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PROJECT QUAD, LONDON NW1.
STRUCTURAL DESIGN AND METHODOLOGY STATEMENT
03/03/2015

Revision	Issued For	Date	Author
P1	Issued for planning	04/03/15	FS
T1	Tender issue		
C1	Construction Issue		

MBP

CONTENTS

1 INTRODUCTION

The purpose of this report is to review at the information currently available to inform the detail design of the refurbishment and extension of 6-10 Cambridge Terrace, Regents Park, London NW1 4JL.

1.1 PREAMBLE

This report has been prepared by Michael Barclay Partnership LLP (MBP) on the instructions and for the sole use and benefit of the Client.

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1.2 TERMS OF REFERENCE

MBP are appointed by the client provide structural design and construction advice for the refurbishment and extension of 6-10 Cambridge Terrace, Regents Park, London NW1 4JL. The proposals include internal structural alterations and the construction of a new basement area beneath the existing building and the private roadway and gardens in front of the buildings. The proposals are described on the scheme drawings prepared by Moxley Architects Ltd.

This report primarily addresses the proposed changes to the basement area in support of the planning application.

In preparing this report we have:

- Reviewed the historic data available
- Reviewed key reference books
- Consulted the MBP archive for local information, including other properties in the area
- Worked with the design team to generate a set of structural solutions for the proposed scheme

Refer to previous planning reports for details of desk studies undertaken.

We have not inspected woodwork or other parts of the structure which are covered unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect.

2 SUMMARY

MBP are appointed by the client to provide structural design and construction advice for the refurbishment and extension of 6-10 Cambridge Terrace. The proposals include internal structural alterations and the construction of a new basement area beneath the existing building and the area to the front of the buildings.

The existing building at 7-10 Cambridge Terrace is a modern reinforced concrete structure. 6 Cambridge Terrace is one of the original terraced houses which has been re-supported over a modern car park with a modern mansard roof and internal alterations. The terrace is Grade I Listed.

The site is underlain by the London Clay and site investigations have indicated this continues to below the depth of the basement. In some locations perched water was found sitting above the clay.

The proposals include internal structural alterations and the construction of a new basement area beneath the existing building and the private roadway and gardens in front of the buildings. The structural works include:

Once complete the property will consist of a single family dwelling.

MBP have used experience from similar projects to propose practical building solutions which minimises the impact of the development on the local area. The parameters used and methods envisaged for this work have been described. These will be developed further with input from the main contractor and specialists.

3 THE SITE

Cambridge Terrace is located on the east side of the Outer Circle of Regents Park. The property forms the north end of a terrace of ten properties. To the front of the building is a private road that is separated from the Outer Circle by landscaping.

Full address: 6-10 Cambridge Terrace, Regents Park, London NW1 4JL.

National Grid Reference: 528740E 182580N.

Ordinance Survey maps show the site just above the 30m contour with the ground level sloping down towards the south and east.

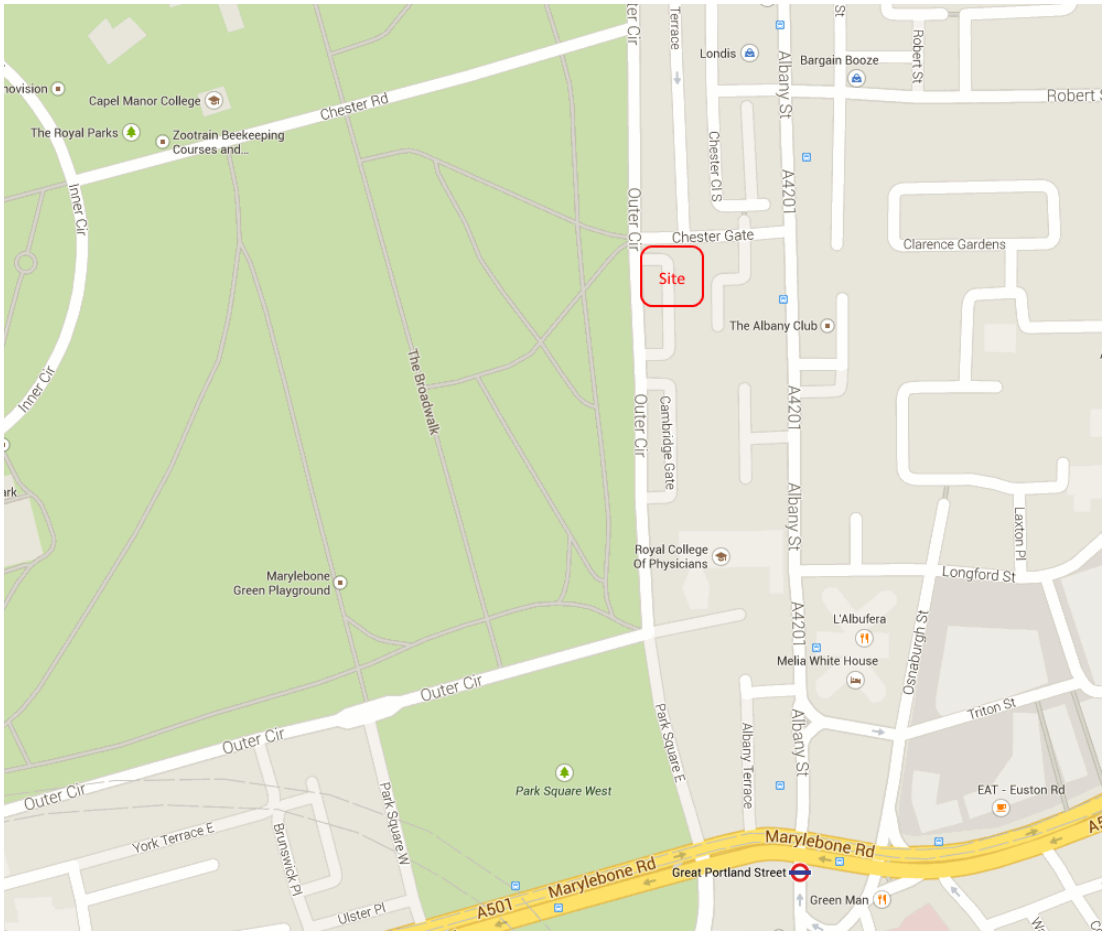

Figure 1: Extract from Google maps, site indicated in red.

Refer to Project Quad Desk Study Report, MBP (Appendix A) for further information on the site, existing buildings and ground conditions.

3.1 GROUND CONDITIONS & GEOLOGY

Site investigations have been carried out and records from previous investigations have been reviewed (see Appendix B). These indicate that the site has made ground 1-2 m deep underlain by the London Clay. Geological records suggest that the London Clay extends to about 30m depth in this area.

At lower ground floor level concrete slabs approximately 300mm thick were found throughout (internally and externally). Immediately beneath this was a granular layer and made ground. In some locations perched water was found pooled above the clay.

The London Clay was found to consist initially of weathered firm, becoming stiff, brown fissured clay with blue-grey veins, partings of orange-brown sand and scattered selenite crystals. Laboratory testing showed partial desiccation of the clay soils to a depth of up to about 4.50m (+26.0mOD). The weathered zone was found to extend to a depth of approximately 8m to reveal typical un-weathered stiff grey fissured clay varying slightly between boreholes, with the lowest point found to be +22.1m OD.

3.2 HYDROLOGY

The Environment Agency surface water flood risk maps indicate the Outer Circle and the access road at the rear have potential susceptibility to surface water flooding. At the front of the site the ground slopes up to the house and the map indicates this lifts the front of main house out of the flood risk zone.

The basement structure will be designed for the possibility that the water level rises to ground level at times during the lifetime of the building. Allowance should be made for the possibility of the ground water rising during construction due to inclement weather.

4 EXISTING BUILDING

6-10 Cambridge Terrace consists of two 6 storey structures. 6 Cambridge Terrace is one of the original terraced houses which has been re-supported over a modern car park with a modern mansard roof and internal alterations. 7-10 Cambridge Terrace is a modern reinforced concrete structure which replicates the appearance of the original façade of the terrace. The terrace is Grade I Listed.

4.1 HISTORY

Cambridge Terrace was designed by John Nash and was constructed in 1825. The northern part of the building (Nos 7 to 10) suffered significant fire damage in 1947 and was recorded as “ruins” on the historical OS maps from the 1950’s. It was subsequently demolished.

The demolished section of the building was finally rebuilt in 1984 to match the appearance of the surviving section of the structure. The re-built section of the building (Nos7 to 10) was re-constructed as a reinforced concrete frame structure supported on large diameter augered piles.

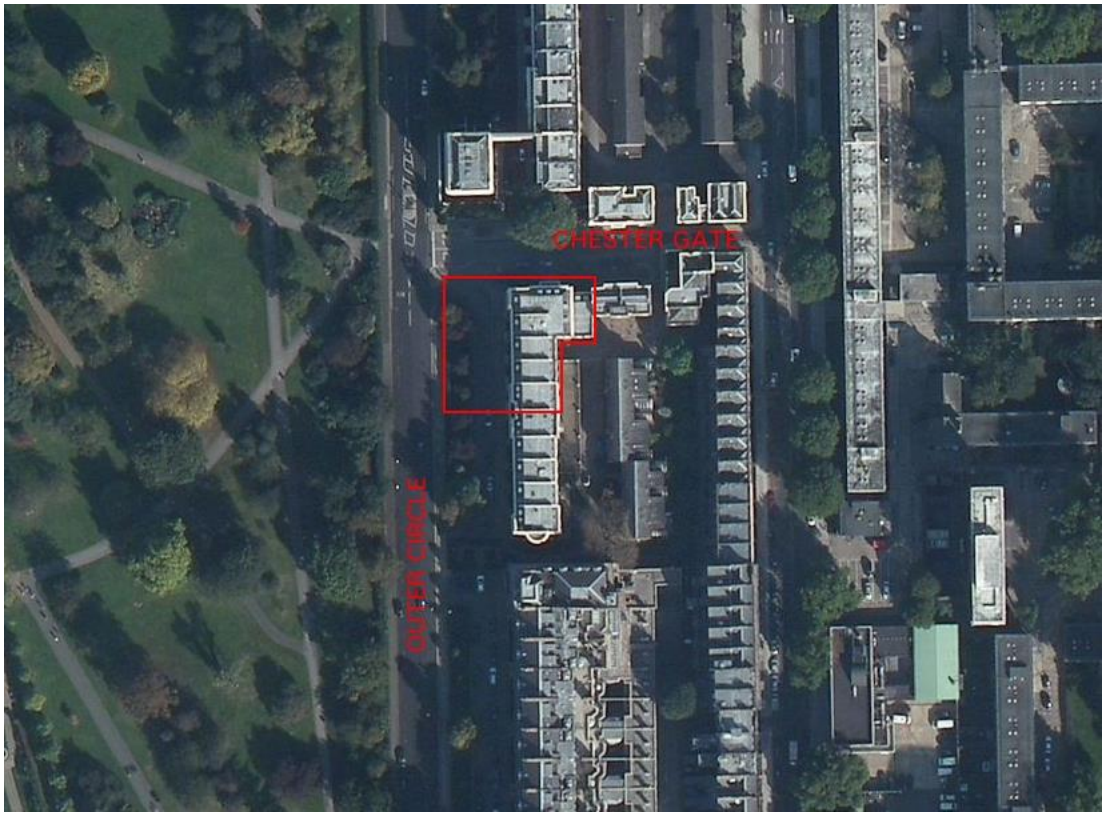

Figure 2: Aerial view of site with outline shown in red. The RC framed part of the building is towards the top of the image and No.6 beneath the final roof bay towards middle of the terrace.

4.2 CONSTRUCTION

When the property at 7-10 Cambridge Terrace was reconstructed in the 1980's the new reinforced concrete structure was supported on reinforced concrete piled foundations down into the underlying London Clay. Similarly 6 Cambridge terrace was underpinned using reinforced concrete ground beams and piles on to the London Clay. The lower ground floor is thought to be ground bearing. We have record drawings showing the pile arrangements and pile caps (but not the pile lengths & reinforcement details). We also have the site investigation report including recommended foundation parameters from 1982.

The superstructure to 7-10 Cambridge Terrace is RC framed with ribbed concrete slabs and wide 'band' beams along the central column lines. Stability is provided by the RC lift core and also external walls. Externally the frame is clad in masonry. The existing roof structure is formed in steel and timber. Some of the details are shown on the record drawings we have received from Faber Maunsell.

Above ground 6 Cambridge Terrace is believed to be of traditional construction with generally timber floors supported by beams and load bearing walls. In addition to the masonry elevations and party walls, some of the internal masonry and timber stud walls will be carrying floor loads.

4.3 BOUNDARIES, PARTY WALLS AND ADJOINING STRUCTURES

The existing buildings are joined to their neighbours with what are assumed to be the original party walls which are likely to contain flues:

- 1 Chester Gate to the East.
- 5 Cambridge Terrace to the South.

Record drawings show the RC frame of 10 Cambridge Terrace is separated from the party wall to 1 Chester Gate with a 25mm Flexcell joint. Cantilevering pile caps pick up the existing RC columns against this wall at lower ground floor level. The joint appears to continue up to roof level. In the proposed scheme the foundations to this wall will need to be re-supported to prevent undermining.

The party wall between 5 and 6 Cambridge Terrace is at the centre point of the terrace and the layouts are expected to mirror on that line. In the front façade the central window on the terrace (presumably included for aesthetic reasons) is shared between the two houses with blanked off central panel visible from the outside. The detail at this point will need to be investigated on site. Below ground level this wall has been re-supported over the car park and is supported on modern piled foundations.

Cambridge Terrace has a front courtyard that is occupied by planting and a driveway which runs through to the Outer Circle. Beyond the line of the existing vaults we believe that no construction has taken place previously other than hard landscaping.

5 SUBSTRUCTURE WORKS

The lateral and vertical extent of the proposed basement takes into account the methods to be employed and their performance in both temporary and permanent conditions. The parameters considered in selecting a solution included:

- Ability to transfer vertical loads from the existing building and new basement structure to the ground.
- Control of heave resulting from excavation of the basements and any net reduction in long term vertical loading of the ground.
- Control of horizontal movement of retaining walls and effects on neighbouring properties
- Construction process and temporary works

The proposed basement is founded within the London Clay. Piles will be required to support vertical loads under columns, prevent heave, provide temporary support and act as retaining walls. Where possible piles will be utilised for dual functions. Apart from the secant piled walls piles will be installed from lower ground floor level or deeper to reduce the extent to which the piles need to be broken down and to allow them to be installed to closer tolerances.

The permanent structure of the basement will consist of an RC ground bearing slab with tension piles introduced where needed to control heave. Local deepening of the excavation and construction will be necessary to accommodate drainage sumps, lift shaft etc. The walls will be formed with reinforced concrete underpins or contiguous piling, with structural liner walls cast using waterproof concrete. The top of the basement will also be formed in RC.

Temporary propping will be needed to control movement during construction. A ‘top down’ sequence is proposed with the lower ground floor slab cast before the bulk dig to permanently prop the tops of the retaining walls at an early stage. This will minimise movements and also provide a

barrier between the works within the basement and the surrounding properties. Temporary waler beams against the retaining walls will be required for intermediate levels of propping as the basement progresses. Once complete the basement floor slab will prop the retaining wall at the bottom, forming a stiff concrete box under the property, and the temporary props will be removed.

Tension piles are required to resist heave and prevent buoyancy of the basement to the front of the property. It is intended to install these from within the basement dig where possible to reduce the amount of cutting down required.

The waterproofing strategy is by the architect and the primary water proofing is to be provided by an internal drained cavity specified by the architect. Water ingress to the drained cavity will be controlled by the use of 'waterproof' concrete from a specialist supplier.

5.1 NEW BASEMENT CONSTRUCTION

In order to form the new basement under the existing building the perimeter walls will need to be extended down and the internal structures re-supported on the new foundations.

Where possible contiguous piles walls are proposed to form the retaining walls. Temporary piles will be introduced to support vertical loads in the temporary condition and simplify the basement construction and shorten the programme. The contiguous walls will be lined by an RC liner wall installed after the basement slab is cast. The liner wall will resist all lateral loads from the retained soil and external water pressures in the permanent condition.

Where piling is not possible reinforced concrete underpinning will be used to form the temporary and permanent retaining walls (subject to consents if necessary). Underpinning will be carried out in a 1-5 sequence with pins approximately 1m in length. Generally these will need to be formed in two vertical stages, but in deeper locations such as the car lift three stages are likely to be required.

Using reinforced underpins avoids additional stages of propping would extend the construction period and increase the stages where movement can take place. Dowel bars between the pins will spread point loads from above in to the ground below.

The vaults will be re-supported on a Pynford slab spanning between temporary piles and then internal walls in the permanent condition.

The party wall to 1 Chester Gate is currently separate from the structure of 10 Cambridge Terrace and will need to be underpinned to below the formation level of the basement. These reinforced pins will be horizontally propped against lateral loads by the new basement structure but free to move vertically. Allowance should be made for use of steel dowel connections and flexible join filler.

To form the new basement below the current Lower Ground Floor, the existing pile caps will need to be removed and the ground bearing basement slab formed at the lower level to replace the existing foundations. New vertical structure will be installed to re-support the retained columns on the new foundations. In the permanent structure no reliance will be placed on the existing piles, the details and condition of which are unknown and difficult to prove with any certainty.

The proposed basement does not extend under 6 and 7 Cambridge Terrace. Record drawings indicate both of these properties are supported on deep piled foundations.

It is expected that the drainage from the building above will be run at high level basement to fall under gravity to the existing sewer connections. Drainage from the basement is expected to be pumped to the existing sewer connections. Drainage strategy and routes are to be confirmed by drainage designer.

6 DESIGN AND PERFORMANCE PARAMETERS

6.1 RETAINING WALLS AND SURCHARGE LOADS

The following parameters are suggested for the design of the retaining walls - London Clay/made ground:

- Density: 20 kN/m^3
- Effective Cohesion: zero.
- ϕ ' crit : 21 degrees, mobilisation factor 1.
- Structure to be designed to resist 'at rest' pressures.
- Water table at ground level against roadway (lowest credible).

The surcharge for the design of retaining walls should assume traffic/highway 'HA' loadings in both the temporary and permanent condition. The contractor should inform the engineer if their proposed construction loads exceed the limits below so the walls can be designed appropriately (for instance by introducing additional temporary propping).

The requirements from different bodies are as follows:

- CEPC (Highways Authority for the terrace): Full axle loads as defined by HA loading.
- Crown Estate (freeholder): To be agreed with the freeholder's engineer.
- Royal Parks (Highways Authority for the Outer Circle): HA loading proposed and accepted.

Subject to confirmation, designs should allow for worst of three load cases:

- A UDL combined with a 120kN Knife Edge Load (KEL) with loading intensity dependant on notional lanes as defined for HA loading DMRB, volume 1 section 3.
- A wheel load of 100kN, over a 300x300mm^2, applied 600mm from the face of the retaining wall.
- A nominal live load of 10kN/m2.

6.2 DURABILITY

The design life of the new building is taken as a minimum period of 60 years. This falls into category 4 in Table 1 of BS7543:1992; Durability of Buildings and Building Elements, Products and Components, and corresponds to a 'normal' category of building, which includes new housing and high quality refurbishment of public buildings.

The site investigation interpretive report recommends designing for an Aggressive Chemical Environment for Concrete (ACEC) site classification of AC-2 representing the made ground which contains groundwater flows. This corresponds to a DC-class DC-2 such as an FND2 designated mix.

Note that the concrete for the retaining wall is expected to include a Pudlo additive to provide additional water resistance to the concrete box.

6.3 DISPROPORTIONATE COLLAPSE

The building matches the criteria for Disproportionate Collapse set out in Approved Document A, July 2004, for a 2B building, i.e. 7 storey single occupancy housing. It is expected that the existing reinforced concrete structure will have been designed to this standard. The requirements of BS 8110 will be followed and the proposed structure tied in to the existing to ensure continuity and robustness for the completed structure.

6.4 DESIGN CODES AND STANDARDS

The following documents are to be used:

- BS648 - Schedule Of Weights Of Building Materials
- BS6399 Pt 1 - Code of Practice for Dead and Imposed Loads
- BS6399 Pt 2 - Code of Practice for Wind Loads
- BS6399 Pt 3 - Code of Practice for Imposed Roof Loads
- BS5268:Pt 2 - Code of Practice for Structural use of Timber
- BS5950: Pt 1 - Design of Steel Structures
- BS8004: Pt. 1 - Code of Practice for Foundations
- BS8110: Pt 1 - Structural Use of Concrete
- The Building Regulations 1991 - Approved Documents A, B, C, E, H, K & N

6.5 SPECIFICATION

The proposed construction materials, components, workmanship etc. will be based on the National Building Specification documents and separate performance specifications. The sections scheduled by MBP are shown on the current specifications issue sheet.

It is Michael Barclay Partnership's practice to specify materials and construction-practices that do not cause undue harm to the environment. For example, timber used in temporary and permanent works must be obtained from a certified sustainable source, and be identified as such. The paint specification will avoid red lead, zinc chromate or coal-tar content and have a low solvent (VOC) content and offer manufacturers with an Environmental Policy in operation. The Contractor will be encouraged to use Portland cement replacement materials for the reinforced concrete elements.

7 CONSTRUCTION

MBP have used their experience of constructing similar basements to generate a practical building solution which minimises the impact of the development on the local area. Key aspects of this are minimising the disruption to traffic and parking and using modern fast track construction techniques to reduce the duration of the main structural works.

The basement will progress in a top down sequence. This will free up the site at ground level and allow the super-structure to progress in advance of the bottoming out of the basement.

7.1 MONITORING PROPOSAL

During the works the party walls and existing structure will be monitored for movement. Limits will be agreed with the Party Wall surveyors and procedures linked to the degree of movement. The contractor shall arrange for a monitoring specialist to undertake the monitoring on their behalf.

Monitoring locations are to be agreed with the party wall surveyors.

The control points will be monitored at not less than:

Underpinning and mass excavation	Weekly
Basement construction	Fortnightly for 8 weeks
During fit out	Monthly

7.2 CONSTRUCTION MANAGEMENT

The proposed construction has standard materials and components, is of common form within the construction industry for this type of project. We do not anticipate any unusual risks which a competent contractor with experience in projects of this type would not reasonably be able to anticipate. Nevertheless MBP will develop their CDM documentation as the detailed design proceeds. This report, in conjunction the drawings, provides additional information to aid the contractor's management of the project.

Matters of particular hazard or risk to the Contractor are highlighted below. Low risk hazards associated with the operation and maintenance of plant and tools and handling of common building materials (such as steelwork, cement, wet concrete and reinforcing bars), being usual to modern construction practices are not addressed.

Several 'specialist' techniques are to be employed for the construction of the basement. Procedures such as underpinning and restricted access piling are commonly used in basement projects and should not pose any unusual risks to a suitably experienced contractor.

Existing services.
The contractor should allow for identifying all existing services in & around the site before commencing excavation. Prior to excavation these should be marked, removed, capped off or disconnected as is necessary.

Excavation.
The contractor should be aware of the requirements for temporary support of excavations and should make their own assessment of the ground conditions described in the Site Investigation

Report and exposed on site. Allowance should be made for the potential of the ground conditions and water table to vary and departures from the expected conditions reported to the engineer and procedures reviewed to ensure safety. The contractor should assess the ground exposed during excavation and provide additional support if there are doubts as to the stability of the soil face.

Water ingress in to the excavation, either surface water or ground water should be reported to the engineer. The potential of the water to weaken surrounding soils should be assessed, in particular for granular deposits.

The contractor should exercise caution when excavating the upper levels of the strata which are made ground and could be variable.

Brick Vaults
The brick vaults at the front of the site are typical of vaults of this era and the load capacities of these are known to be variable. The contractor should avoid heavy loads over the vaults, especially point loads and under no circumstances should this area be used for skips or storage of spoil of other heavy materials.

Existing Structure
The details and condition of the existing are unknown and will need to be confirmed on site. Although records exist for the primary structure, the accuracy of those is not known. We do not have details for areas including: the retaining walls, vaults (including any in-filled), 1-2 Chester Gate and 6 Rutland Gate. Where details are found which vary from the expected construction the engineer should be informed.

Chasing & vibrations
Vibration is both a health consideration for the operatives & a nuisance/party wall consideration for the neighbours. The scheme includes works to the existing reinforced concrete structure including cutting back and demolition. The contractor should use low/no vibration methods where possible, including sawing reveals, stitch drilling and coring. The use of hand scabbling and demolition by hand held breakers should be eliminated from the project where possible.

Site welding
Site welding is to be avoided where practical. If required, proposals must be submitted to the engineer for agreement.

7.3 POTENTIAL IMPACT ON EXISTING AND NEIGHBOURING STRUCTURES

The proposed substructure works have been developed to limit the movements of the existing retained building above and neighbouring buildings. On site construction will be carefully managed in order to mitigate damage to party walls/neighbouring properties

With the works carried out correctly and propping maintained at all times, movements of the existing house and party walls are expected to be modest.

Assuming that the works are carried out with a reasonable degree of care and attention we do not anticipate potential damage to the surrounding properties to exceed Ciria building damage category 1 ‘very slight’. Refer to GCG’s Hydrogeological and Geotechnical Review for additional details of the damage assessment.

8 CONCLUSION

MBP's have extensive experience of this type of development and are capable of designing and monitoring on site the appropriate structural solution. The scheme produced has been developed with a specialist sub-contractor, again with considerable experience in this area, so that it can be achieved safely using proven construction methods.

The additional depth proposed in this scheme compared to the consented scheme does not change the structural strategy nor construction sequence and methods employed. The key structural challenges relate to the re-support of the structures over and are common to both schemes, the viability of which was demonstrated by the report submitted with the previous application.

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Date:

6 - 10 CAMBRIDGE TERRACE

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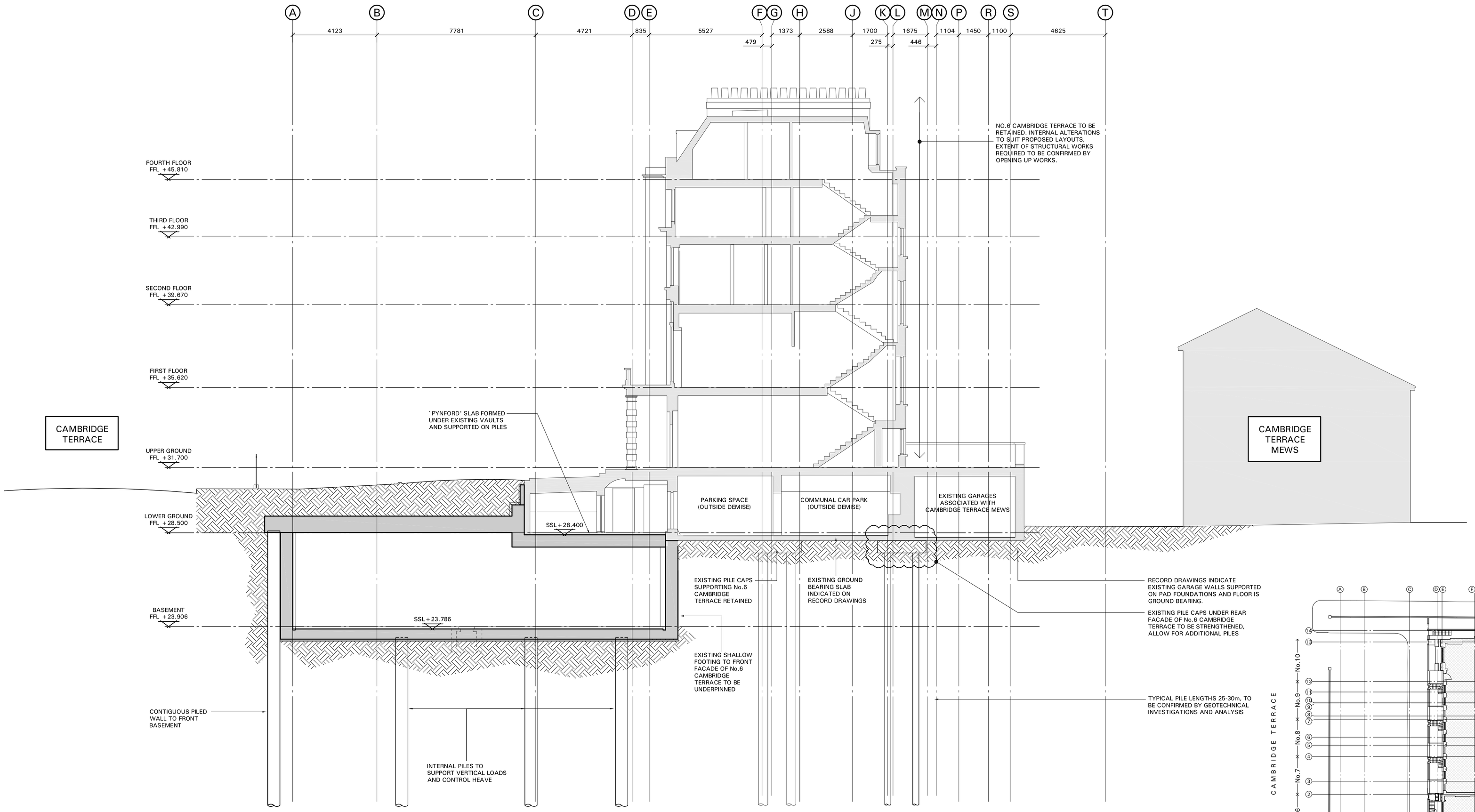
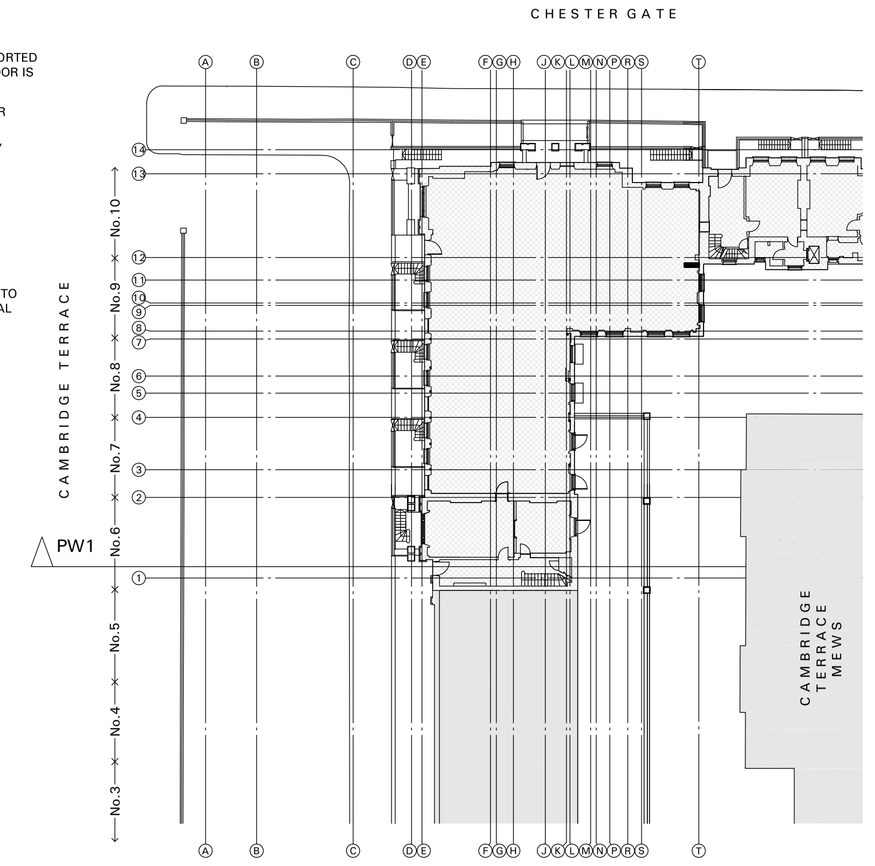


TYPICAL PILE LENGTHS 25-30m, TO BE CONFIRMED BY GEOTECHNICAL INVESTIGATIONS AND ANALYSIS.

PARTY WALL CROSS SECTION PW1

SCALE 1:100

CHESTER GATE



NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. FOR SETTING OUT REFER TO ARCHITECT'S DRAWINGS.
3. ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS NOTED OTHERWISE.
4. DO NOT SCALE FROM THE DRAWING OR THE COMPUTER DIGITAL DATA. ONLY FIGURED DIMENSIONS TO BE USED.

Rev	Date	Description	By
P3	04/03/15	PRELIMINARY ISSUE	HP
P2	07/01/15	KEYPLAN ADDED	FS
P1	05/01/15	PRELIMINARY ISSUE	FS

Job: PROJECT QUAD

Drawing Status: PRELIMINARY

Title: PARTY WALL CROSS SECTIONS SHEET 1

Scale	Date	By	Checked
1:100 @ A1	Dec 2014	MF	FS

Drawing Number: 6108 / PW-001

Revision: P3

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