CONSTRUCTION METHOD STATEMENT
FOR INCLUSION WITH THE PLANNING APPLICATION
AT
6 LANCASTER ROAD, LONDON W11 1QP

15011 /CMS
OCTOBER 2015
REVISION 1
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1 INTRODUCTION

We have been commissioned to provide an outline Construction Method Statement for the proposed works to the above for which Guy Stansfield Architects are acting as Designers, and in accordance with the guidelines set out in The Royal Borough of Kensington and Chelsea’s Basements Planning Policy Document from January 2015.

The existing property is a period terraced house with rear return extension comprising ground and first floors and with front and rear gardens. The layouts of the ground and first floors will be largely retained as existing, as will the front elevation, as shown on the drawings by Guy Stansfield Architects.

In principle the following works are proposed:
- Construction of a new full-length single level basement below the full extent of the lower ground floor, and extending this basement into the back garden by approximately 1.5m from the rear elevation;
- Works to the front garden: lowering the slab level and extending stair into the basement;
- Extending stairs into the basement area at the rear of the house;
- Providing a new access lift to the basement area at the back of the house;
- Providing a new rooflight to the basement at the rear of the house;
- Forming a new opening for the lift at the rear of the property, infilling one existing lift opening and forming a lightweight terrace at the rear) at ground floor.

mbok will act as Consulting Structural Engineers for the proposed development and will be responsible for the design of the permanent basement and superstructure works. mbok will also undertake periodic site supervision for the construction works. It is envisaged that a specialised Contractor will be appointed for the Construction works and this Contractor will be responsible for the design and implementation of the temporary works necessary to build the basement. mbok will check these designs and comment as necessary.
2 GEOLOGY

A preliminary Site Investigation was carried out on 07/04/2015, 07/05/2015 and 20/05/2015, as indicated on drawing 15011/SI_01 in Appendix A attached, and as follows:

- 5 hand-dug trial pits to expose the profile of existing foundations of both the main building and external boundary walls.
- Window sampling in one of the trial pits to a depth of 5m below ground level.
- One separate borehole to a depth of 10m.
- Pocket penetrometer tests in the borehole.

The results from this investigation are included in Appendix A. They show that the existing foundations sit on a layer of soft to firm clay. This becomes firm clay with silty pockets at about 800mm below ground, which becomes stiff brown clay with occasional siltstone crystals at depth of approximately 3m.

The allowable bearing pressures at foundation depth (3M minimum) in the new basement will be designed to limit ground bearing pressure to $100\text{N/m}^2$.

The basement excavation lies within the firm to stiff band of clay and the proposed formation level is roughly at the level at which the window samplers refused, though the borehole equipment was able to get past it.

We conclude that the existing geology at the depth of the proposed basement will be capable of supporting the new imposed loads and is suitable for the proposed basement.

Ground water was not encountered in the borehole and the window sampler.

We have been involved with underpinning projects in similar ground to this before and it has proved excellent to work in.

3 ENGINEERING SCHEME AND PROPOSED CONSTRUCTION SEQUENCE AND METHODOLOGY

The Engineering Scheme to form the basement is described on attached drawings 15011/SQ_01 to SQ_15, in Appendix E. Structural Calculations for the underpinning and new proposed Basement and Lower Ground level slabs are attached in Appendix C.

In preparing the outline scheme of works we have had to consider:

- general access
- sequencing of works
- stability of the party walls shared with the adjoining properties
- stability of retained walls both during demolition and reconstruction.

As far as we know, the adjoining properties at 4 and 8 Lancaster Road have not previously had works carried out to form basement. Their lowest floor is assumed to be the same as the lowest level of the property at 6 Lancaster road, which is the Lower Ground Level.

The current building is a terraced property, of a traditional timber internal structure, with joists generally spanning front to back onto a central load bearing spine wall. There is a two storey return extension at the rear, which is being fully retained. Inside the main building, the spine wall has already been partially removed at Ground floor and Lower Ground floor, with an assumed steel frame having been installed at the Lower Ground floor.
No works are currently proposed to the Upper Floors, with some minimal works proposed to the Ground Floor (namely a new opening for the lift at the rear of the property, infilling one existing lift opening and forming a lightweight terrace at the rear).

The lower ground has to be removed during the excavation works and it is proposed that this is replaced with concrete slab, 215mm thick, or with timber joists. The advantage of RC slab would be that it would also offer a substantial base to what are normally hard finishes at Ground Floor level. This would also offer some weight to partially offset the effect of the loss of excavated material on the underlying clay. It is also additional weight should the water level, currently below the proposed basement level, rise sometime in the future.

The new basement walls are provided by thick concrete underpins to the sides and the front and contiguous bored piles to the rear (which will be covered by a layer of sprayed concrete). In the permanent case the underpins will receive lateral support from columns and transfer beams which both support the new lower ground floor slab and transfer the lateral soil forces on the underpins to the basement and lower ground floor slabs. From the preliminary calculations, the underpins will need to be reinforced to resist the permanent loadcase.

The basement slab will be a 350mm thick concrete raft, transferring loads from the columns directly into the ground below. Bearing capacity of the ground will not be a problem as, even with the new concrete slabs, the weight of the new building will be less than that of the earth being removed.

Whilst the excavation is being carried out, much of the building will be supported on temporary piles. As well as supporting the building in its temporary case, these piles will distribute any “heave” effects from the underlying clay. These temporary piles will remain below this base slab after completion of the works and the reinforcement design of the slab will be a worst case taken from both considering the piles acting and ignoring them.

The proposed Construction Sequence and Methodology to form the basement is shown on the attached drawings 15011/SQ-01 to SQ-015, and a brief description follows. The appointed Contractor will be required to design any temporary works sequencing and sizing to comply with the ‘Code of Practice for temporary works procedures and the permissible stress design of falsework’ (BS 5975: 2008 +A1 2011).

1. TEMPORARY WORKS TO LOAD BEARING WALLS - Install temporary steel needle beams to the underside of Ground Floor Level to support Load Bearing Walls over (shaded on sketch).

2. NEW RC TRANSFER BEAMS - Construct new RC beams at the base of the load bearing walls at Lower Ground Floor Level, using the “Pynford” method. Beams to match the width of the walls, and be approximately 330mm wide x 500mm deep. Sequence shown on Structural Engineer’s Drawings. Reinforcement will be detailed on Structural Engineer’s Drawings.

3. Remove the entire Lower Ground Floor timber boards and floor joists together with any sleeper walls.

4. TEMPORARY WORKS TO FRONT BAY – extend the window opening in the front bay all the way to the lower ground floor level. This is to allow access to the mini piling rig from the front garden and into the lower ground through the front bay opening.

5. INSTALL TEMPORARY PILES - Construct piles to the centre of the house. Refer to Appendix D for Piling Specification.

6. PILED WALL TO REAR - Install new contiguous piled wall to the rear of the house.

7. Construct reinforced concrete pile caps to internal piles, top of pile cap to be the same as the soffit of the transfer beam. The load bearing walls above are now supported off the temporary piles. The Temporary works to the load bearing walls at the Lower Ground Level can now be removed.
8. Construct capping beam to the contiguous piled wall.

9. FIRST STAGE EXCAVATION - Excavate ground to near underside of existing footings. This level may need to vary to suit differing footing levels. Spoil to be taken out through the front bay and the front garden.

10. FIRST PHASE UNDERPINNING - PARTY WALL and GARDEN WALL to No 4, PARTY WALL and GARDEN WALL to No 8 and FRONT BAY WALL and FRONT GARDEN WALL – to be carried out in 1m sections, sequence to be confirmed, in accordance with the Specification for Underpinning works – refer to Appendix B.

11. SECOND STAGE EXCAVATION - Excavate out second stage from rear to front, adding wailing beams and propping to underpins as excavation progresses.

12. SECOND PHASE UNDERPINNING - PARTY WALL and GARDEN WALL to No 4, PARTY WALL and GARDEN WALL to No 8 and FRONT WALL – to be carried out in 1m sections, sequence to be confirmed, in accordance with the Specification for Underpinning works – refer to Appendix B.

13. THIRD STAGE EXCAVATION – Complete excavation down to formation level of basement slab.

14. BASEMENT SLAB - Lay blinding and break out as necessary for drainage and sumps. Cast reinforced concrete basement raft slab, 350mm thick.

15. Erect perimeter columns supporting LGF beams and propping underpins to a height just below existing wailing beam. Diagonally prop columns to raft level.

16. Construct the liner wall to the piled wall at the rear.

17. Construct the Retaining RC wall to the front garden to a height just below existing wailing beam. Diagonally prop wall to raft level.

18. Remove wailing and horizontal props to the underpins, extend the new RC columns and retaining wall to underside of Lower Ground Floor. Ensure the transfer beam to column reinforcement detailing is carried out in accordance with Structural Engineer’s drawings.

19. Remove temporary piles and pile caps.

20. LOWER GROUND FLOOR REAR OF THE HOUSE - Install the external Lower Ground Floor slab in the rear part of the house over the new basement. Slab to be supported off the Transfer RC beams.

21. LOWER GROUND FLOOR MAIN HOUSE - Install new internal RC ground floor, supported by RC Ground Beams.

22. Complete remaining construction elements and finishes.

23. GROUND FLOOR: Complete remaining construction elements and finishes.
4 IMPACT OF PROPOSALS ON STRUCTURAL INTEGRITY OF NO 6 LANCASTER ROAD AND ADJACENT PROPERTIES AND STRUCTURES

The property is bounded on both sides by existing properties. The party walls between each property will require careful consideration and be subject to the provisions of the Party Wall etc, Act 1996. When a party wall surveyor is appointed, structural details will be designed and detailed to the agreement of all parties where necessary.

Clearly this is a confined site. Access for equipment and materials is only from the front or (via a crane) over building. Prior to construction, the Contractor will be required to submit Method Statements for approval by the Design Team describing all proposed temporary vertical and lateral supports. Once these are approved the Contractor will be required to follow this methodology.

It is assumed that neither of the party walls with No 4 Lancaster Road and with 8 Lancaster Road have been underpinned to form a basement. The trial pits show that the existing external walls are founded on a layer of clay some 450-500mm below external ground level. It is reasonable to expect that the Party Walls are similarly founded and that is what we have shown on our sections.

The proposed basement will be formed using an underpinning method to a new level c.3.0M below ground at the front of the house and c.4.5metres below ground at the rear of the house, constructed in sections each no wider than 1.0metre, with no adjacent underpins constructed within a 48 hour period as described in the Underpinning Specification in Appendix B. As this is a deep excavation, we propose to carry out the underpins in two sections. The first will take place in sort to hard clay and will be dowelled together to form a stiff beam. The first level will be completed before excavation and work begins on the second level.

This method of construction reduces the amount of potential ground movement and so minimizes the effects of settlement of the adjacent structures.

In practice some settlement is possible but provided an experienced Contractor is appointed who undertakes the works using good practice and in accordance with the structural design, this should be no worse than 'aesthetic', according to the BRE's definition. Any settlement that occurs is likely to be minimal and is likely to be accommodated in the elasticity of the superstructure as is the experience in most well executed developments of this kind.

The design and construction methodology, as described above, deals with the potential risks and ensures that the excavation and construction of the proposed basement will not affect the structural integrity of the property and adjoining properties.

Prior to construction the contractor will be required to submit Method Statements for approval by the design team. Once these are approved the contractor will be required to follow this methodology.

5 SLOPE STABILITY

The site is located on ground that is relatively flat and so slope instability can only be initiated in the temporary condition via a collapse of the partially formed underpinning as the basement is being built. This is highly unlikely due to the underlying ground type (Firm Clay), the construction sequence and methodology as described in section 6 below.
6 WAYS TO MINIMISE DISTURBANCE INCLUDING:

6.1 DRILLING OF BOREHOLES

A borehole has been drilled on site as part of the site investigation on 7 April 2015, by SJM (refer to Appendix A for results). It was done in a way as to minimise the disturbance to the local residents and no complaints have been received. It is unlikely that a further borehole will need to be drilled on site.

6.2 IMPACT OF PROPOSALS ON EXISTING OR PROPOSED TREES

No existing trees will be felled during the construction of the proposed basement. In addition, there are no trees protected by Tree Preservation Orders in the vicinity of the proposed basement that will be damaged by the construction works. There is a tree within the rear garden to the property and all necessary precautions will be made to ensure the condition of the tree is maintained as set out within the attached arboricultural report.

A large portion of the rear garden will remain unexcavated, thus allowing new trees and shrubs to be planted, if so desired. In addition to allowing part of the garden to remain undeveloped, soil depth of approximately 1.0m is provided above the part of basement that projects into the rear garden. This will allow for planting and maintaining sustainable urban drainage.

Aerial photo showing that there are no existing trees in the close proximity of proposed basement.

6.3 IMPACT OF PROPOSALS ON STRUCTURAL INTEGRITY AND NATURAL ABILITY FOR MOVEMENT OF EXISTING AND SURROUNDING STRUCTURES, UTILITIES, INFRASTRUCTURE AND MANMADE CAVITIES

The exact location of any local services on the site will not be known until the works start but as these services will be maintained during construction and re-routed if necessary, any impact should be negligible.

If it is necessary to relocate or divert any utilities, the Contractor and Design Team are under a statutory obligation to notify the utility owner prior to any works. This will be so that they can assess the impact of the works and grant or refuse their approval. There are no known man-made cavities (e.g. tunnels) in the vicinity of the proposed basement.
6.4 THE SEQUENCE OF TEMPORARY WORKS TO MINIMISE THE EFFECT ON NEIGHBOURS

The sequence of works has been carefully considered at this preliminary design stage and is shown in Appendix E, drawings 15011/SQ_01 to SQ_15. The design and construction methodology, as described above in Chapter 3 of this report, deals with the potential risks and ensures that the excavation and construction of the proposed basement will minimise the effect of construction works on the adjoining properties.

6.5 POTENTIAL IMPACT OF PROPOSALS ON DRAINAGE, SEWAGE, SURFACE AND GROUNDWATER FLOWS AND LEVELS

All existing drainage and sewage connections will be maintained throughout the construction works so there will be no impact on these existing systems.

The proposed basement will remain as part of a single-family residence and therefore there will be no significant increased discharge into the existing drainage and sewage systems.

Surface water will not be altered as the proposed works are underground and there will be no additional proposed ‘hard surfaces’ formed at ground level. The lightwell formed at the front of the property will be drained utilising trapped gullies draining into the basement drainage system.

Below Ground Drainage: All foul water in the basement will be piped to a Delta type Sewage collection tank from where it will be pumped back to the front garden manhole. The pump set will be a duplex unit with an anti gravity pipe section before discharge into the manhole. The collection tank will require a vent pipe to atmosphere.

Surface water drainage: The basement will be waterproofed using a plastic membrane system. Beneath the membrane a perimeter drainage system will be installed to collect any ground water, the drainage system will be piped to a dedicated collection tank. Water from the collection tank will be pumped into the foul drain. The pump set will be a duplex unit with an anti gravity pipe section before discharge into the manhole. The collection tank will require a vent pipe to atmosphere. All pumps will be fitted with control panels with pump failure and high level alarms.

Sewer water flooding: Provision will be made for the basement to have a positive pumped device to protect the development from sewer water flooding.

As can be seen from the North Kensington Critical Drainage Area Boundary (Appendix A, page 5), the site is a substantial way away from the critical boundary.

We have also checked historical maps and reference sources and can confirm that there are no subterranean watercourses in the vicinity of the property.
The map shows the location of known, historic underground ‘rivers’ in the vicinity of the site none which will have any impact on the site in question. Approximate location of 6 Lancaster Road is shown as a red circle.

6.6 THE CONSIDERATION OF RELATED CUMULATIVE IMPACTS

The cumulative impact of multiple basements within a locality can give rise to structural issues with existing buildings. As far as we are aware, the neighbouring properties at number 4 and 8 Lancaster Road do not have basements and have not applied for consent to build basement. In addition, there are no listed buildings in the W11 1QP postcode, so subterranean development to 6 Lancaster Road should have a minimal structural impact.

6.7 THE LINK BETWEEN A BASEMENT AND THE HOST PROPERTY

The new basement walls are provided by thick concrete underpins to the Party walls at the sides and the bay window at the front and contiguous bored piles to the rear. In the temporary case, the underpins will be propped. In the permanent case the underpins will receive lateral support from columns which both support the new lower ground floor slab and transfer the lateral soil forces on the underpins to the basement and lower ground floor slabs.

The vertical loads from external and internal load bearing walls of the host property above are transferred into the basement by a series of reinforced concrete beams at lower ground level. Those beams will be formed using the “Pynford” method of construction and will be supported off the new columns in basement. The basement slab will act as a concrete raft, transferring loads from the columns directly into the ground below. The deflection of the transfer beams will be considered and minimized to eliminate any potential long term defects in the host property.

6.8 THE NEED FOR PROFESSIONAL VERIFICATION OF CERTAIN WORKS

The following works will need professional verification by Structural Engineer or a Specialist Subcontractor:

- Monitoring the host property and party walls for movement during the underpinning works;
- Full testing of temporary piles and contiguous piled well, as per piling specification;
- Structural Engineer and a Building Inspector to inspect at least the first underpin;
- Reinforcement to the underpins to be carried out by the Contractor and inspected by the Structural Engineer;
- Reinforcement to the raft, columns and transfer beams to be inspected by the Structural Engineer.
6.9 SAFEGUARDING AMENITY (NOISE, VIBRATION AND DUST FROM CONSTRUCTION WORKS)

There are a number of ways that the Contractor will be able to minimise the impact of this construction project, through the careful consideration of access, vehicle movements, working hours, noise, vibration and public safety and removal of material from a site, as well as the transport and storage of plant, machinery and equipment. Prior to construction the contractor will be required to submit Method Statements for approval by the design team. Once these are approved the contractor will be required to follow this methodology.

7 DRAFT CONSTRUCTION TRAFFIC MANAGEMENT PLAN (CTMP)

For construction traffic management plan please refer to Appendix F of this report.

8 CONCLUSIONS

With careful planning, detailed design and sequencing the proposed structural works as outlined above can be safely carried out without damaging the existing neighboring properties trees and infrastructure. All design proposals should be coordinated between the Main Contractor, Engineers and Architects and agreed prior to commencing any works on site.

Document prepared by: VERONIKA TARASOVA MEng (Oxon) CEng MStructE

Document Approved by: ORLA E KELLY BEng (Civ) CEng MStructE

Signed: [Signature]

Date: 27.10.2015
CONSTRUCTION METHOD STATEMENT
AT
6 LANCASTER ROAD, LONDON W11 1QP
APPENDIX A
SITE INVESTIGATION
**BOREHOLE NO.**

- Ground Level: 85.02.00
- Diameter of Boring: 8"
- Water Struck: None
- Standing Water Level: None
- Method: Shell and Auger
- Start: 29.4.70
- Finish: 29.4.70

**REMARKS:** 1½ hours pitting through obstructions to 3'6"

<table>
<thead>
<tr>
<th>Description of Strata</th>
<th>Thickness</th>
<th>Depth</th>
<th>Reduced Level</th>
<th>Disturbed Samples</th>
<th>Undisturbed Samples and Index Tests</th>
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<tr>
<td>Made ground (black soil, bricks, gravel, brown clay and ashes)</td>
<td>11'9&quot;</td>
<td>11'9&quot;</td>
<td>72.3</td>
<td>2'6&quot; J419</td>
<td>6'0&quot; U420</td>
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<td>Soft to firm brown clay</td>
<td>10'3&quot;</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Stiff brown clay with sulphate crystals</td>
<td>15'0&quot;</td>
<td>22'0&quot;</td>
<td>62.0</td>
<td>15'6&quot; J423</td>
<td>18'0&quot; U424</td>
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<tr>
<td>Stiff dark brown clay</td>
<td>13'0&quot;</td>
<td>37'0&quot;</td>
<td>47.0</td>
<td>45'6&quot; J432</td>
<td>48'6&quot; U433</td>
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<tr>
<td>Bottom of Borehole</td>
<td></td>
<td>50'0&quot;</td>
<td>34.0</td>
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**TOTALS**

- 50'0" 50'0"

**NOTES:** Descriptions in accordance with C.P. 2001 "Site Investigations"

- J = Jar Sample
- B = Bulk Sample
- W = Water Sample
Also try a window spiroule in one of the
of both. Try (TP 2 and TP 3 - take measurements)
BH - deep bole hole at least 1m

KEY:
Date: 7/4/15

Site: 6 LANCASTER ROAD, LONDON W11

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<tr>
<th>Ground Water Record</th>
<th>Strata Depth (m)</th>
<th>Length (m)</th>
<th>Sample Depth</th>
<th>Sample Type</th>
<th>Pocket Penetrometer</th>
<th>Root Identification</th>
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<td>NIL</td>
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**Date:** 7/4/15  
**Site:** 6 Lancaster Road, London W11

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<th>Strata Depth (m)</th>
<th>Length (m)</th>
<th>Sample Depth</th>
<th>Sample Type</th>
<th>Pocket Penetrometer</th>
<th>Root Identification</th>
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<tr>
<td>Stiff Grey Brown Clay with occasional carbonate inclusions, silt, pebbles and tiny crystals</td>
<td>5</td>
<td></td>
<td>7.00 m</td>
<td>Ds</td>
<td></td>
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<td>4</td>
<td></td>
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<td>3</td>
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<td>9.00 m</td>
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<td>2</td>
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<td>9.00 m</td>
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<td>1</td>
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<td>9.00 m</td>
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<td>6</td>
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</tbody>
</table>
### S J Martindale: Site Investigation Services

#### Probe Borehole No. WSL

**Date:** 20/5/15

**Site:** 6. LANCASTER ROAD, LONDON

19mm Pipe Installed To 5.00m.

<table>
<thead>
<tr>
<th>Ground Water Record</th>
<th>Strata Depth (m)</th>
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<th>Sample Type</th>
<th>Pocket Penetrometer</th>
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<tbody>
<tr>
<td><strong>Concreate Slab</strong></td>
<td>0.24 m</td>
<td>2</td>
<td>1.00 m</td>
<td>D3</td>
<td>NKR</td>
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<tr>
<td>Soft Grey/Brown</td>
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<td>2</td>
<td>2.00 m</td>
<td>2.50</td>
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<td>Silt Clay Fill with Brick, Clinker and Occasional Fine Rocks</td>
<td>3.30 m</td>
<td>1</td>
<td>3.00 m</td>
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<td>From Brown/Gray Clay with Silt Pockets Occasional Siltstone Fragments</td>
<td>5.00 m</td>
<td>6</td>
<td>4.00 m</td>
<td>4.25</td>
<td>5.00 m</td>
</tr>
</tbody>
</table>

**Client:** M.B.A.K.

**Job No.:** 15011

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**Description**

- **Concrete Slab**
- Soft Grey/Brown Silt Clay Fill with Brick, Clinker and Occasional Fine Rocks
- From Brown/Gray Clay with Silt Pockets Occasional Siltstone Fragments
CONSTRUCTION METHOD STATEMENT
AT
6 LANCASTER ROAD, LONDON W11 1QP

APPENDIX B
SPECIFICATION FOR UNDERPINNING WORKS
1. Before starting the work the contractor is to check for any services that could be damaged by the underpinning work.

2. The Contractor shall be responsible for ensuring that his operations do not in any way impair the safety or condition of the building both before and during the execution of the work and should immediately inform the Engineer if he considers that more stringent procedures than those specified are necessary.

3. Underpinning is to be carried out in small sections of about 1 metre in length. Underpinning should not be carried out in depths more than 1m. The bottoms of the foundation shall be inspected and approved by the Engineer and the Building Inspector before concrete is poured. The underpinning is to be carried out to the satisfaction of the Engineer and the Building Inspector.

4. Due to the depth of Proposed Basement, the underpinning is proposed to be carried out in two sections. The first will take place in soft to hard clay and will be dowelled together to form a stiff beam. The first level will be completed before excavation and work begins on the second level.

5. Projecting portions of existing footings are to be carefully cut off where directed and the underside of the footings are to be cleaned and hacked free of all dirt, soil or loose materials before underpinning.

6. The body of the underpinning is to be constructed in 1:2:4 mix concrete and in to be cast to the widths shown unless otherwise directed by the Engineer. Excavation and concreting of any section of underpinning shall be carried out on the same day.

7. The mass concrete is to be stopped off 75mm below the underside of the existing footing and the final pinning up over the whole width of the footing is to be carried out with 1:3 mix cement to sharp sand dry pack mortar well rammed in 24 hours after the concrete has been poured.

8. Excavation to any section of underpinning shall not be started until at least 48 hours after completion of any adjacent sections of the work.

9. The sides of the previous underpinning bays are to be roughened or keyed to the satisfaction of the Engineer and the Building Inspector. The underside of the existing footings is to be cleaned of all loose materials or soil prior to underpinning.

10. Sequence of underpinning to be as shown. All sections marked 1 to be excavated, cast and dry-packed before starting excavation of sections marked 2; and all sections marked 2 to be excavated, cast and dry-packed before starting excavation of sections marked 3 etc.

11. The contractor is to keep a record of the sequence and dimensions of the underpinning actually carried out, including details of excavation, casting concrete and pinning up for each section.

12. Excavated material intended for backfilling is to be kept protected from drying out or wetting and is to be placed in maximum 150mm layers, carefully compacted with a pneumatic or percussion tool with a compacting plate.

13. Provide 4 number dowel bars between each underpin, 2 H16 top and 2H16 bottom, 250mm length into each underpin (500mm total length for each bar).

14. Provide reinforcement to each section of underpin as detailed by Structural Engineer.