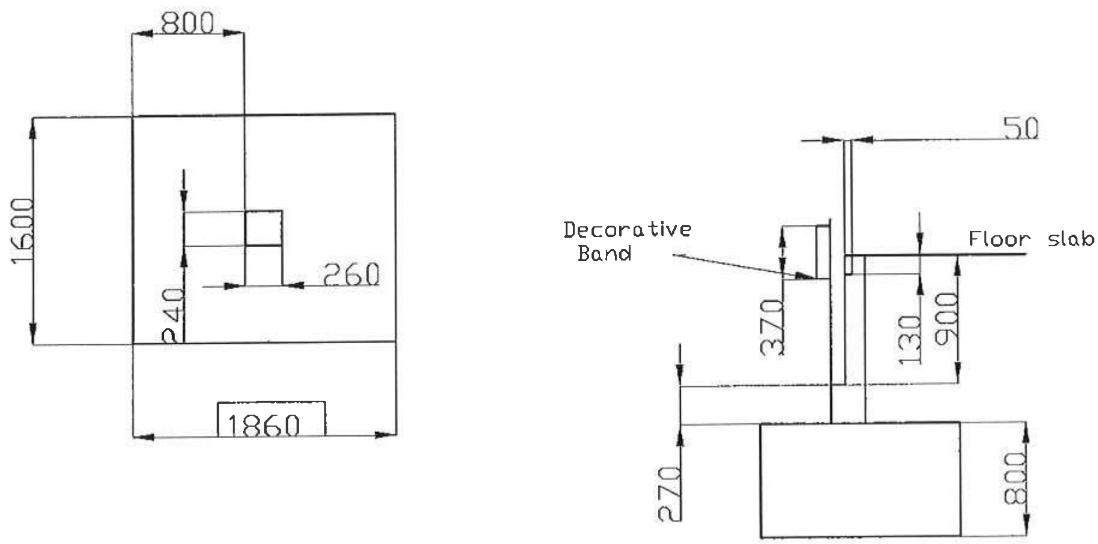


BARRIE HOUSE TRIAL PITS LOCATIONS MARCH 2011



TRIAL HOLE 1

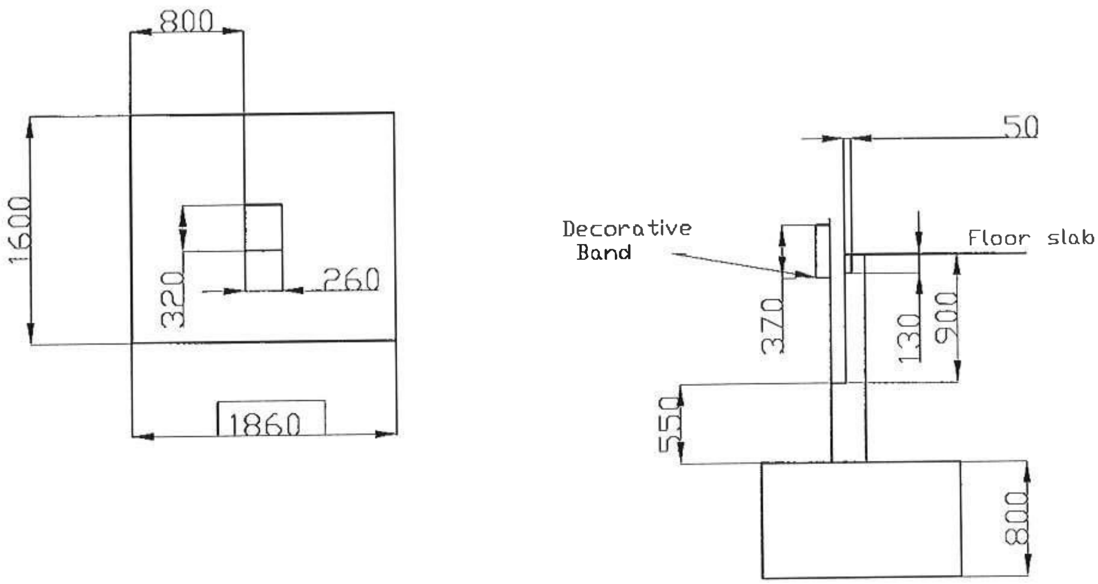
BARRIE HOUSE TRIAL PITS MARCH 2011



ASSUMED DIMENSION

TRIAL HOLE 2

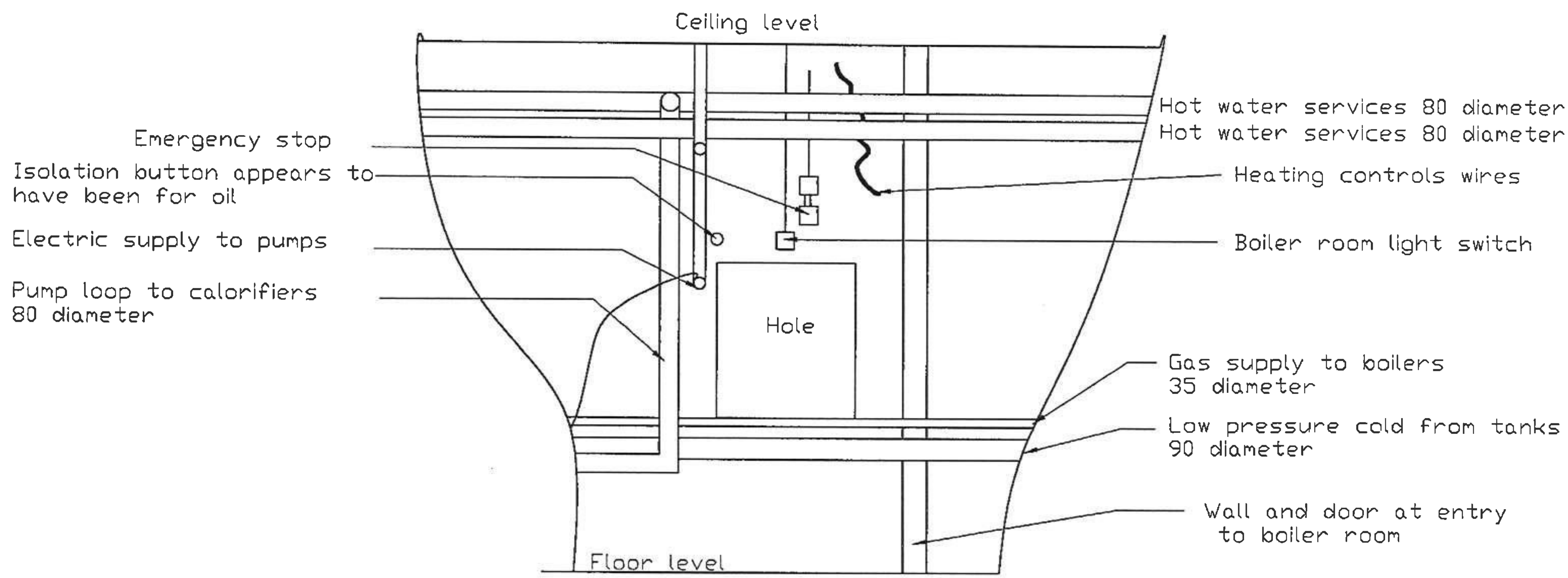
BARRIE HOUSE TRIAL PITS MARCH 2011



ASSUMED DIMENSION

TRIAL HOLE 3

BARRIE HOUSE TRIAL PITS MARCH 2011



ELEVATION OF WALL IN BASEMENT WITH CORE DRILLED HOLE
Scale 1:25

BARRIE HOUSE

FOREWORD/GUIDANCE NOTES

CABLE PERCUSSION BORING

GENERAL
The Borehole Records are compiled from the driller's description of the strata encountered, an examination of the samples by our Geotechnical Engineer and the results of in-situ and laboratory tests. Based on this data, the report presents an opinion on the configuration of strata within the site. However, such reasonable assumptions are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

BORING METHODS
The Cable Percussion technique of boring is normally employed and allows the ground conditions to be reasonably well established. However, some disturbance of the ground is inevitable, particularly some "softening" of the upper zone of clay immediately beneath a granular soil. The presence of thin layers of different soils within a stratum may not always be detected.

GROUND WATER
The depth at which ground water was struck is entered on the Borehole Records. However, this observation may not indicate the true water level at that period. Due to the speed of boring and the relatively small diameter of the borehole, natural ground water may be present at a depth slightly higher than the water strike. Moreover, ground water levels are subject to variations caused by changes in the local drainage conditions and by seasonal effects. When a moderate inflow of water does take place, boring is suspended for at least 10 minutes to enable a more accurate short term water level to be achieved. An estimate of the rate of inflow is also given. This is a relative term and serves only as a guide to the probable flow of water into an excavation.

Further observations of the water level made during the progress of the borehole are shown including end of shift and overnight readings and the depth at which water was sealed off by the borehole casing, if applicable.

Whilst drilling through granular soils, it is usually necessary to introduce water into the borehole to permit their extraction. When additional water has been used a remark is made on the Borehole Record and the implications are discussed in the text.

SAMPLES
Undisturbed samples of the predominantly cohesive soils are obtained using a 100mm diameter open-drive sampler. In granular soils, disturbed bulk samples are taken and placed in polythene bags. Small jar samples are taken at frequent intervals in all soils for subsequent visual examination. Where ground water is encountered in sufficient quantity, a sample of the ground water is also taken.

IN-SITU STANDARD PENETRATION TESTS
This test is performed in accordance with the procedure given in B.S.1377: 1990. The individual blow count record for each test is given on a separate table. The 'N' value is normally the number of blows to achieve a penetration of 0.3m following a seating distance of 0.15m and is quoted at the mid-depth of the test zone. However if a change of stratum occurs within the test zone then a revised 'N' value is calculated to assess one layer in particular. In hard strata full penetration may not be obtained. In such cases the suffix + indicates that the result has been extrapolated from the limited penetration achieved. Where ground water has affected the measured values, the resultant 'N' value has been placed in brackets since it is unlikely to represent the true in-situ density of the soil.

Site	**Barrie House**	Borehole No:	**BH1**
Location	**29 St Edmund's Terrace, London NW8 7QH**		
Client:	**Robert Morley, Kaleminster Ltd**	Sheet	**1 of 1**
Engineer:	**StructureMode Ltd**	Report No:	**9241/OT**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]	Level[mOD]	Strata Description
BH constructed 17 Sep 2012				0.00	+46.00	MADE GROUND: asphalt [100mm] over grey/black mixture of ashy sand with asphalt, clinker and flint gravel; below about 0.35m becoming grey/brown clay with some ash and clinker
BH dia: 150mm				0.50	+45.50	
Cased to: 1.50m	D	0.60				Soft brown CLAY with grey patches
	U	1.10				
Groundwater not observed						
	D	1.60				…below about 1.6m becoming firm brown CLAY with occasional grey gleying
	S/D	2.30	6			
	D	2.70				
	U	3.00				
	D	3.50				
	S/D	4.30	12			
	D	4.60				
	U	5.00				
	D	5.50				
						…becoming stiff below about 6.0m
	S/D	6.30	16			
	D	6.60				
	U	7.00				
	D	7.50		7.50	+38.50	END OF BOREHOLE

Constructed using cable percussive techniques

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Backfilled with arisings and surface reinstated on completion
Ground level interpolated from topographical survey

Borehole No: **BH1**

[* = extrapolated SPT 'N' value]

SCL Chart Generator Ver_1_5_11

Foreword to: WINDOW SAMPLING

Window Sample Boreholes are constructed by driving in steel sample tubes containing long cut out 'windows', which is extruded to enable the soil to be examined, tested or sampled. The tubes are 1m in length. The borehole commences using a large diameter tube, usually 90mm, with each succeeding tube reducing usually by 10mm in diameter to assist the extraction of the tube from the ground. Thus, it is theoretically possible to obtain a total continuous sample of the soil for examination or testing.

Window Sample boreholes are a means of rapid and economic sampling where access is not necessarily good or where impact of the investigation must be kept to a minimum.

The method is primarily suited to clay soils and can also achieve reasonable penetration into many granular soils. Soil recovery beneath the water table in granular soils can however be reduced.

The open slot in the sample tube allows hand shear vane and pocket penetrometer tests to be carried out. Samples can also be taken where necessary for laboratory testing, including moisture content, index property tests and contamination analyses.

Hand Shear Vane: The shear strength of cohesive soils are reported in kPa.

Pocket Penetrometer: The unconfined compression strengths values are reported in kg/cm^2.

Site	Barrie House	Borehole No: WS1
Location	29 St Edmund's Terrace, London NW8 7QH	
Client:	Robert Morley, Kaleminster Ltd	Sheet 1 of 2
Engineer:	StructureMode Ltd	Report No: 9241/OT

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]	Strata Level[mOD]	Strata Description
BH constructed 17 Sep 2012				0.00	+45.60	MADE GROUND: [trial pit] - brown topsoil and clay with occasional building rubble
BH dia: 60mm reducing with depth						
Groundwater at 0.95m on				0.90	+44.70	Concrete foundation [no reinforcement observed]
Groundwater at 1.4m on						
				1.75	+43.85	Stiff brown CLAY with occasional grey gleying, selenite crystals and rare orange sand partings
Some disturbance in upper 200mm of clay due to coring operations and HV testing	HV	1.90	47			
						…incipient claystone at 2.05m
	HV/D	2.10	81			
	HV	2.30	88			
	D	2.40				
	HV	2.50	88			
	D	2.60				
	HV	2.70	78			
	D	2.80				
	HV	2.90	99			
	D	3.10				
	HV	3.20	84			
	HV/D	3.40	82			
	HV	3.60	80			
	D	3.70				
	HV	3.80	82			
	HV/D	4.00	90			
	HV	4.20	98			
	D	4.30				
	HV	4.40	92			
	D	4.60				
				5.00	+40.60	END OF BOREHOLE

Constructed using hand held window sample equipment

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

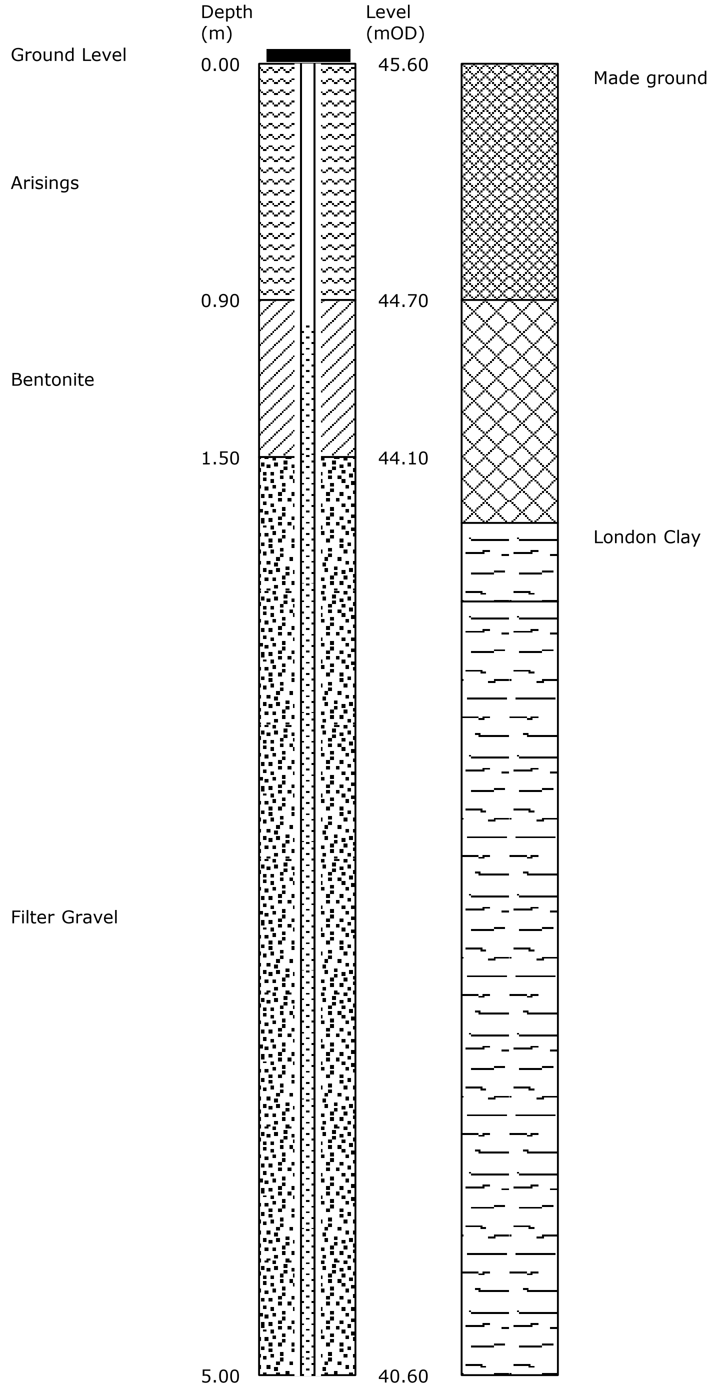
Remarks :- Borehole constructed through an open trial pit which exposed the top of a footing and cored to base of footing at 75mm dia
Standpipe installed to 5.0m depth
Ground level interpolated from topographical survey

Borehole No: WS1

[* = extrapolated SPT 'N' value]

Site	**Barrie House**	Borehole No:	**WS1**
Location	**29 St Edmund's Terrace, London NW8 7QH**		
Client:	**Robert Morley, Kaleminster Ltd**	Sheet	**2 of 2**
Engineer:	**StructureMode Ltd**	Report No:	**9241/OT**

Borehole Installation and Backfill Details



Constructed using hand held window sample equipment

Remarks :-	[i] Pipe diameter: 19mm [ii] Tip at 5m depth [40.6m OD approx]	Borehole No: **WS1**

Site	**Barrie House**	Borehole No:	**WS2**
Location	**29 St Edmund's Terrace, London NW8 7QH**		
Client:	**Robert Morley, Kaleminster Ltd**	Sheet	**1 of 2**
Engineer:	**StructureMode Ltd**	Report No:	**9241/OT**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]	Level[mOD]	Strata Description
BH constructed 17 Sep 2012 BH dia: 60mm reducing with depth				0.00	+44.60	MADE GROUND: [trial pit] - brown topsoil and clay with occasional building rubble
				1.13	+43.47	MADE GROUND: soft to firm brown clay with occasional flint gravel and dark brown sand/silt lenses
	HV/D	2.10	88	2.10	+42.50	Stiff, locally firm brown CLAY with orange patches and scattered selenite crystals
	HV/D	2.30	74			…below 2.25m becoming brown with occasional grey gleying and selenite crystals
	HV	2.50	63			
	D	2.60				
	HV	2.70	82			
	HV/D	2.90	78			
	HV/D	3.10	74			
	HV	3.30	76			
	D	3.40				
Groundwater at 3.5m on 15/10/12	HV	3.50	93			
	HV/D	3.70	86			
	HV	3.90	84			
	HV/D	4.10	68			
	HV	4.30	80			
	HV/D	4.50	106			
	HV	4.70	92			
	HV	4.90	120			
				5.00	+39.60	END OF BOREHOLE

Constructed using hand held window sample equipment

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

Remarks :- Borehole constructed off edge of pad footing
Standpipe installed to 5.0m depth
Ground level interpolated from topographical survey

Borehole No: **WS2**

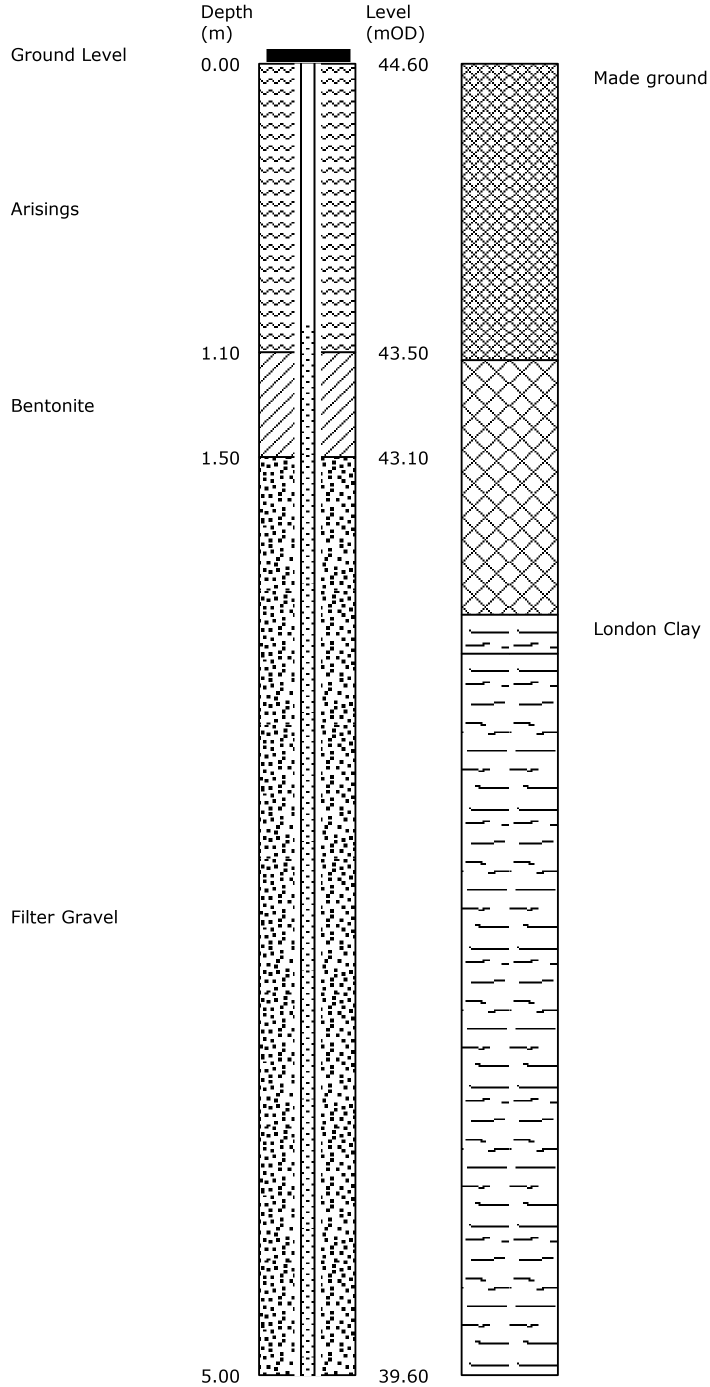
[* = extrapolated SPT 'N' value]

SoilConsultants

SCL Chart Generator Ver_1_5_11

Site	**Barrie House**	Borehole No:	**WS2**
Location	**29 St Edmund's Terrace, London NW8 7QH**		
Client:	**Robert Morley, Kaleminster Ltd**	Sheet	**2 of 2**
Engineer:	**StructureMode Ltd**	Report No:	**9241/OT**

Borehole Installation and Backfill Details



Constructed using hand held window sample equipment

Remarks :-	[i] Pipe diameter: 19mm [ii] Tip at 5m depth [39.6m OD approx]	Borehole No:	**WS2**

Site	**Barrie House**	Borehole No:	**WS3**
Location	**29 St Edmund's Terrace, London NW8 7QH**		
Client:	**Robert Morley, Kaleminster Ltd**	Sheet	**1 of 1**
Engineer:	**StructureMode Ltd**	Report No:	**9241/OT**

Comments	Samples Type	Samples Depth[m]	Field Test	Strata Depth[m]	Strata Level[mOD]	Strata Description
BH constructed 17 Sep 2012 BH dia: 60mm reducing with depth				0.00	+45.30	MADE GROUND: [trial pit] - brown topsoil and clay with occasional building rubble
Groundwater not observed				0.90	+44.40	Concrete foundation [single reinforcement bar, c.10mm dia, observed at 0.5m in core]
				1.62	+43.68	Stiff brown CLAY with occasional grey gleying, selenite crystals and rare orange sand partings
Some disturbance in upper 200mm of clay due to coring operations and HV testing						…incipient claystone at 2.05m
	HV	2.10	87			
	D	2.20				
	HV	2.30	97			
	HV	2.50	114			
	HV	2.70	109			
	D	2.80				
	HV	2.90	119			
	HV/D	3.10	85			
	HV	3.30	87			
	HV	3.50	90			
	D	3.60				
	HV	3.70	85			
	HV	3.90	94			
	HV	4.10	64			
	D	4.20				
	HV	4.30	86			
	HV	4.50	96			
	HV	4.70	98			
	D	4.80				
	HV	4.90	97			
				5.00	+40.30	END OF BOREHOLE

Constructed using hand held window sample equipment

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water S = SPT 'N' [split spoon sampler] C = SPT 'N' [solid cone] HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm^2]

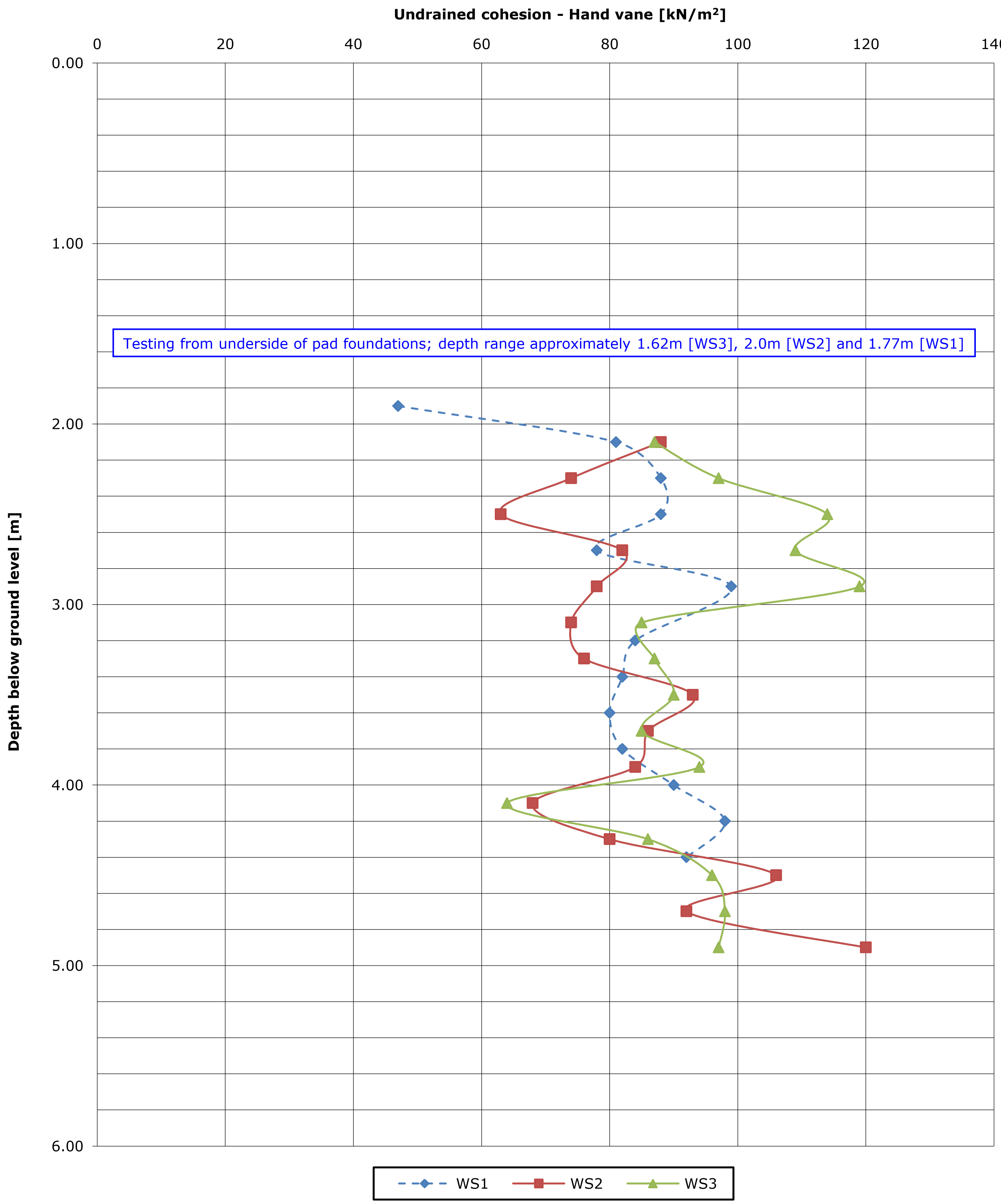
Remarks :- Borehole constructed through an open trial pit which exposed the top of a footing and cored to base of footing at 75mm dia
Standpipe installed to 5.0m depth
Ground level interpolated from topographical survey

Borehole No: **WS3**

[* = extrapolated SPT 'N' value]

Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

Strength Profile [Hand Vane]



Site Location	Barrie House□ 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

Pocket Penetrometer Strength Profile

WS1		WS2		WS3							
Depth [m]	Value [n]	Depth [m]	Value [n]	Depth [m]	Value [n]	Depth [m]	Value [n]	Depth [m]	Value [n]	Depth [m]	Value [n]
1.9	1.30	2.1	2.30	2.1	2.80						
2.1	1.80	2.3	1.80	2.3	2.40						
2.3	2.10	2.5	1.70	2.5	2.50						
2.5	2.10	2.7	2.10	2.7	2.90						
2.7	2.10	2.9	1.90	2.9	2.60						
2.9	2.40	3.1	1.80	3.1	2.30						
3	2.30	3.3	1.80	3.3	2.40						
3.2	2.30	3.5	2.60	3.5	2.50						
3.4	2.30	3.7	2.20	3.7	1.80						
3.6	2.20	3.9	1.90	3.9	2.50						
3.8	2.40	4.1	1.90	4.1	1.90						
4	2.40	4.3	2.50	4.3	2.40						
4.2	2.90	4.5	3.00	4.5	2.40						
4.4	2.30	4.7	3.00	4.7	2.60						
4.5	2.20	4.9	2.50	4.9	2.60						
4.7	2.40										
4.9	2.10										

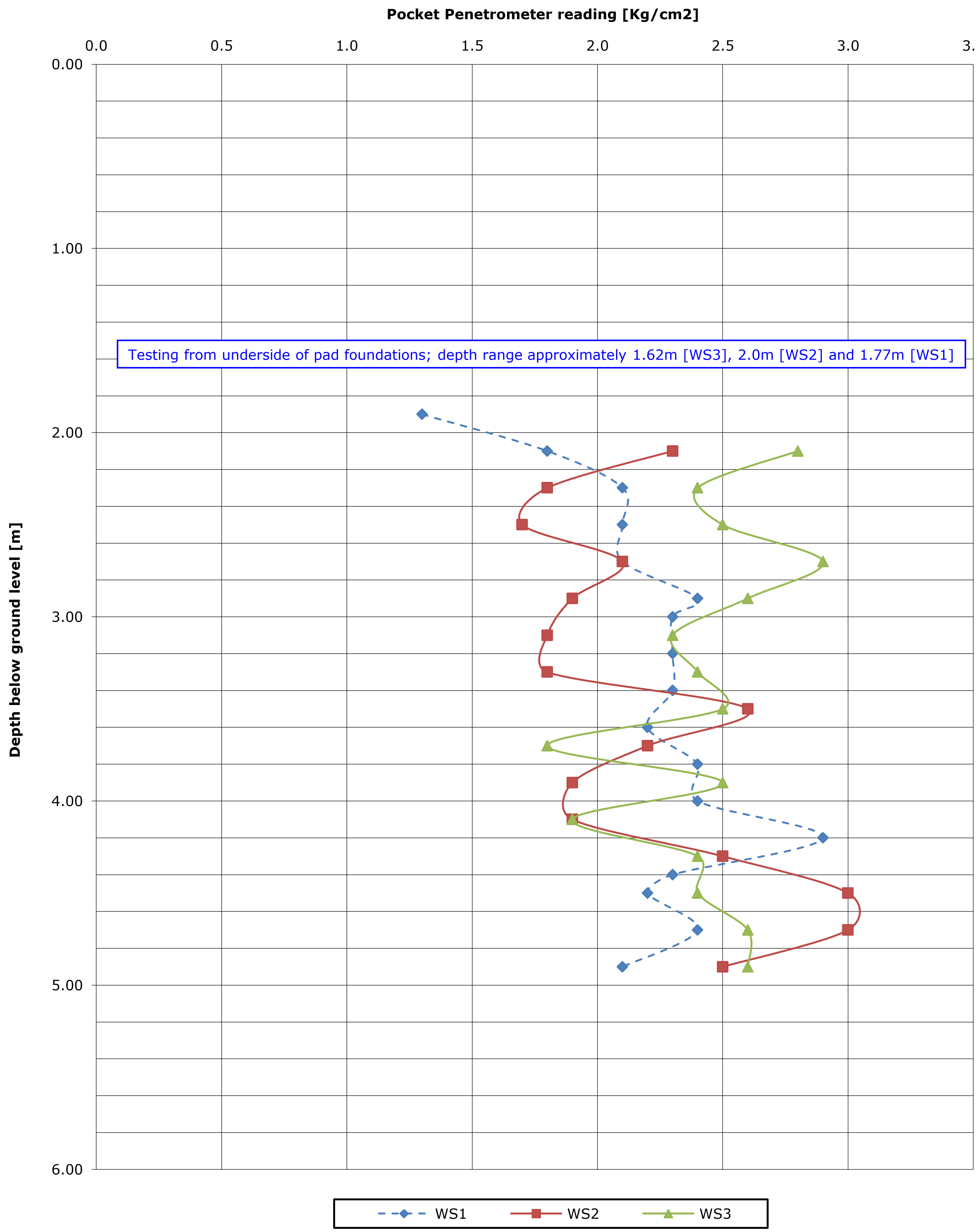
Notes

- Standard Penertration Test : BS1377 : Part 9 (1990) Clause 3.3
- * = Extrapolated Value

Soil Consultants

Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

Strength Profile [Pocket Penetrometer]



Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

Index Property Test Results

Sheet 1 of 3

Sample Location	Depth (m)	Sample Description	Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	Percent Passing [%]	Remarks
WS1	2.10	Brown CLAY with occasional grey gleying	20	78	25	53	>95	
WS1	2.40	Brown CLAY with occasional grey gleying	28					
WS1	2.60	Brown CLAY with occasional grey gleying	30					
WS1	2.80	Brown CLAY with occasional grey gleying	30	78	30	48	>95	
WS1	3.10	Brown CLAY with occasional grey gleying	31					
WS1	3.40	Brown CLAY with occasional grey gleying	32					
WS1	3.70	Brown CLAY with occasional grey gleying	31	83	30	53	>95	
WS1	4.00	Brown CLAY with occasional grey gleying	33					
WS1	4.30	Brown CLAY with occasional grey gleying	34					
WS1	4.60	Brown CLAY with occasional grey gleying	34					
WS2	2.10	MADE GROUND: Brown clay with occasional flint gravel and dark brown sand/silt lenses	28					
WS2	2.30	Brown CLAY with orange patches and grey gleying	30	83	27	56	>95	
WS2	2.60	Brown CLAY with orange patches and grey gleying	28					

Notes

- Moisture content test: BS 1377:Part 2 [1990] Clause 3.2 [value in brackets = calculated matrix moisture content for comparison with LL and PL]
- Liquid and Plastic Limit: BS 1377:Part 2 [1990] Clauses 4.4, 5.2, 5.3, 5.4 is carried out on fine grained soil matrix
- Percent passing 425 micron sieve is by estimation, by hand* or by wet sieving**
- LOI = Loss on Ignition

Sample examined by OT (Engineer)

Results checked by OT (Engineer)

Certificate date : 02/10/2012

Site Location	Barrie House□ 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

Index Property Test Results

Sample Location	Depth (m)	Sample Description	Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	Percent Passing [%]	Remarks
WS2	2.90	Brown CLAY with orange patches and grey gleying	31					
WS2	3.10	Brown CLAY with orange patches and grey gleying	32	91	30	61	>95	
WS2	3.40	Brown CLAY with orange patches and grey gleying	30					
WS2	3.70	Brown CLAY with orange patches and grey gleying	32					
WS2	4.10	Brown CLAY with orange patches and grey gleying	29					
WS2	4.50	Brown CLAY with orange patches and grey gleying	28					
WS3	2.20	Brown CLAY with occasional grey gleying	29	70	28	42	>95	
WS3	2.80	Brown CLAY with occasional grey gleying	31	80	28	52	>95	
WS3	3.10	Brown CLAY with occasional grey gleying	32					
WS3	3.60	Brown CLAY with occasional grey gleying	29					
WS3	4.20	Brown CLAY with occasional grey gleying	33					
WS3	4.80	Brown CLAY with occasional grey gleying	32					
BH1	1.10	Brown CLAY with grey patches	26					

Notes

- Moisture content test: BS 1377:Part 2 [1990] Clause 3.2 [value in brackets = calculated matrix moisture content for comparison with LL and PL]
- Liquid and Plastic Limit: BS 1377:Part 2 [1990] Clauses 4.4, 5.2, 5.3, 5.4 is carried out on fine grained soil matrix
- Percent passing 425 micron sieve is by estimation, by hand* or by wet sieving**
- LOI = Loss on Ignition

Sample examined by OT (Engineer)

Results checked by OT (Engineer)

Certificate date : 02/10/2012

SoilConsultants

Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

Index Property Test Results

Sheet 3 of 3

Sample Location	Depth (m)	Sample Description	Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	Percent Passing [%]	Remarks
BH1	1.60	Brown CLAY with grey patches	27					
BH1	2.70	Brown CLAY with grey patches	29					
BH1	3.50	Brown CLAY with grey patches	28	71	29	42	>95	
BH1	4.60	Brown CLAY with grey patches	29					
BH1	5.50	Brown CLAY with grey patches	28	83	28	55	>95	
BH1	6.60	Brown CLAY with grey patches	30					
BH1	7.50	Brown CLAY with grey patches	30	82	30	52	>95	

Notes

- Moisture content test: BS 1377:Part 2 [1990] Clause 3.2 [value in brackets = calculated matrix moisture content for comparison with LL and PL]
- Liquid and Plastic Limit: BS 1377:Part 2 [1990] Clauses 4.4, 5.2, 5.3, 5.4 is carried out on fine grained soil matrix
- Percent passing 425 micron sieve is by estimation, by hand* or by wet sieving**
- LOI = Loss on Ignition

Sample examined by OT (Engineer)

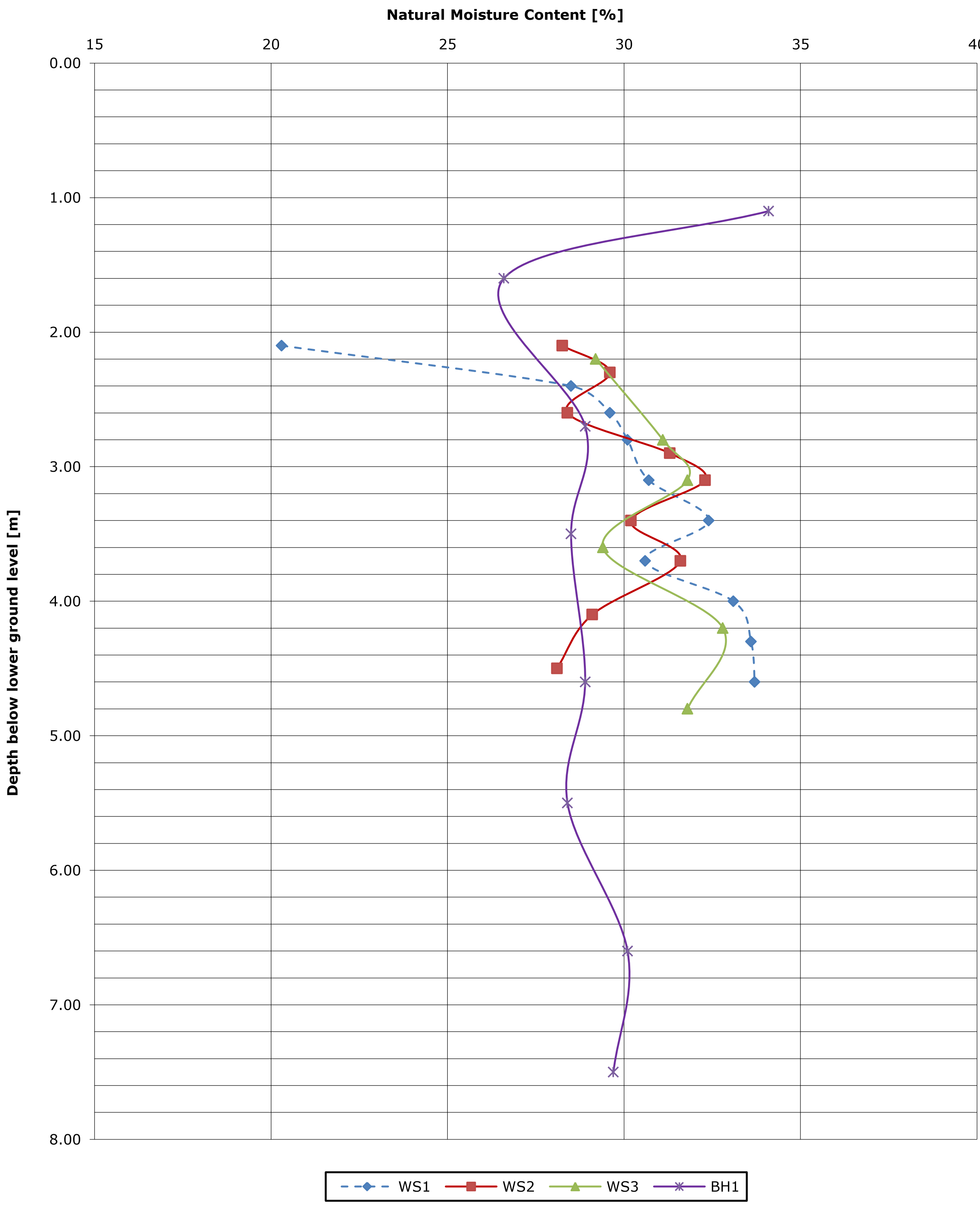
Results checked by OT (Engineer)

Certificate date : 02/10/2012

SoilConsultants

Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

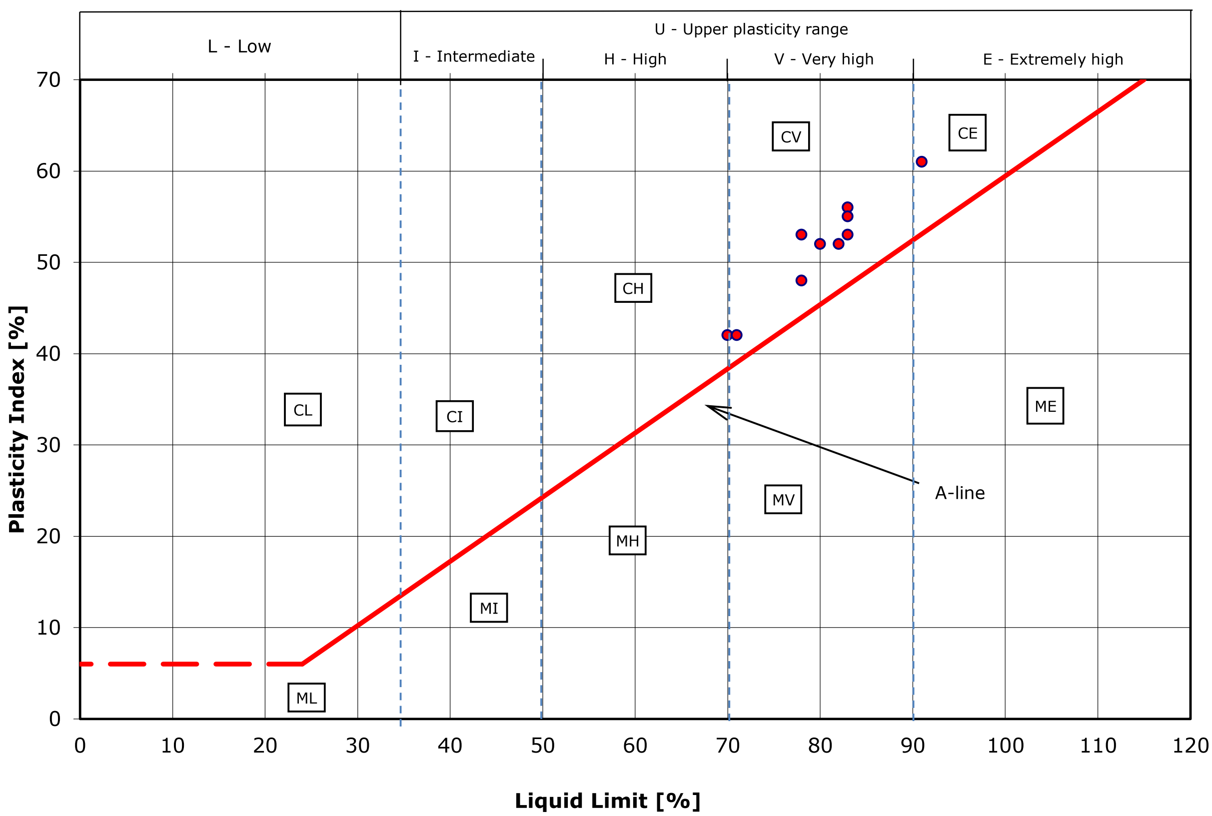
Moisture Content Profile



SCL Chart Generator Ver_1_5_11

Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

PLASTICITY CHART - BS5930 classification



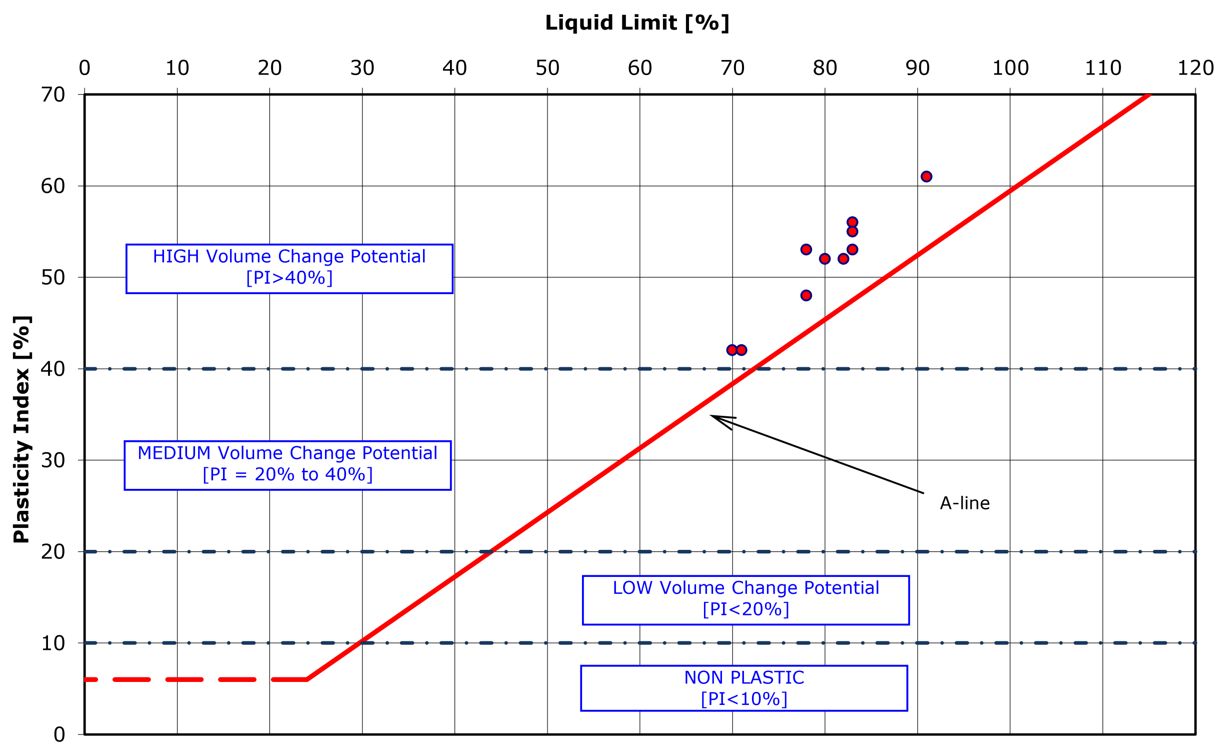
M - Silt [M-soil] plots below the A-line
C - Clay plots above the A-line

Notes:

Classification based upon BS5930:1999 'Code of practice for site investigations'

Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

PLASTICITY CHART - NHBC classification



Notes:

Classification based upon NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

Site Location	Barrie House□ 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

Triaxial Compression Test Result

Sample Location	Depth (m)	Test Type	Cell Pressure [kN/m2]	Comp Strength [kN/m2]	Bulk Density [Mg/m3]	Moisture Content [%]	Cohesion [kN/m2]	Angle of Friction [deg]	Remarks
BH1	1.10	U102	60	51	1.99	34	26	0	

Notes

- Key : 38, 102 = dia in mm, U=Undrained, M= Multistage, MC = Moisture Content, QD = Quick Drained Test

SoilConsultants

K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmund's Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	3.00	3.00	3.00
Date		01/10/2012	01/10/2012	01/10/2012
Disturbed / Undisturbed		undisturbed	undisturbed	undisturbed

Description of Specimen

Brown with blue grey veins CLAY with occasional selenite crystals

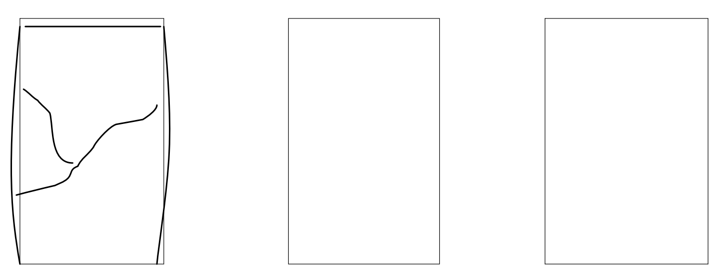
Initial Specimen Conditions

		Specimen 1	Specimen 2	Specimen 3
Height	mm	202.00		
Diameter	mm	105.00		
Area	mm^2	8659.01		
Volume	cm^3	1749.12		
Mass	g	3339.90		
Dry Mass	g	2559.80		
Density	Mg/m^3	1.91		
Dry Density	Mg/m^3	1.46		
Moisture Content	%	30.48		
Degree of Saturation	%	96.54		
Specific Gravity (assumed/measured)		2.72 assumed		

Final Specimen Conditions

		Specimen 1	Specimen 2	Specimen 3
Moisture Content	%			31.00
Density	Mg/m^3			2.02
Dry Density	Mg/m^3			1.54

Sketch of Failure of the Specimen



Specimen 1 Specimen 2 Specimen 3

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Date: 15/10/2012

K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmund's Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	3.00	3.00	3.00
Date		01/10/2012	01/10/2012	01/10/2012

Test Setup

		Specimen 1	Specimen 2	Specimen 3
Date started		20/09/2012		
Date Finished		30/09/2012		
Top Drain Used		y		
Base Drain Used		n		
Side Drains Used		y		
Pressure System Number		1		
Cell Number		1		

Saturation

		Specimen 1	Specimen 2	Specimen 3
Cell Pressure Incr.	kPa	400.00		
Back Pressure Incr.	kPa	390.00		
Differential Pressure	kPa	10.00		
Final Cell Pressure	kPa	400.00		
Final Pore Pressure	kPa	391.00		
Final B Value		0.97		

Consolidation

		Specimen 1	Specimen 2	Specimen 3
Effective Pressure	kPa	30.00	60.00	120.00
Cell Pressure	kPa	430.00	460.00	520.00
Back Pressure	kPa	400.00	400.00	400.00
Excess Pore Pressure	kPa	17.10	34.90	69.70
Pore Pressure at End	kPa	401.20	401.90	401.60
Consolidated Volume	cm^3	1680.52	1657.37	1620.67
Volumetric Strain		0.013073233	0.00459183	0.007381168
Consolidated Height	mm	199.36	193.67	187.67
Consolidated Area	mm^2	8432.61	8558.26	8636.70
Vol. Compressibility	m^2/MN	2.46665	0.41744	0.32516
Consolidation Coef.	$m^2/yr.$			

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Date: 15/10/2012

K4 Soils Laboratory

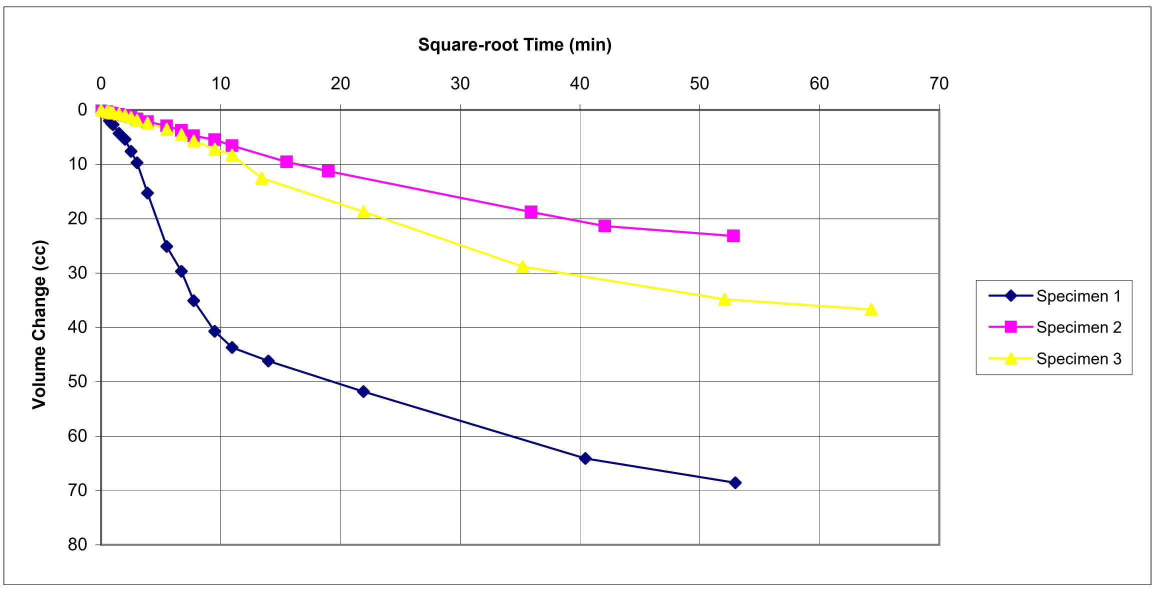
Consolidated Undrained Triaxial Compression Test

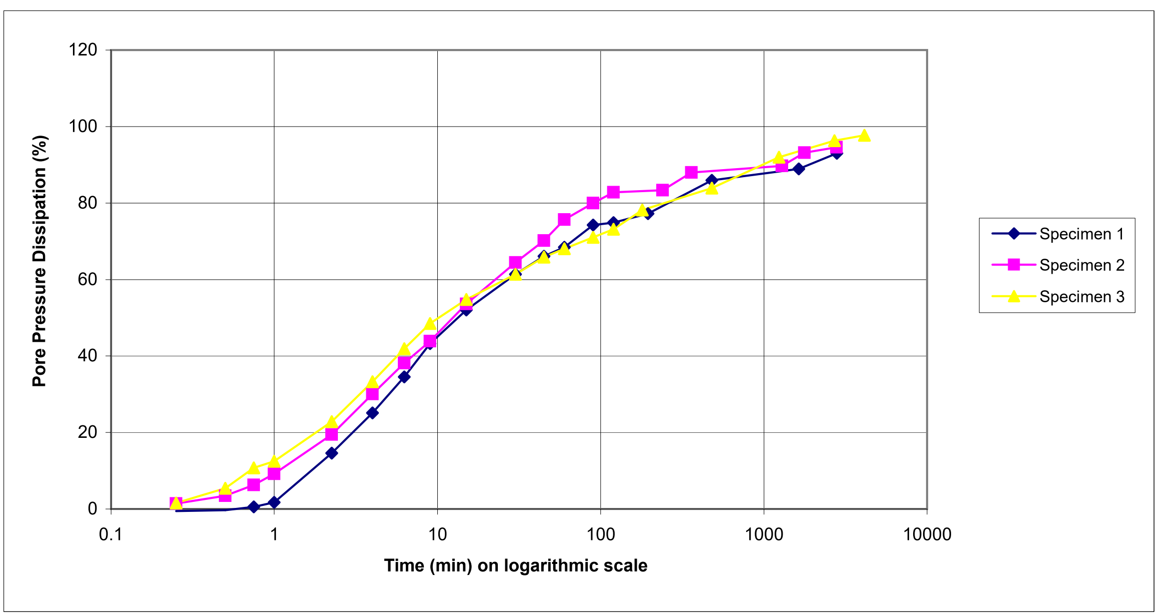
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmund's Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	3.00	3.00	3.00
Date		01/10/2012	01/10/2012	01/10/2012

Consolidation Stage





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K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

		Specimen 1	Specimen 2	Specimen 3
Specimen Details				
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmund's Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	3.00	3.00	3.00
Date		01/10/2012	01/10/2012	01/10/2012

Shearing				
Initial Cell Pressure	kPa	430	460	520
Initial Pore Pressure	kPa	401	401	401.1
Rate of Strain	%/hour	0.594059406	0.61677883	0.634699585
Max Deviator Stress				
Axial Strain		2.247	2.231	5.536
Axial Stress	kPa	54.21	77.46	133.70
Cor. Deviator stress	kPa	53.51	76.73	132.94
Effective Major Stress	kPa	68.11	107.83	201.94
Effective Minor Stress	kPa	14.40	30.90	68.80
Effective Stress Ratio		4.730	3.490	2.935
s'	kPa	41.26	69.37	135.37
t'	kPa	26.86	38.47	66.57
Shear Resistance Angle	degs	25.00	25.00	25.00
Cohesion c'	kPa	10.21	10.21	10.21
Max Effective Priciple Stress Ratio				
Axial Strain		2.247	2.375	4.710
Axial Stress	kPa	54.21	77.34	133.03
Cor. Deviator stress	kPa	53.51	76.62	132.26
Effective Major Stress	kPa	68.11	107.32	200.46
Effective Minor Stress	kPa	14.40	30.50	68.00
Effective Stress Ratio		4.730	3.519	2.948
s'	kPa	41.26	68.91	134.23
t'	kPa	26.86	38.41	66.23

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K4 Soils Laboratory

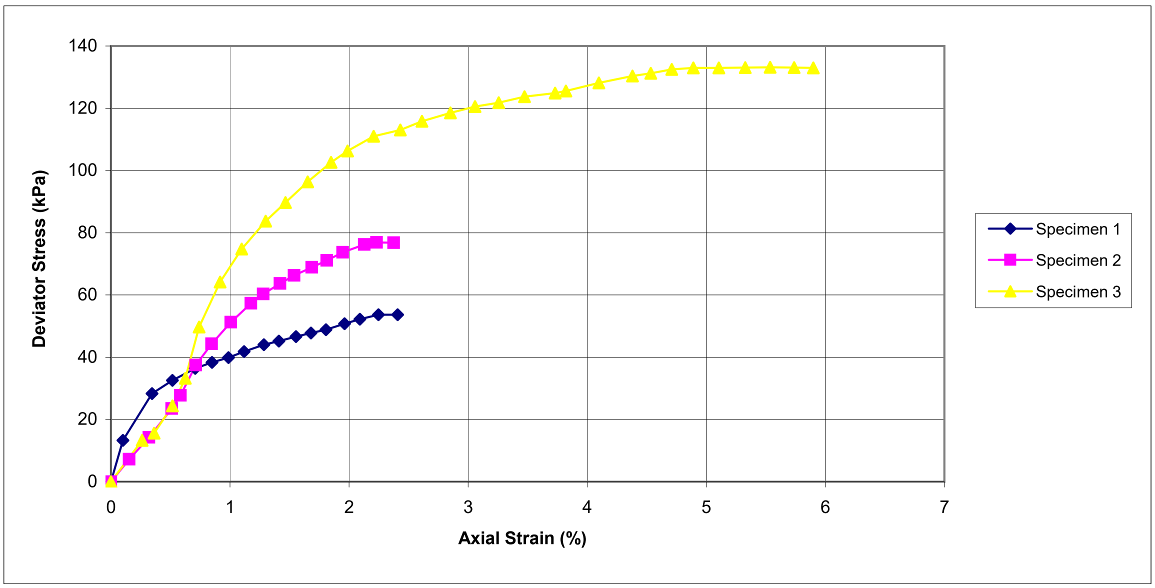
Consolidated Undrained Triaxial Compression Test

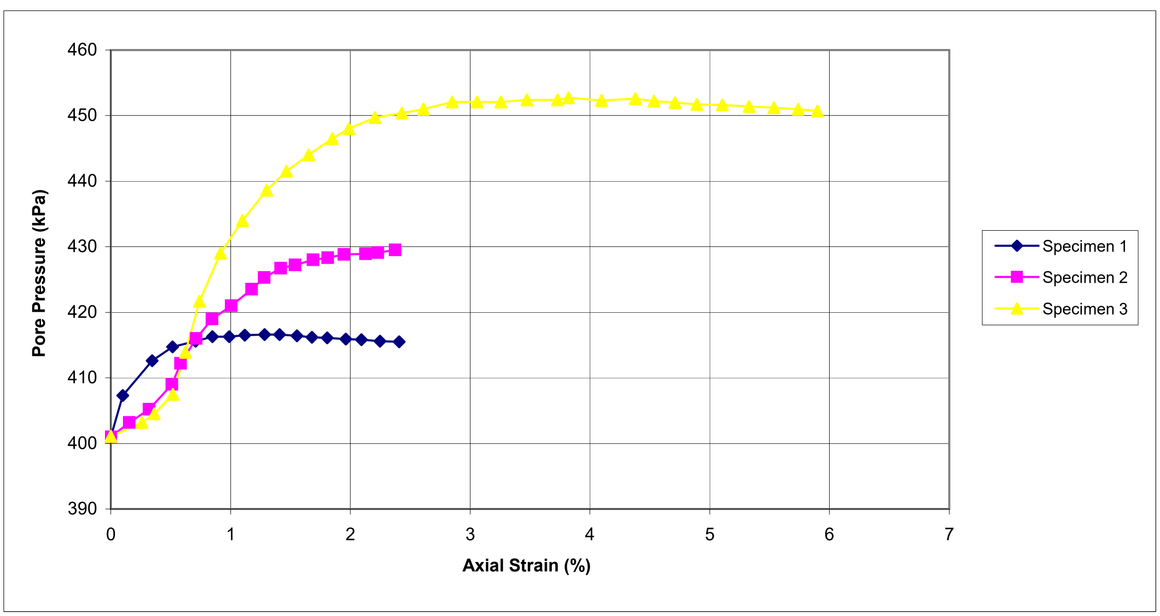
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmund's Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	3.00	3.00	3.00
Date		01/10/2012	01/10/2012	01/10/2012

Shearing Stage





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K4 Soils Laboratory

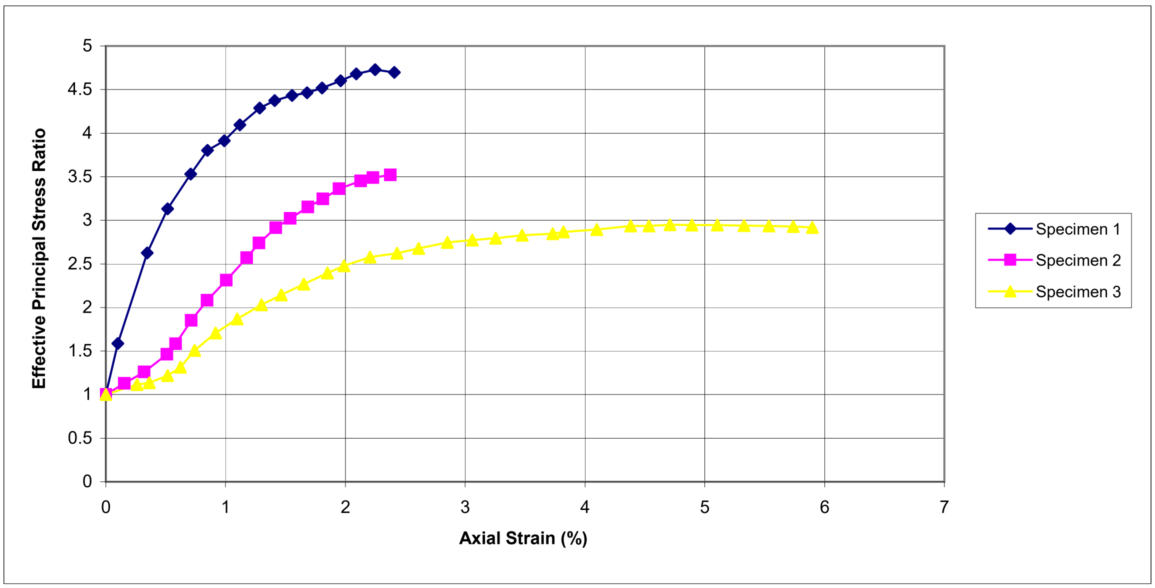
Consolidated Undrained Triaxial Compression Test

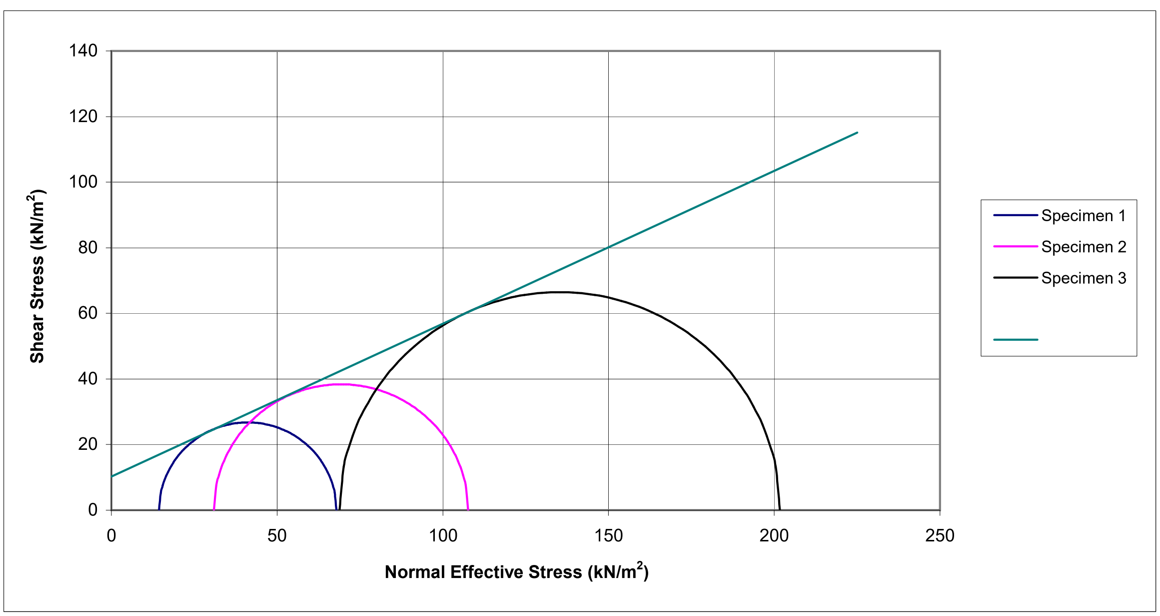
BS 1377 : Part 8 : 1990

Sample Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmund's Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	3.00	3.00	3.00
Date		01/10/2012	01/10/2012	01/10/2012

Shearing Stage





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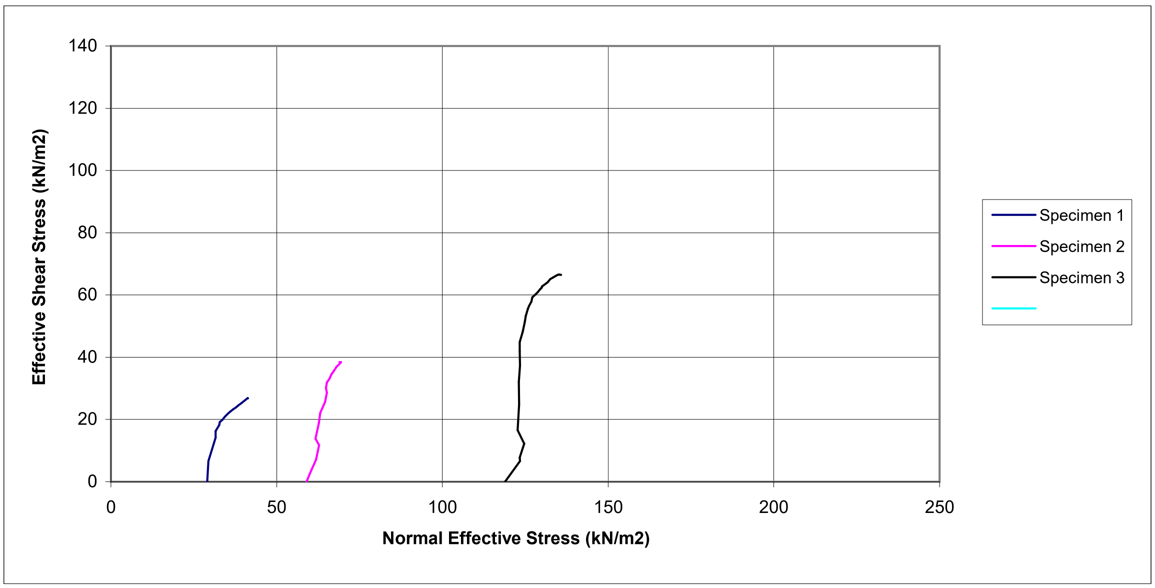
K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Sample Details		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmund's Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	3.00	3.00	3.00
Date		01/10/2012	01/10/2012	01/10/2012

Shearing Stage



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K4 Soils laboratory

Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Edmunds Terrace		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	5.00	5.00	5.00
Date		20/09/2012	20/09/2012	20/09/2012
Disturbed / Undisturbed		undisturbed	undisturbed	undisturbed

Description of Specimen

Brown and blue grey slightly silty CLAY with occasional selenite crystals

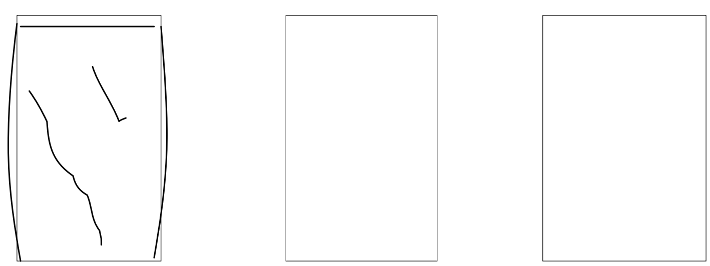
Initial Specimen Conditions

		Specimen 1	Specimen 2	Specimen 3
Height	mm	206.00		
Diameter	mm	105.00		
Area	mm^2	8659.01		
Volume	cm^3	1783.76		
Mass	g	3360.70		
Dry Mass	g	2554.50		
Density	Mg/m^3	1.88		
Dry Density	Mg/m^3	1.43		
Moisture Content	%	31.56		
Degree of Saturation	%	95.45		
Specific Gravity		2.72		
(assumed/measured)		assumed		

Final Specimen Conditions

		Specimen 1	Specimen 2	Specimen 3
Moisture Content	%			32.00
Density	Mg/m^3			1.96
Dry Density	Mg/m^3			1.49

Sketch of Failure of the Specimen



Specimen 1 Specimen 2 Specimen 3

Date: Date:

Checked by: Approved by:

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Date: 19/10/2012

K4 Soils laboratory

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Edmunds Terrace		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	5.00	5.00	5.00
Date		20/09/2012	20/09/2012	20/09/2012

Test Setup

	Specimen 1	Specimen 2	Specimen 3
Date started	20/09/2012	20/09/2012	20/09/2012
Date Finished	18/10/2012	18/10/2012	18/10/2012
Top Drain Used	y	y	y
Base Drain Used	n	n	n
Side Drains Used	y	y	y
Pressure System Number	1	1	1
Cell Number	1	1	1

Saturation

		Specimen 1	Specimen 2	Specimen 3
Cell Pressure Incr.	kPa	500.00		
Back Pressure Incr.	kPa	0.00		
Differential Pressure	kPa	500.00		
Final Cell Pressure	kPa	500.00		
Final Pore Pressure	kPa	485.20		
Final B Value		0.97		

Consolidation

		Specimen 1	Specimen 2	Specimen 3
Effective Pressure	kPa	50.00	100.00	200.00
Cell Pressure	kPa	350.00	400.00	500.00
Back Pressure	kPa	300.00	300.00	300.00
Excess Pore Pressure	kPa	30.70	45.80	88.65
Pore Pressure at End	kPa	292.40	299.40	300.30
Consolidated Volume	cm^3	1754.06	1718.26	1683.41
Volumetric Strain		0.005550083	0.006803276	0.006760727
Consolidated Height	mm	204.86	200.36	196.00
Consolidated Area	mm^2	8562.90	8576.48	8589.61
Vol. Compressibility	m^2/MN	0.43473	0.43987	0.22957
Consolidation Coef.	m^2/yr.			

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Date: 19/10/2012

K4 Soils laboratory

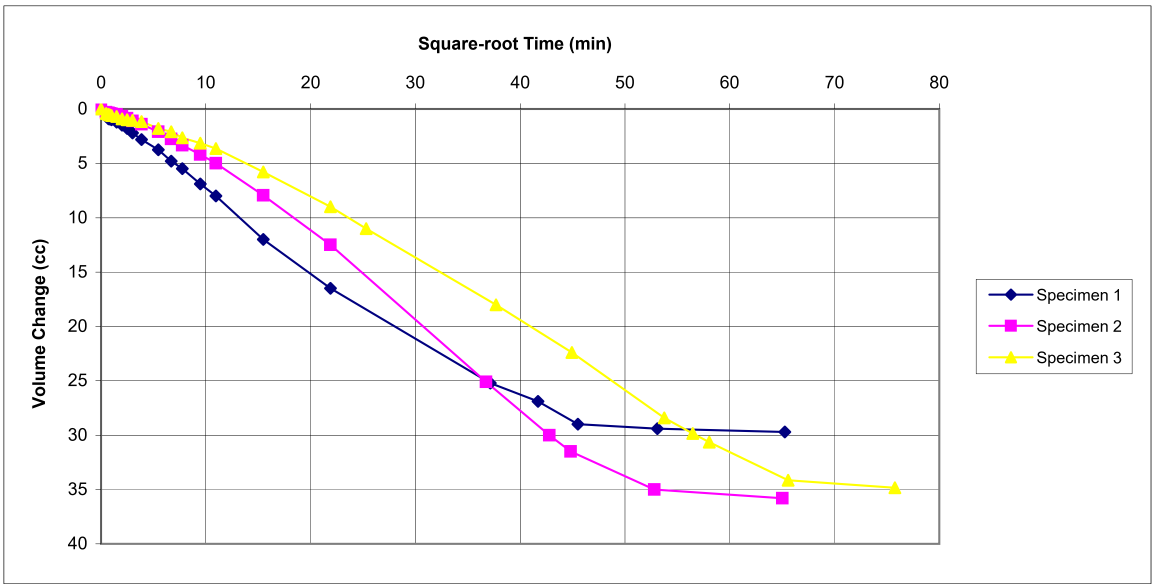
Consolidated Undrained Triaxial Compression Test

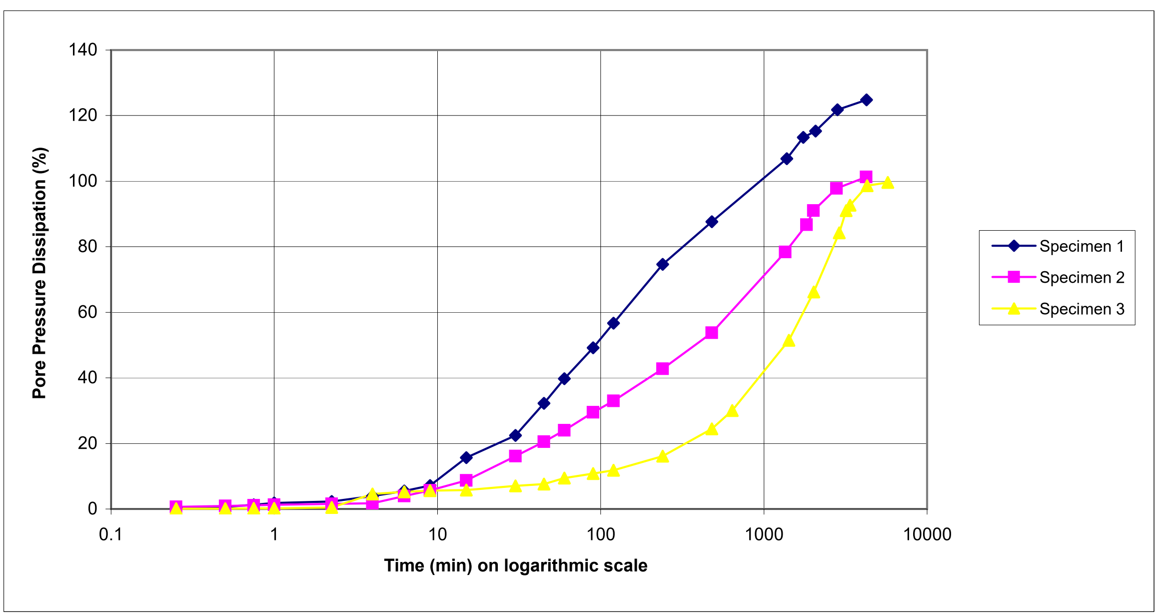
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Edmunds Terrace		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	5.00	5.00	5.00
Date		20/09/2012	20/09/2012	20/09/2012

Consolidation Stage





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Filename: Date: 19/10/2012

K4 Soils laboratory

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

		Specimen 1	Specimen 2	Specimen 3
Specimen Details				
Job Ref.		13381		
Job Location		Edmunds Terrace		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	5.00	5.00	5.00
Date		20/09/2012	20/09/2012	20/09/2012

		Specimen 1	Specimen 2	Specimen 3
Shearing				
Initial Cell Pressure	kPa	350	400	500
Initial Pore Pressure	kPa	292	288.8	299.4
Rate of Strain	%/hour	0.349514563	0.356900882	0.364863239
Max Deviator Stress				
Axial Strain		1.328	1.512	2.781
Axial Stress	kPa	48.49	69.81	114.54
Cor. Deviator stress	kPa	47.89	69.15	113.78
Effective Major Stress	kPa	85.69	149.25	243.68
Effective Minor Stress	kPa	37.60	79.90	129.70
Effective Stress Ratio		2.279	1.868	1.879
s'	kPa	61.65	114.57	186.69
t'	kPa	24.05	34.67	56.99
Shear Resistance Angle	degs	18.00	18.00	18.00
Cohesion c'	kPa	0.00	0.00	0.00
Max Effective Priciple Stress Ratio				
Axial Strain		1.328	1.512	2.602
Axial Stress	kPa	48.49	69.81	114.37
Cor. Deviator stress	kPa	47.89	69.15	113.61
Effective Major Stress	kPa	85.69	149.25	243.21
Effective Minor Stress	kPa	37.60	79.90	129.40
Effective Stress Ratio		2.279	1.868	1.880
s'	kPa	61.65	114.57	186.31
t'	kPa	24.05	34.67	56.91

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Approved by:
Date: 19/10/2012

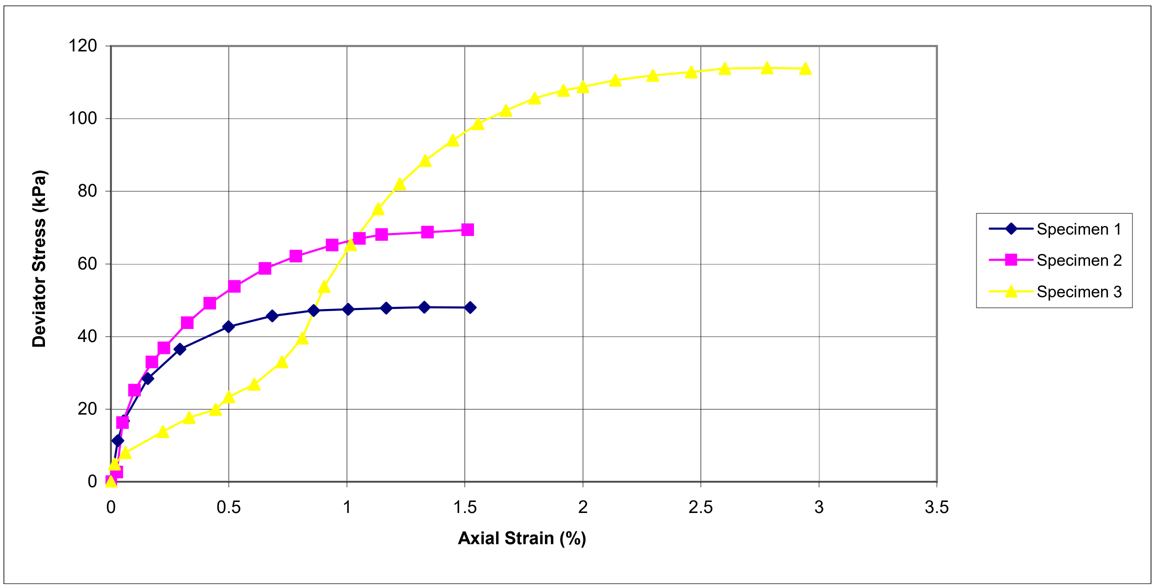
K4 Soils laboratory

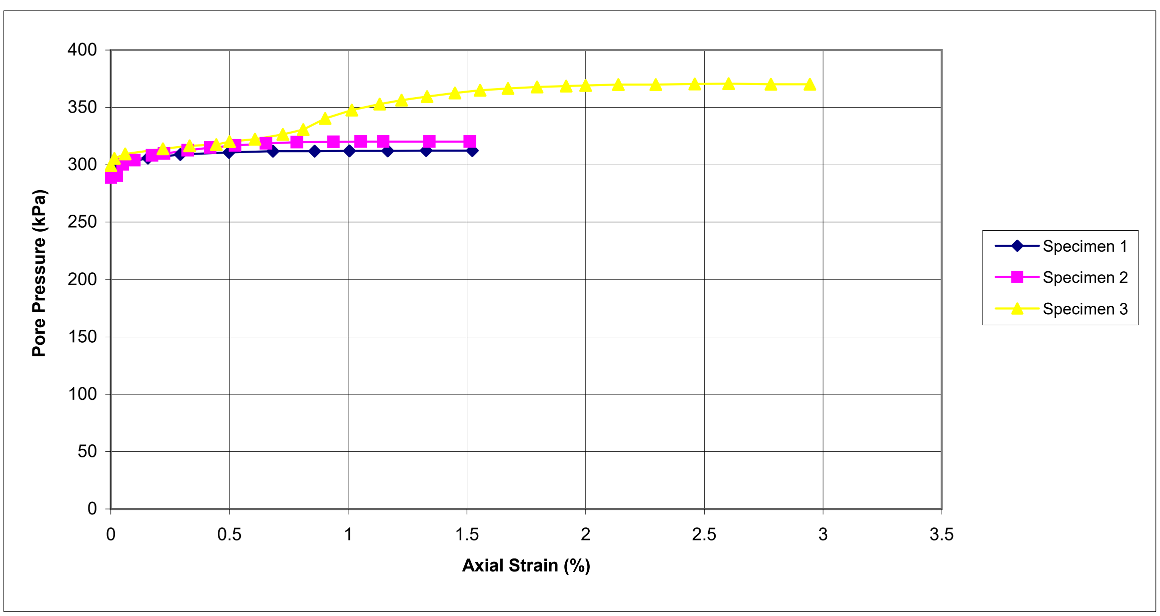
Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Edmunds Terrace		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	5.00	5.00	5.00
Date		20/09/2012	20/09/2012	20/09/2012

Shearing Stage





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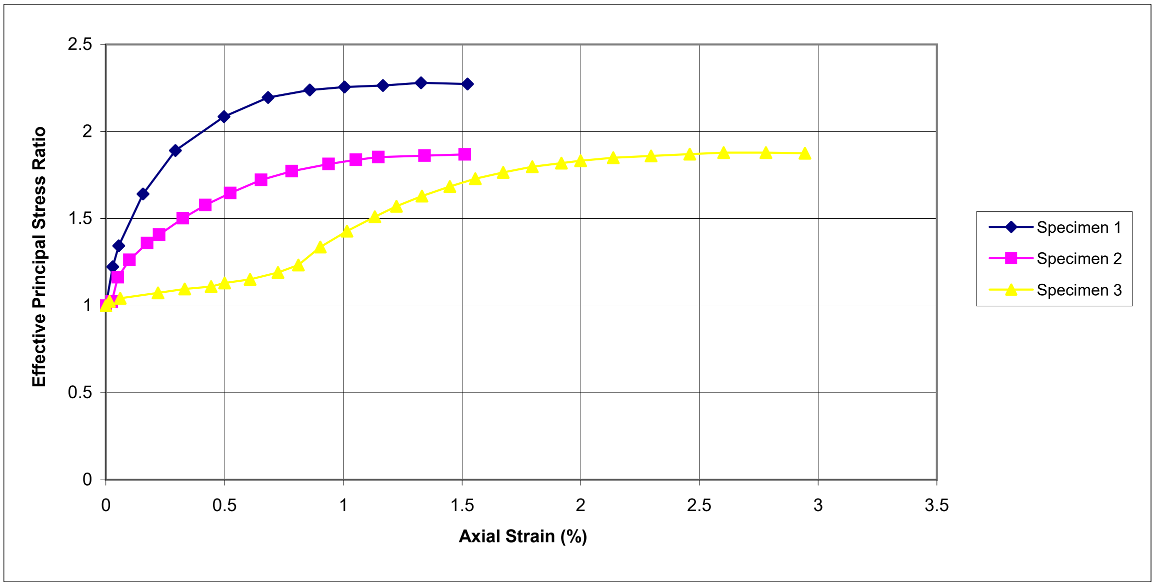
K4 Soils laboratory

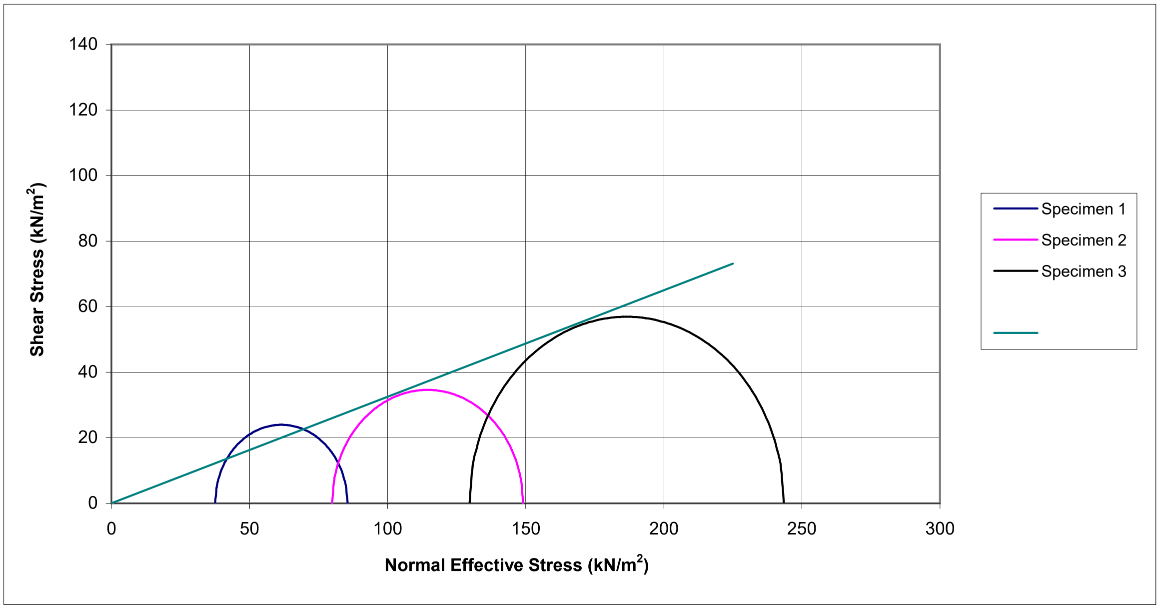
Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Sample Details

	Specimen 1	Specimen 2	Specimen 3
Job Ref.	13381		
Job Location	Edmunds Terrace		
Borehole	BH1	BH1	BH1
Sample No.	U2	U2	U2
Depth m	5.00	5.00	5.00
Date	20/09/2012	20/09/2012	20/09/2012

Shearing Stage





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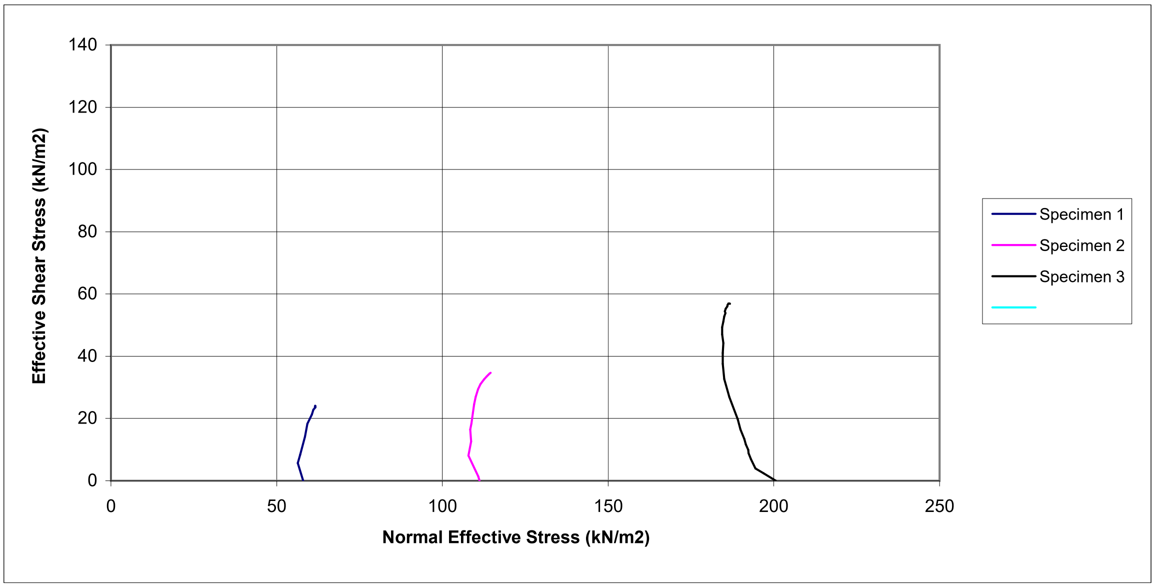
K4 Soils laboratory

Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Sample Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Edmunds Terrace		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	5.00	5.00	5.00
Date		20/09/2012	20/09/2012	20/09/2012

Shearing Stage



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Date: 19/10/2012

K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmunds Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	7.00	7.00	7.00
Date		21/09/2012	21/09/2012	21/09/2012
Disturbed / Undisturbed		undisturbed	undisturbed	undisturbed

Description of Specimen

Brown CLAY with selenite crystals

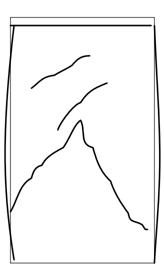
Initial Specimen Conditions

		Specimen 1	Specimen 2	Specimen 3
Height	mm	206.00		
Diameter	mm	105.00		
Area	mm^2	8659.01		
Volume	cm^3	1783.76		
Mass	g	3433.90		
Dry Mass	g	2666.71		
Density	Mg/m^3	1.93		
Dry Density	Mg/m^3	1.49		
Moisture Content	%	28.77		
Degree of Saturation	%	95.50		
Specific Gravity (assumed/measured)		2.72 assumed		

Final Specimen Conditions

		Specimen 1	Specimen 2	Specimen 3
Moisture Content	%			28.68
Density	Mg/m^3			2.00
Dry Density	Mg/m^3			1.55

Sketch of Failure of the Specimen



Specimen 1 Specimen 2 Specimen 3

Date: Date:

Checked by: Approved by:

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Date: 15/10/2012

K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Date: Date: Checked by: Approved by: Y:\2012\CLIENTS\Soils Consultants\13381\[13381bh1at700.xls]Report 15/10/2012 Filename: Date:

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmunds Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	7.00	7.00	7.00
Date		21/09/2012	21/09/2012	21/09/2012

Test Setup

		Specimen 1	Specimen 2	Specimen 3
Date started		21/09/2012		
Date Finished		10/10/2012		
Top Drain Used		y		
Base Drain Used		n		
Side Drains Used		y		
Pressure System Number		1		
Cell Number		1		

Saturation

		Specimen 1	Specimen 2	Specimen 3
Cell Pressure Incr.	kPa	400.00		
Back Pressure Incr.	kPa	0.00		
Differential Pressure	kPa	400.00		
Final Cell Pressure	kPa	400.00		
Final Pore Pressure	kPa	383.60		
Final B Value		0.96		

Consolidation

		Specimen 1	Specimen 2	Specimen 3
Effective Pressure	kPa	70.00	140.00	280.00
Cell Pressure	kPa	370.00	440.00	580.00
Back Pressure	kPa	300.00	300.00	300.00
Excess Pore Pressure	kPa	46.20	79.80	158.30
Pore Pressure at End	kPa	300.20	301.90	312.00
Consolidated Volume	cm^3	1752.76	1717.46	1678.06
Volumetric Strain		0.005793016	0.006713233	0.007646965
Consolidated Height	mm	204.81	196.72	188.45
Consolidated Area	mm^2	8558.69	8731.40	8905.36
Vol. Compressibility	m^2/MN	0.37781	0.25853	0.15681
Consolidation Coef.	$m^2/yr.$			

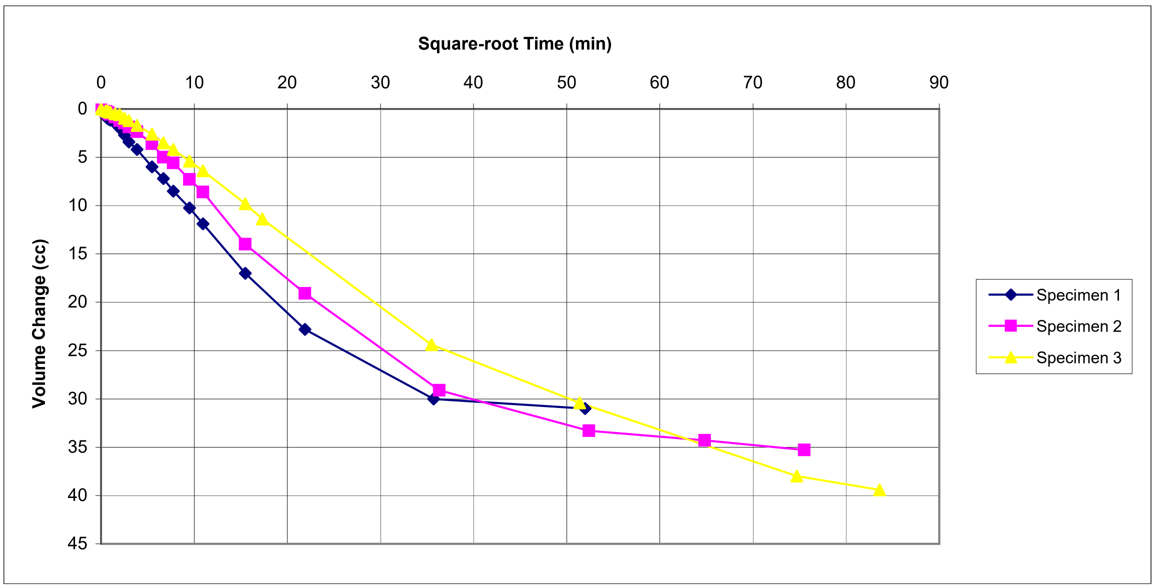
K4 Soils Laboratory

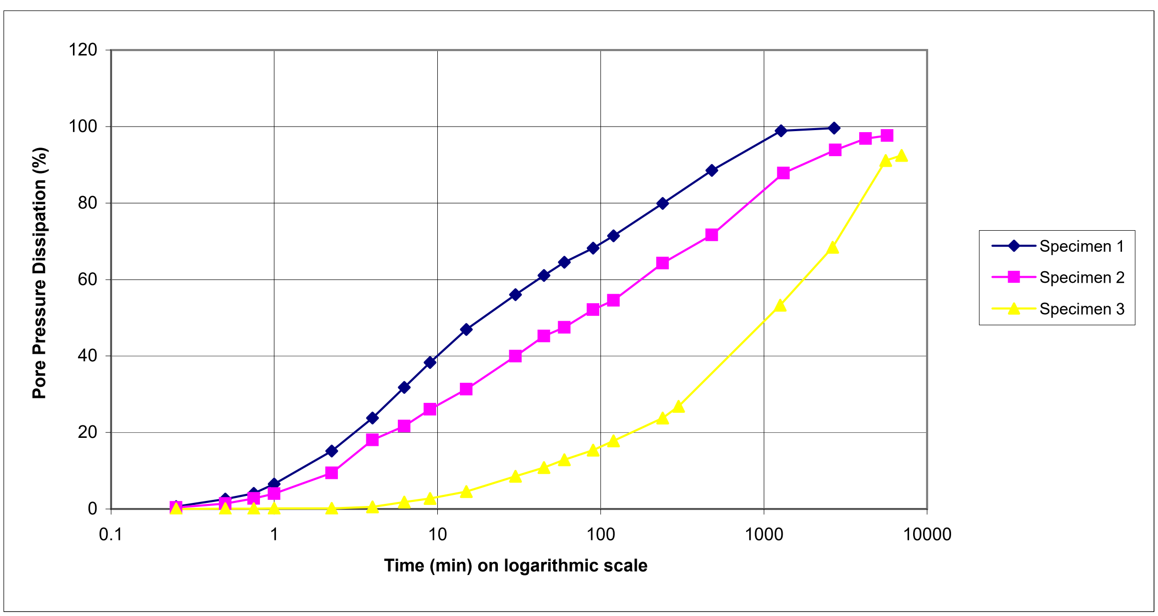
Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmunds Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	7.00	7.00	7.00
Date		21/09/2012	21/09/2012	21/09/2012

Consolidation Stage





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K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

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Filename: Y:\2012\CLIENTS\Soils Consultants\13381\[13381bh1at700.xls]Report
Date: 15/10/2012

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmunds Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	7.00	7.00	7.00
Date		21/09/2012	21/09/2012	21/09/2012

Shearing

		Specimen 1	Specimen 2	Specimen 3
Initial Cell Pressure	kPa	370	440	580
Initial Pore Pressure	kPa	300.2	301.5	300.5
Rate of Strain	%/hour	0.582524272	0.605917883	0.631887889
Max Deviator Stress				
Axial Strain		3.301	3.462	3.667
Axial Stress	kPa	83.90	135.60	229.71
Cor. Deviator stress	kPa	83.28	134.91	228.89
Effective Major Stress	kPa	121.18	213.51	395.39
Effective Minor Stress	kPa	37.70	78.40	166.30
Effective Stress Ratio		3.214	2.723	2.378
s'	kPa	79.44	145.96	280.84
t'	kPa	41.74	67.56	114.54
Shear Resistance Angle	degs	21.07	21.07	21.07
Cohesion c'	kPa	14.87	14.87	14.87
Max Effective Priciple Stress Ratio				
Axial Strain		3.301	3.020	3.667
Axial Stress	kPa	83.90	134.72	229.71
Cor. Deviator stress	kPa	83.28	134.04	228.89
Effective Major Stress	kPa	121.18	211.44	395.39
Effective Minor Stress	kPa	37.70	77.20	166.30
Effective Stress Ratio		3.214	2.739	2.378
s'	kPa	79.44	144.32	280.84
t'	kPa	41.74	67.12	114.54

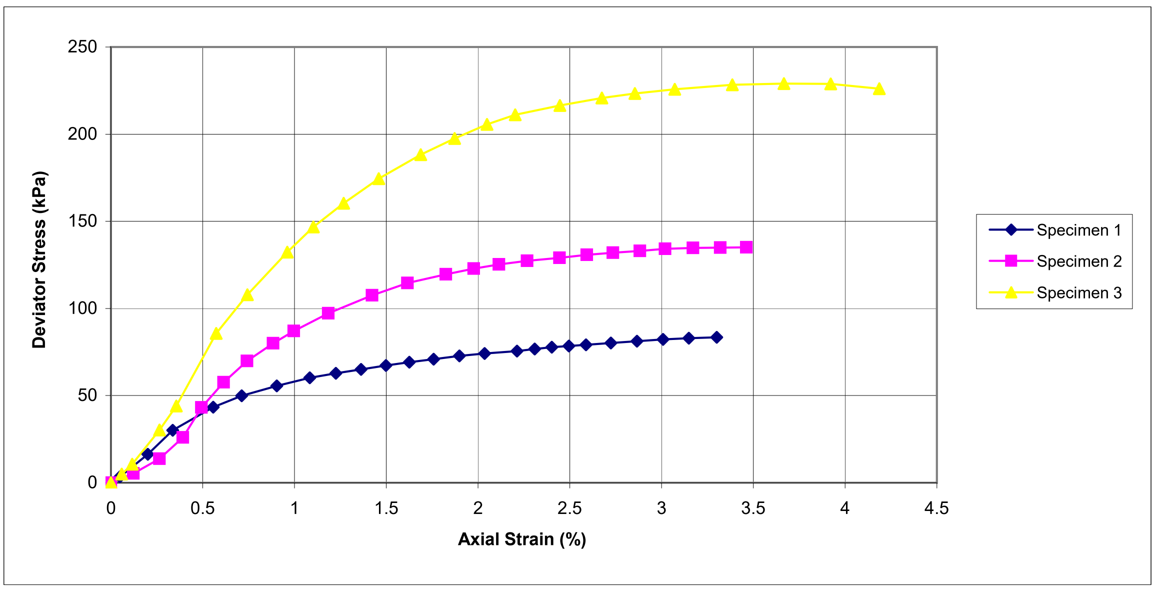
K4 Soils Laboratory

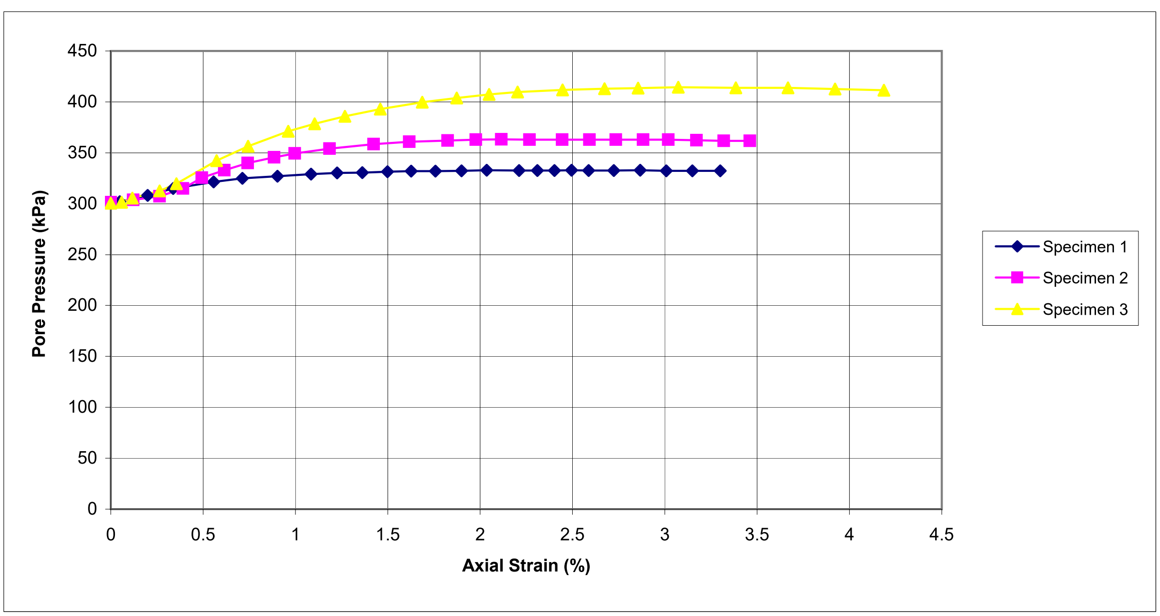
Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Specimen Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmunds Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	7.00	7.00	7.00
Date		21/09/2012	21/09/2012	21/09/2012

Shearing Stage





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Checked by:
Date:
Approved by:
Date:

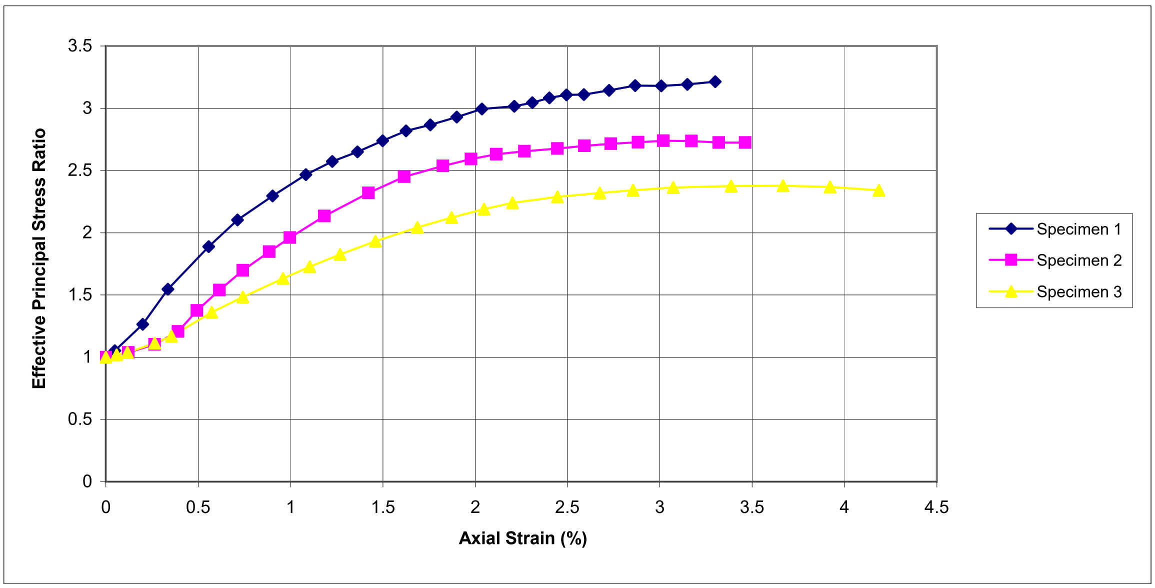
K4 Soils Laboratory

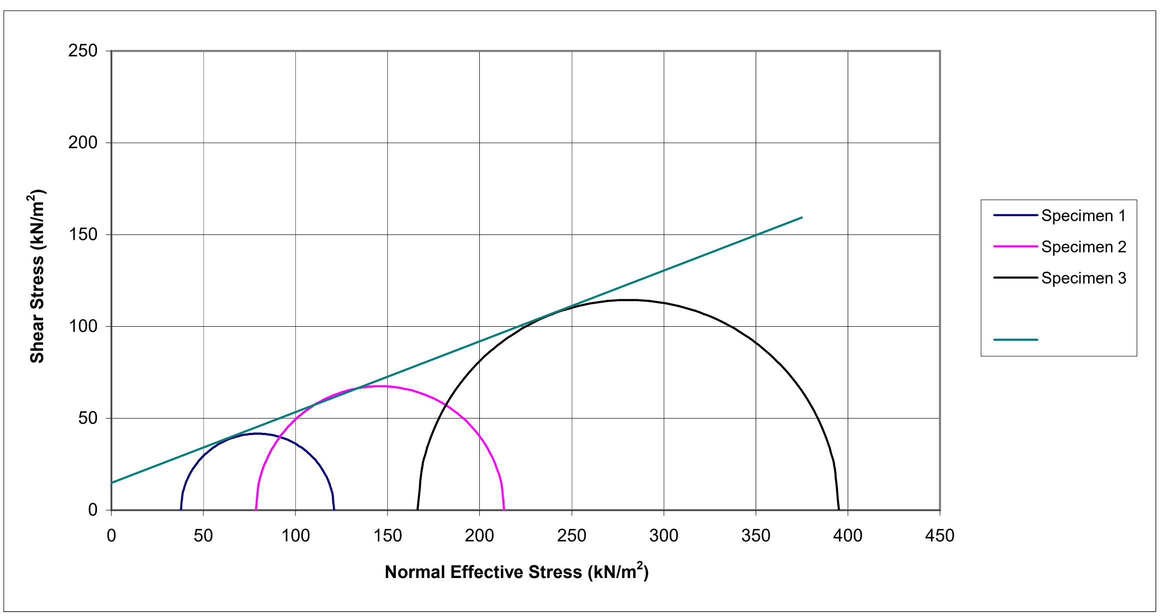
Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Sample Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmunds Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	7.00	7.00	7.00
Date		21/09/2012	21/09/2012	21/09/2012

Shearing Stage





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Date: 15/10/2012

Approved by: Date:

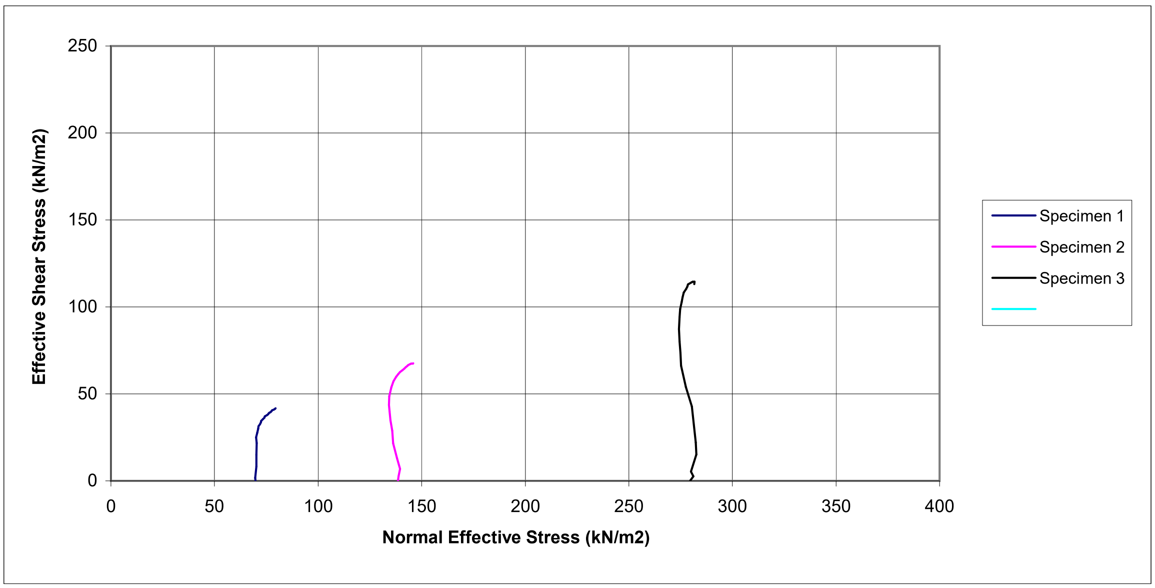
K4 Soils Laboratory

Consolidated Undrained Triaxial Compression Test
BS 1377 : Part 8 : 1990

Sample Details

		Specimen 1	Specimen 2	Specimen 3
Job Ref.		13381		
Job Location		Barrie House, 29 St Edmunds Terrace, London, NW8 7QH		
Borehole		BH1	BH1	BH1
Sample No.		U2	U2	U2
Depth	m	7.00	7.00	7.00
Date		21/09/2012	21/09/2012	21/09/2012

Shearing Stage



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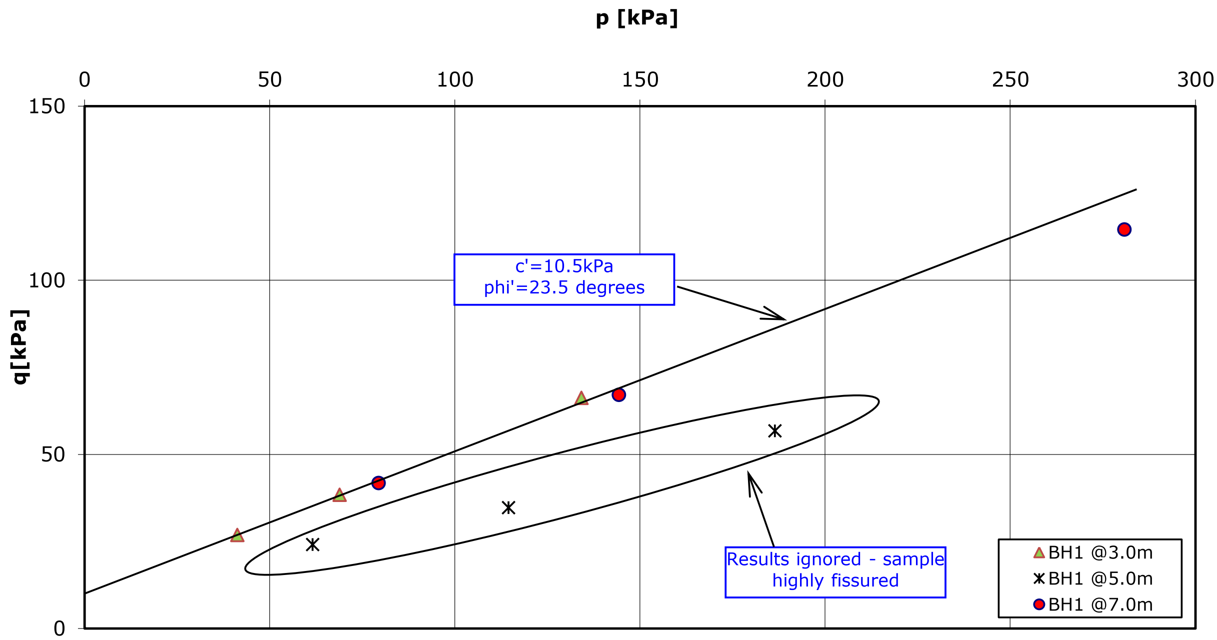
Date: 15/10/2012

Site Location	Barrie House 29 St Edmund's Terrace, London NW8 7QH	Report No:	9241/OT

p-q Plot

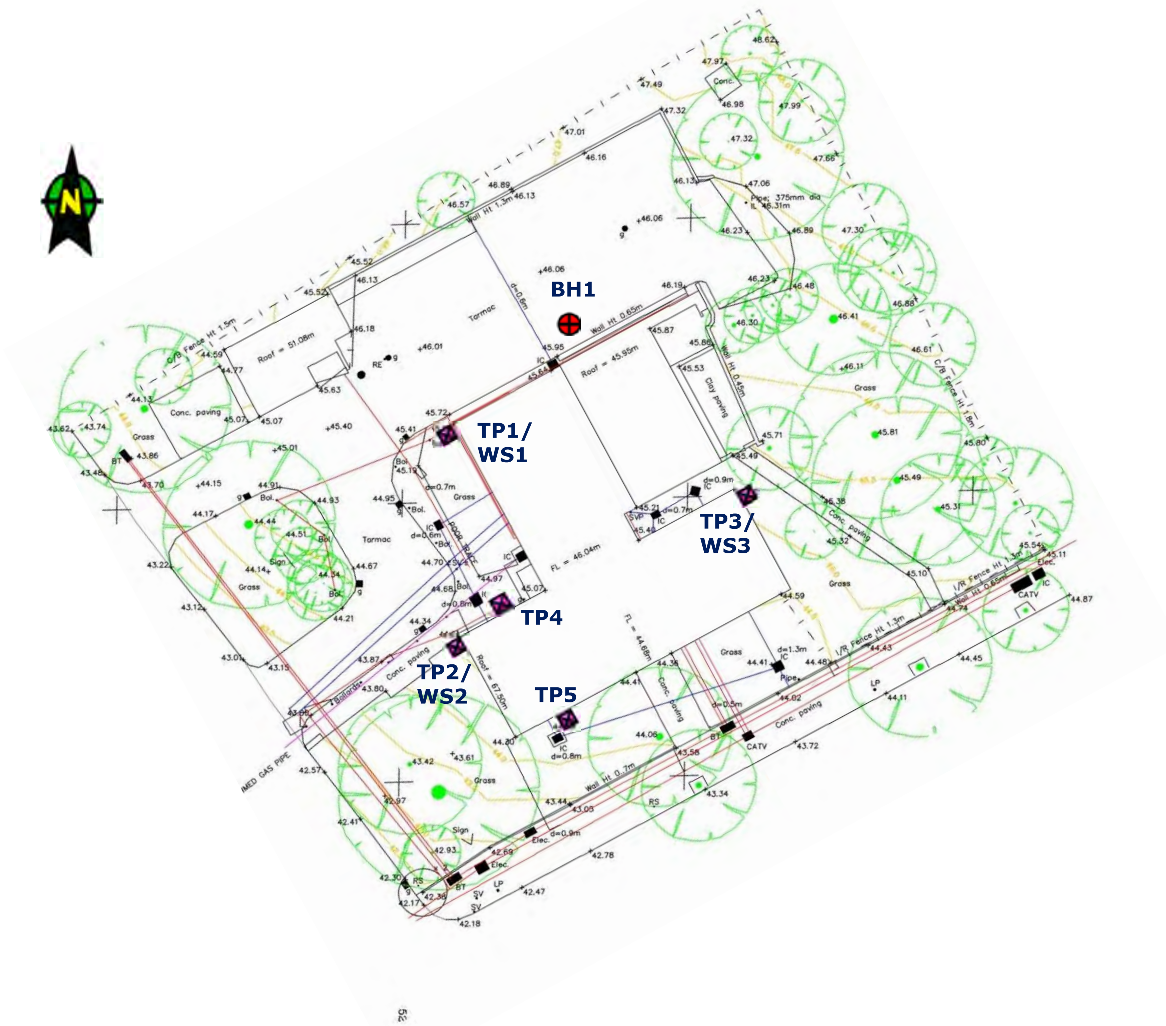


Notes:

Summary of multistage consolidated underained triaxial tests with pore pressure measurement on BH1 samples by K4 Soils Laboratory

Site Location	**Barrie House** **29 St Edmund's Terrace, London NW8 7QH**	Report No	**9241/OT**

Site Plan



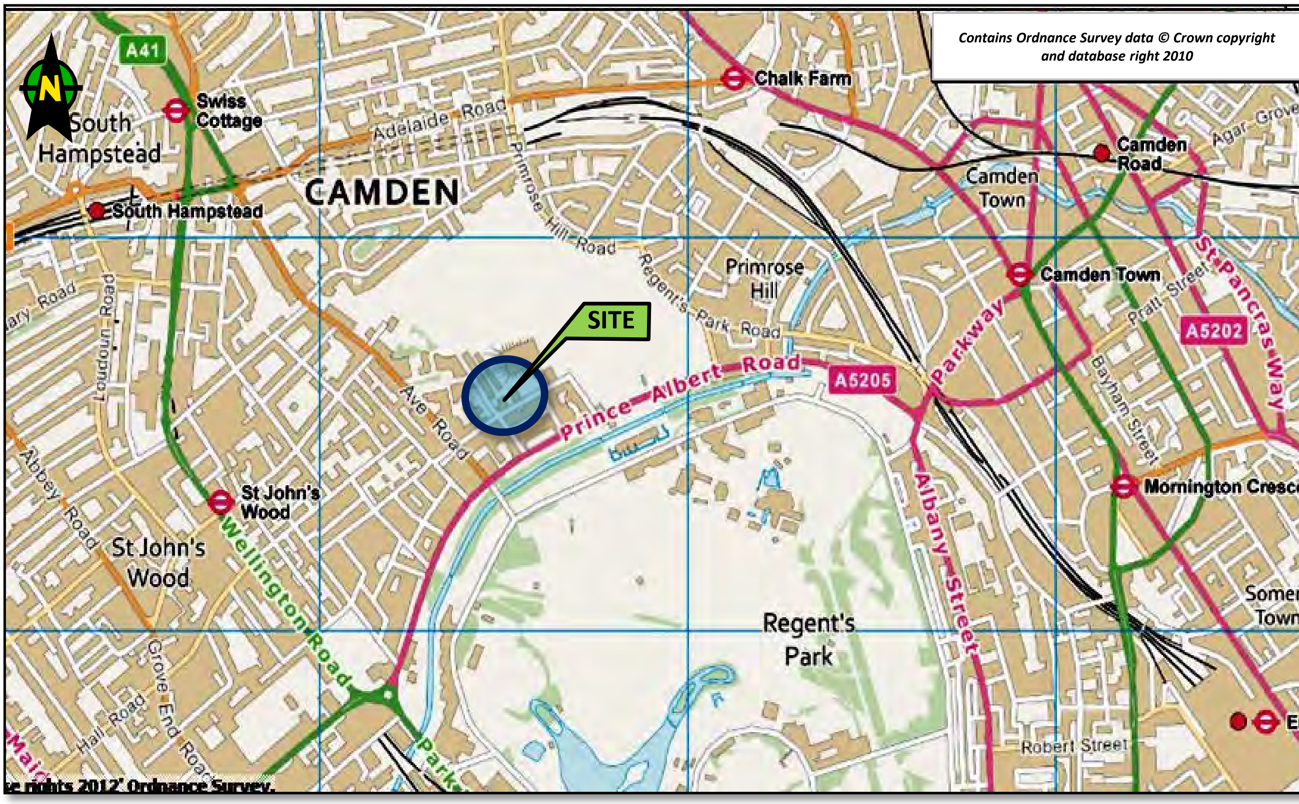
0 20m

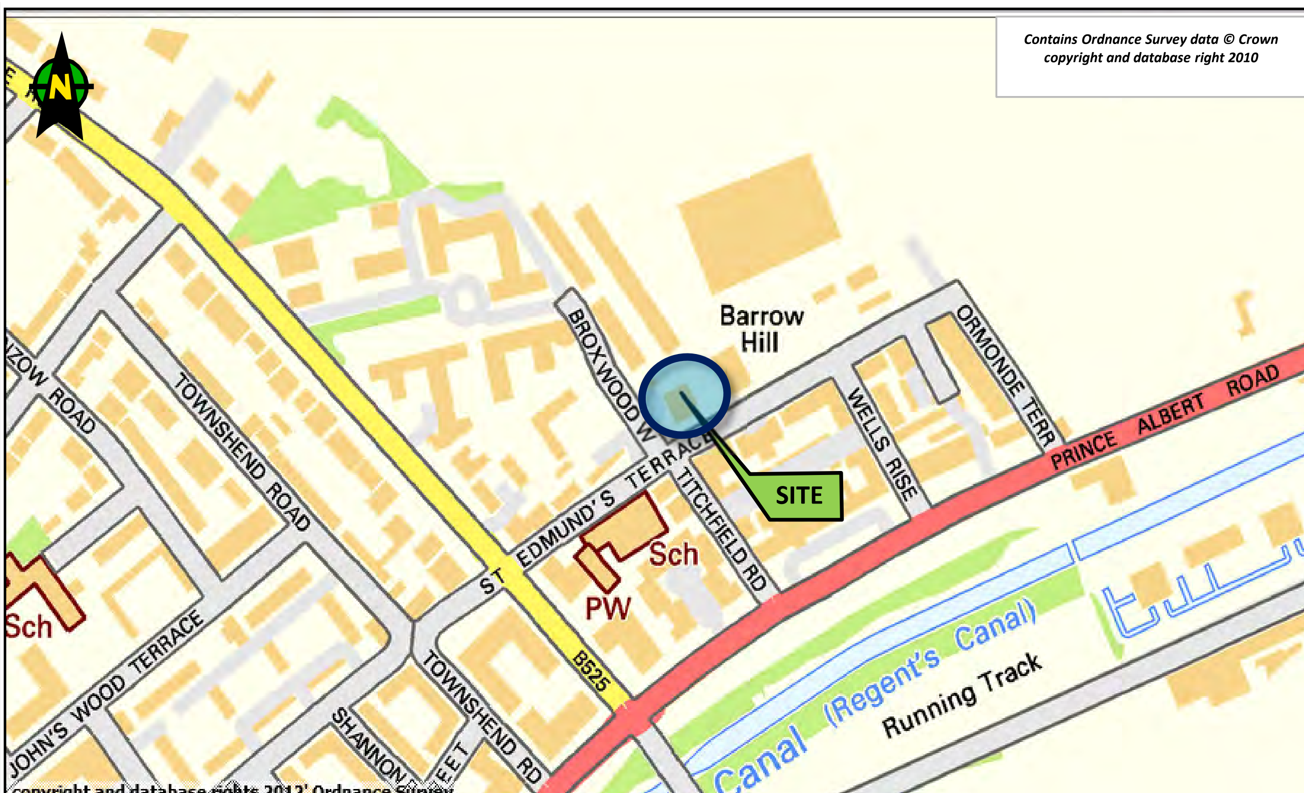
Approx scale 1:500 [@A4]

Soil Consultants

Site Location	**Barrie House** **29 St Edmund's Terrace, London NW8 7QH**	Report No	**9241/OT**

Location Map





Approx NGR of site 527495E, 183575N

Richard Tant Associates
Consulting Civil & Structural Engineers

Broxwood View
(Previously 29 Barrie House)

Appendix 6
Calculations

For

Attanasio d'Aponte
Arbitrage Broxwood Ltd

5295

March 2023

CONTENTS

1.0 General

As part of the redevelopment of a site at Barrie House, 29 St Edmunds Terrace, Camden, London NW8, it is proposed to construct a new four storey residential development including a single level basement. The site is currently occupied by a car park and a two-storey masonry structure.

The site can be located by National Grid Reference TQ27497 83580 and lies off the East side of Broxwood Way, which provides the site access. The southern boundary adjoins the existing Barrie House block, while the Northern boundary adjoins block of flats on Broxwood Wat. The Eastern boundary adjoins the gardens and multi-storey block of number 35 St Edmund's Terrace.

The proposed basement is to be constructed by utilizing a secant and contiguous piled retaining wall around the perimeter of the site except for a small section between grid lines 12 and 15 (refer to Appendix 3 drawing 5295-S02) where a reinforced concrete underpinned wall is proposed. The piled retaining wall will retain the soil pressures and adjacent surcharge loads (including adjacent foundation loads where applicable). The piled wall will be temporarily propped during constriction and permanently propped via the capping beam and ground floor slab. A 200mm thick liner wall is proposed within the basement to retaining water pressures. A raft foundation is proposed to transfer the vertical loads into the ground. These calculations justify the design of the elements above.

These calculations are not to be relied on by any third party without prior written consent from RTA.

2.0 Design Criteria

2.1 Design Life
The design life of the building is to be 60 years and as such categorized as 'Normal Life' to BS 7543.

2.2 Loading

2.2.1 Dead Loading

The following loads have been assumed for the weight of the structure / finishes and facades. Loads have also been provided for the CLT superstructure, refer to Appendix 3.

Element	Description	DL Load press. (kN/m²)	DL Applied UDL (KN/m)
Basement			
	950 Raft	23	
	100 Screed	1.8	
	Finishes	0.5	
	Total	25.3	
Ground Floor			
	325 Slab	7.8	
	100 Screed	1.8	
	Finishes	0.5	
	Ceiling	0.5	
	Total	10.6	
Retaining Wall	200 wall	5	15
Façade	Masonry skin	2.5	7.5
Super Structure	Refer to loads from superstructure designer.		

2.2.2 Imposed Loading

Element	Description	LL Load press. (kN/m²)	Point Load (kN)
Floors	Category A1 (residential)	1.5	2
	Partitions	1	
	Total	2.5	2
Corridors	Category C31 (communal areas in blocks of flats)		
		3	4.5
Stairs	Category C32	3	4
Balconies	Category A5	2.5	2
Super Structure	Refer to loads from superstructure designer.		

2.2.3 Wind Loading
The basic map velocity is 21.5m/s this equates to a peak velocity pressure of 0.728kN/m².

2.2.4 Snow Loading
The superstructure designer has accounted for snow loading in their loadings. Refer to Appendix 3

2.3 Materials
The following structural materials are to be used, Steel grade : S355. Concrete grade C40. Reinforcement fy=500N/mm².

2.4 Durability
Concrete elements will be designed to the recommendations in BS EN 19921-1 Design of Concrete Structures and BS 8500. Concrete mixes specified to suit ‘normal’ structural performance. Where concrete elements are in contact with the ground special consideration has been give to the concrete mix with respect to sulphates.

2.5 Robustness
The design of the building assumes a categorization of building type as Consequence Class 2B Upper Risk Group.
The design of the structure will be to the recommendations made in BS EN 1991-1-7.

2.6 Fire Rating
As informed by the fire statement prepared by Emco, 60mins rating to structural elements.

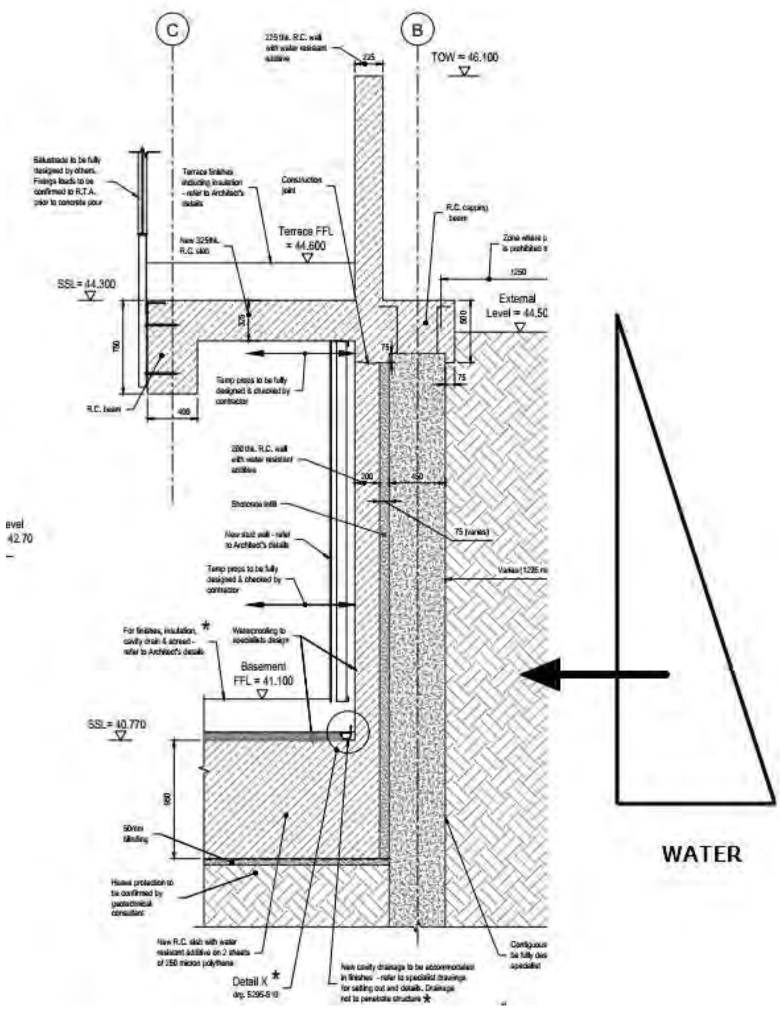
2.7 Design Guides

The following codes of practice and design guides have been used in the assessment of the development to this stage:

Reference	Title
BS648	Weights
BS6399	Loadings
BS7543	Durability
BS8002	Earth Retaining Structure
BS8004	foundations
BS8110	Structural Use of Concrete
BS8500-1:2002	Concrete
BS EN 206-1	Concrete: Specification
BS EN 1991	Loadings

3.0 Retaining Wall

Conservatively the lateral pressure from possible water has been taken assuming a maximum water depth.



Head = 3.4m
Total pressure = 3.4 x 10 x 3.4 x 0.5 = 58kN/m

Propped cantilever
Maximum moment = 26kNm/m (CHAR) = 39kNm/m (ULT)
Maximum shear = 46kN/m (CHAR) = 69kN/m (ULT)

Concrete Design Check to BS8110

Wall Retaining Wall

Job no:	5295
Date:	01/08/2022
By:	DW
Page:	

Design Parameters

Free body diagram		Simply Supported	
Element		Slab/Wall	
Span	L =	3.4	m
Section depth	D =	200	mm
Screed	=	0	mm
Clear cover (tension face)	=	50	mm
Link size	=	0	mm
Bar diameter	ϕ =	16	mm
Concrete strength	F_{cu} =	35	MPa
Steel yield stress	F_y =	500	MPa
Effective depth	d =	142	mm
Breadth	b =	1000	mm

Loading

Uniformly distributed loads			
Self weight	w_{SW} =	0.00	kN/m
Live load	w_{LL} =		kN/m
Additional dead load	w_{DL} =		kN/m
Total UDL (ULT)	w* =		kN/m
Point loads			
Dead point load	P_{DL} =		kN
Live point load	P_{LL} =		kN
Total Point load (ULT)	P* =		kN
Input Point loads (even if 0)			

Bending

Maximum moment	M* =	39.00	kNm
(Calculated or input)			
Compressive capacity	M_u =	110.10	kNm
No compression reinforcement required			
	K =	0.0553	
	K' =		
Lever arm	z =	132.67	mm
Depth to NA	x =		mm
Clear cover (comp face)	=		mm
Comp bar diameter	ϕ' =		mm
Depth to comp steel	d' =		mm
Area defl steel req	$A_{sc\ req}$ =		
Area defl steel provided	$A_{sc\ prov}$ =		mm^2
Area steel required	$A_{st\ req}$ =	675.79	mm^2
Provide B 16	**@**	**150**	**c / c**
Area steel provided	$A_{st\ prov}$ =	1340	mm^2

Shear

Max shear force	V* =	69.00	kN
Shear stress	v =	0.49	MPa
	$100A_s/bd$ =	0.94	
Concrete shear stress	v_c =	0.90	MPa
No shear reinforcement required			
Link spacing	s_v =		mm
Shear steel required	$A_{sv\ req}$ =		mm^2
Shear steel provided	$A_{sv\ prov}$ =		mm^2

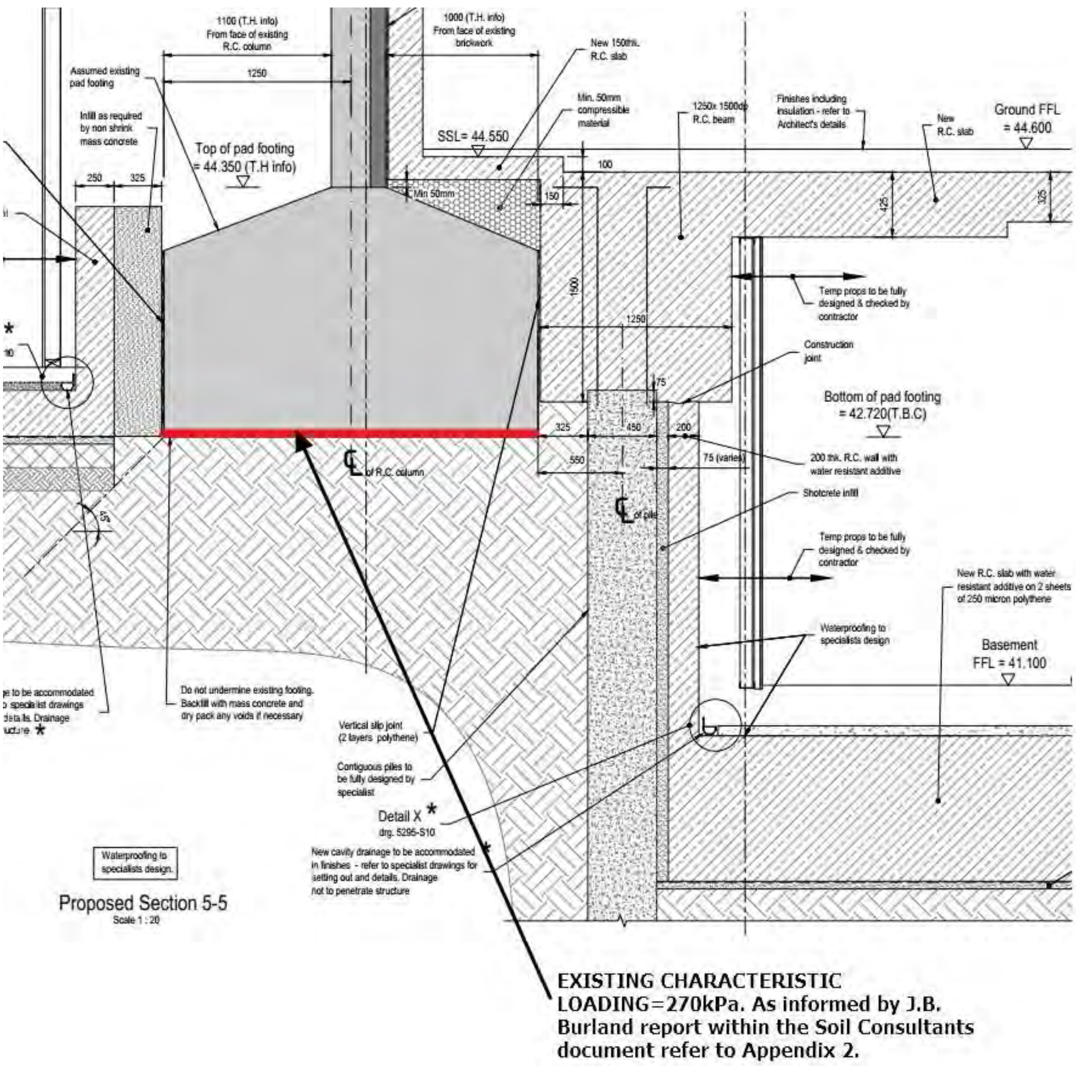
Deflection

Steel stress	f_s =	157.60	MPa
Modification factor	MF =	1.49	
Modification factor	MF' =		
Min effective depth	d_{min} =	114.16	mm
Deflection check OK			

Therefore the 200 thick wall is satisfactory with B16 bars at 150c/c.

4.0 Piled Retaining Wall

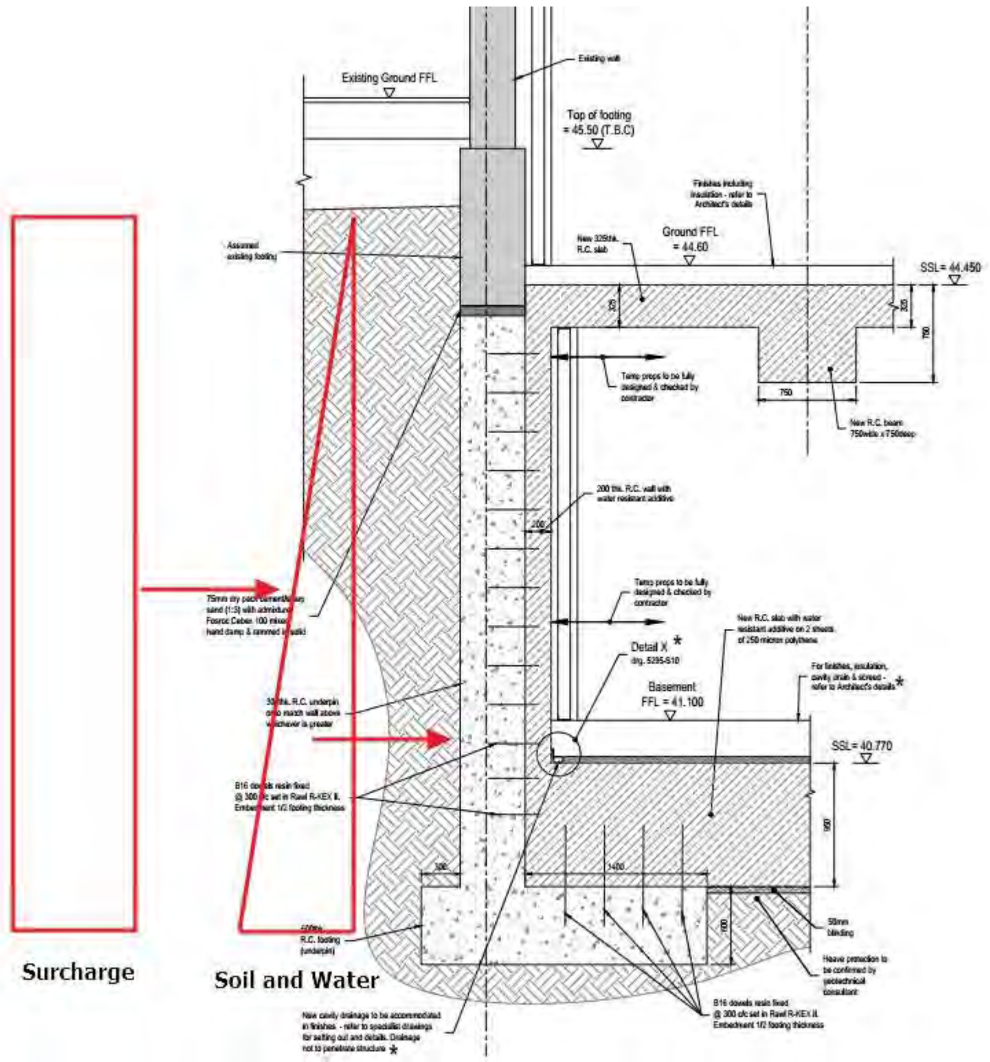
The piled retaining wall will be fully designed by a specialist however for the purposes of this report an assessment has been carried out to justify that a 450mm dia contiguous piled wall is suitable. The most onerous load arrangement has been looked at; adjacent to the existing pad foundations of Barrie House. When the specialist designs the other sections of the wall fire truck loading will be added to the surcharge loads in the relevant areas – refer to Appendix 3 drawing 5295-S02.



Refer to CGL BIA Appendix G for the Pile Design.

5.0 Underpinned Retaining Wall

The underpinning, on grid line F between 12 and 15 is designed to transfer the vertical loads from the single storey building down to the basement level and retain the earth under the adjacent single storey building. The temporary condition is the most onerous before the raft is poured where the wall is spanning 4.5m between the temporary top and bottom lateral props.



Surcharge load: 5kN/m² x Ko = 3kN/m²
Soil load submerged: 10kN/m² x Ko x 4.5m = 27kN/m²
Water Load = 10 x 4.5m = 45kN/m²
Vertical load = 20kN + 55kN(Self) = 75kN/m

Propped:
Maximum Bending = 72kNm/m (CHAR) = 108kNm/m (ULT)
Maximum Shear = 124kN/m (CHAR) = 186kN/m (ULT)

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	Date:	01/08/2022
Underpinning	By:	DW
	Page:	

Design Parameters

Free body diagram		Simply Supported	
Element		Slab/Wall	
Span	L =	4.5	m
Section depth	D =	300	mm
Screed	=	0	mm
Clear cover (tension face)	=	50	mm
Link size	=	0	mm
Bar diameter	ϕ =	20	mm
Concrete strength	F_{cu} =	40	MPa
Steel yield stress	F_y =	500	MPa
Effective depth	d =	240	mm
Breadth	b =	1000	mm

Loading

Uniformly distributed loads			
Self weight	w_{SW} =	75.00	kN/m
Live load	w_{LL} =	0.00	kN/m
Additional dead load	w_{DL} =	0.00	kN/m
Total UDL (ULT)	w* =	105.00	kN/m
Point loads			
Dead point load	P_{DL} =	0.00	kN
Live point load	P_{LL} =	0.00	kN
Total Point load (ULT)	P* =	0.00	kN

Bending

Maximum moment	M* =	108.00	kNm
(Calculated or input)			
Compressive capacity	M_u =	359.42	kNm
No compression reinforcement required			
	K =	0.0469	
	K' =		
Lever arm	z =	226.77	mm
Depth to NA	x =		mm
Clear cover (comp face)	=		mm
Comp bar diameter	ϕ' =		mm
Depth to comp steel	d' =		mm
Area defl steel req	$A_{sc\ req}$ =		
Area defl steel provided	$A_{sc\ prov}$ =		mm^2
Area steel required	$A_{st\ req}$ =	1094.83	mm^2
Provide B 20	**@**	**150**	**c / c**
Area steel provided	$A_{st\ prov}$ =	2090	mm^2

Shear

Max shear force	V* =	186.00	kN
Shear stress	v =	0.78	MPa
	$100A_s/bd$ =	0.87	
Concrete shear stress	v_c =	0.80	MPa
No shear reinforcement required			
Link spacing	s_v =		mm
Shear steel required	$A_{sv\ req}$ =		mm^2
Shear steel provided	$A_{sv\ prov}$ =		mm^2

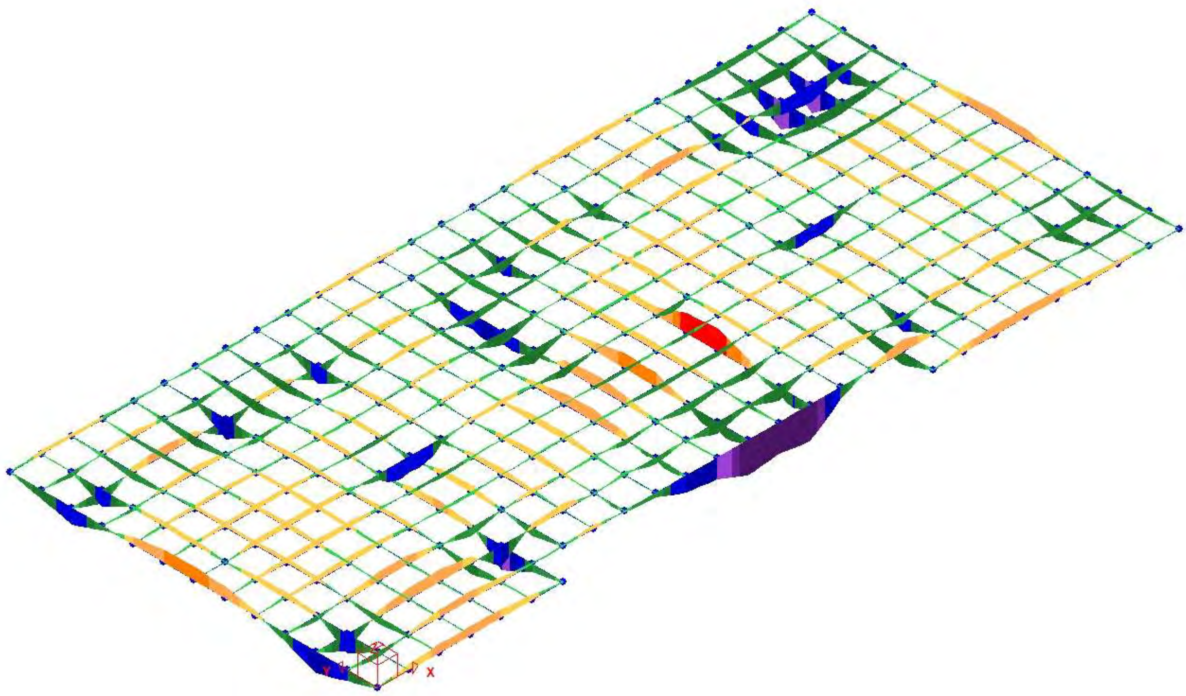
Deflection

Steel stress	f_s =	163.70	MPa
Modification factor	MF =	1.49	
Modification factor	MF' =		
Min effective depth	d_{min} =	150.92	mm
Deflection check OK			

Therefore 300mm underpinning is satisfactory with B20 bars @ 150 c/c.

6.0 Raft Foundation

The raft foundation has been analyzed as a grillage with nodes and springs to model the soil properties. We have been informed by CGL regarding the spring stiffnesses. A number of models have been analyzed, with stiffer springs and softer springs and with cracked and uncracked concrete; also soft spot sensitivity analysis has been carried out and the most onerous results have been taken through to the final design of the raft foundation.



Taking the maximum vertical loads from the superstructure the average characteristic bearing pressure is 88kN/m². We have been informed by CGL that a safe bearing capacity of 120kPa can be assumed.

Broxwood View
(Previously 29 Barrie House)

Appendix 7
SUDS Confirmation of Approval

For

Attanasio d'Aponte
Arbitrage Broxwood Ltd

5295

March 2023

CONTENTS

Application ref: 2022/1340/P
Contact: Elaine Quigley
Tel: 020 7974 5101
Email: Elaine.Quigley@camden.gov.uk
Date: 31 January 2023

Camden

Development Management
Regeneration and Planning
London Borough of Camden
Town Hall
Judd Street
London
WC1H 9JE

Phone: 020 7974 4444

planning@camden.gov.uk
www.camden.gov.uk/planning

Carbogno Ceneda Architects
Angle House, 48a Anthill Road
London
N15 4BA

Dear Sir/Madam

DECISION

Town and Country Planning Act 1990 (as amended)

Approval of Details Granted

Address:
Barrie House
29 St Edmund's Terrace
London
NW8 7QH

Proposal:
Details of sustainable urban drainage (SUDS) required by condition 21 of planning permission 2018/0645/P allowed on appeal (ref APP/X5210/W/19/3240401) dated 19/03/2020 for redevelopment of existing two-storey porter's lodge and surface level car park to construct a part four, part five storey extension to provide 9 self-contained residential flats.
Drawing Nos: Covering letter prepared by Carbogno Ceneda Architects dated 31/10/2022; SuDS Assessment prepared by Motion dated January 2018; Pre-enquiry letter from Thames Water dated 25/03/2022; email from Charlotte Orrell of DP9 dated 01/12/2022.

The Council has considered your application and decided to grant permission.

Informative(s):

1 Reasons for granting approval of details:

Details of the sustainable urban drainage system (SuDS) have been submitted which includes a SuDS assessment and a letter from Thames Water dated

25/03/2022. The report proposes a system of below-ground attenuation located below the proposed car park which will hold surface water before being discharged into the sewer. Permeable paving will be installed for all paved walkways. Following discussions with the applicant, details have also been provided of the named party who will undertake maintenance of the SuDS once it has been built.

A letter from Thames Water has been submitted by the applicant which confirms that there will be sufficient foul and surface water capacity in the sewage network to serve the development and that the proposed surface water discharge rates are satisfactory. The proposed run-off rate of 5 l/s is greater than the greenfield run-off rate of 0.3 l/s but meets the 5 l/s contained in the wording of condition 21.

The information has been reviewed by the Council's sustainability officer who is satisfied with the details. The condition can therefore be discharged.

The planning and appeal history of the site has been taken into account when coming to this decision.

The submitted details are consistent with the general expectations of the approved scheme and are acceptable in all other respects.

As such, the proposed details are in general accordance with policies CC2 and CC3 of the Camden Local Plan 2017.

2 You are reminded that Condition 4 (sample of materials); Condition 7 (obscure glazing); Condition 24 (PV cells); Condition 31 (boundary treatment); Condition 33 (waste storage); Condition 34 (acoustic isolation) of planning permission 2018/0645/P dated 19/03/2020 allowed at appeal (ref APP/X5210/W/19/3240401) are outstanding and require details to be submitted and approved.

3 You are advised that details for Condition 5 (noise assessment); Condition 6 (sound insulation measures); Condition 8 (hard and soft landscaping); Condition 10 (ground investigation); Condition 16 (blue-green roof feasibility assessment); Condition 19 (appointment of qualified chartered engineer); Condition 21 (SuDS); Condition 22 (tree protection measures); Condition 23 (ground source heat pumps); Condition 25 (method statement for piling); Condition 26 (lighting strategy); Condition 27 (bird and bat nesting features); Condition 28 (active birds nest); Condition 29 (landscaping for biodiversity) of planning permission 2018/0645/P allowed at appeal (ref APP/X5210/W/19/3240401) dated 19/03/2020 have been submitted to the Council and are pending consideration.

In dealing with the application, the Council has sought to work with the applicant in a positive and proactive way in accordance with paragraph 38 of the National Planning Policy Framework 2021.

You can find advice about your rights of appeal at:
http://www.planningportal.gov.uk/planning/appeals/guidance/guidancecontent

Yours faithfully

Daniel Pope
Chief Planning Officer

Broxwood View
(Previously 29 Barrie House)

Appendix 8
Thames Water Letter of No Further Comment

For

Attanasio d'Aponte
Arbitrage Broxwood Ltd

5295

March 2023

CONTENTS

FAO: **Wieland Kreuder**

Broxwood View LTD
62 St Martins Lane
London
WC2N 4JS

Developer Services - Asset Protection

Your ref	
Our ref	X2039/1807 v1
Name	Alexandru Birgauan
Phone	07768 801 351
E-Mail	alex.birgauan@thameswater.co.uk

04th December 2023

Dear Wieland Kreuder,

RE: Broxwood View, 29 St Edmund's Terrace, NW8 7QH – Letter of No Further Comments on proposed demolition, excavation, piling and construction adjacent to Thames Water's clean water main.

I write to confirm that we have completed the review of your submissions listed below in relation to the proposed development works located adjacent to Thames Water's clean water main.

Based on the information provided, we are satisfied that the proposed works will pose negligible risk to the Thames Water assets, and therefore we have no further comments to make.

Please notify Thames Water of any changes to the design solution as detailed in the submissions below:

a) Report ref: CG/28408B titled "Barrie House, 29 St Edmund's Terrace, London – Thames Water Impact Assessment" Rev 1 produced by Card Geotechnics Limited dated October 2022;
b) Report ref: CG/28408B titled "Barrie House, 29 St Edmund's Terrace, London – Thames Water Emergency Preparedness Plan" Rev 1 produced by Card Geotechnics Limited dated November 2022;
c) Report ref: CG/28408B titled "Barrie House, 29 St Edmund's Terrace, London – Monitoring Movement and Contingency Plan" Rev 1 produced by Card Geotechnics Limited dated November 2022;
d) Drawing no. 5295-TS10 titled "Section 1-1" produced by Carbogno Ceneda Architects dated 27 September 2022;
e) Drawing no. 5295-TS11 titled "Section 2-2" produced by Carbogno Ceneda Architects dated 27 September 2022.

Based on the information presented in the submission, we have no further comments to your proposed development adjacent to Thames Water's 24" cast iron clean water trunk main.

However, the proposal detailed in the documentation listed above is subject to the following conditions:

a) Contractor to contact Thames Water to inform when the below ground works have started and finished.
b) "Real-Time" vibration monitoring is required throughout the demolition phase. The monitoring proposal is to allow for monitor installations as close to the asset alignments as possible, with trigger levels set as follows:
    a. Amber Trigger – 5 mm/s PPV (reportable to Thames Water)

b. Red Trigger – 10 mm/s PPV (reportable to Thames Water and work stops until risk is mitigated

c) The developer shall not place any lifting equipment that will impose point loads greater than the maximum allowable highway loading within the Thames Water asset exclusion zones.

Please be advised that Thames Water will hold **Broxwood View LTD** and any appointed contractors or sub-contractors liable for any losses incurred or damage caused to Thames Water assets arising from the construction and / or subsequent use of the facility.

Yours sincerely,

Alex Birgauan

Alexandru Birgauan
Major Project – Developer Services