Basement Impact Assessment

2 Daleham Gardens
London
NW3 5DA

for

Kathryn and Alex Bayers

This Construction Method Statement is produced for submission to the Camden Council planning department for application only and should not be used for any other purposes, e.g. Party Wall Awards. It is based on the drawings supplied by Dash dated June 24.

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This report has been prepared by DASH House Group Ltd on the instruction of the Client. This report is solely for the use of our Client and is not for the use of, or to be relied upon, by any third party. Studio Dash have a great deal of experience in the design of residential refurbishments and subterranean works such as this, particularly in London, and are familiar with the planning process for subterranean structures.

This report provides information in accordance with the advice provided in the Camden Planning Guidance: Basement Document January 2021.

The following report has been prepared to help ensure that the structures on both the site, neighbouring sites and to the general public are safeguarded during the works. It should be read in conjunction with all other relevant information and reports associated with this planning application.

The author of the report is an experienced civil and structural engineer that has successfully designed and constructed multiple basement projects in the borough and surrounding areas of London.

There has been a consideration of the basement proposal within the local context to meet the design guidance set out by the policy and to meet the pre-planning work and engineering requirements for the proposal. Flooding and trees have also been considered and there is minimal impact on the surrounding properties.

This report supports the conclusion that should the works can be completed by a competent main contractor with design supervision and management. The scheme can be safely constructed without any significant adverse effect on the property, neighbouring properties, groundwater, surface water or on the stability of the adjoining ground.

1.0 Scope of Works

1.1 A new swimming pool is to be created by excavating within the existing basement level. There will also be the internal structural works on the ground floor and new back extension above the new swimming pool at first floor and roof level . The existing ground floor will be adapted and supported by the new structural members or existing members will be strengthened.

1.2 Waterproofing of the basement and swimming pool will take the form of drained cavities (with sumps and pumps) within the basement area. The new drainage to the basement structure will be pumped to the existing gravity-fed systems. The design and specification will be carried out by a waterproofing consultant. The fitting out of the basement is to follow the construction of the structural shell.

2.0 Description of Site and Adjoining Properties

2.1 The property is a four-storey semi-detached house located at the end of the street. It has a masonry construction with timber floors to all levels and timber rafters to form the roof. From an external non-intrusive visual examination, both the property and the adjoining properties look to be in sound condition and are of similar construction.

3.0 Construction and Design Standards

3.1 The design and construction of the proposed works will be undertaken in accordance to statutory regulations and standards, including but not limited to:

- British Standards Codes of Practice
- Building Regulations 2010
- Construction (Design and Management) Regulations 2015
- Health and Safety at Work etc Act 1974
- Party Wall Act 1996

3.2 The proposed basement development is located within adjoining proximity to the neighbouring properties and will be subject to the Party Wall Act 1996. It will be necessary for the client to have party wall agreements with the adjoining owners/surveyors prior to the relevant work commencing on site.

3.3 The detailed structural design of the proposed works will be carried out in accordance with the current European Standards, Building Regulations and appropriate Guidance Documents published by CIRIA, ICE, IStructE etc. The design and drawings will be submitted to the local Building Control for approval and the construction inspected by the Building Control Officer on site.

For the retaining wall and steel beam analysis and design, the following references should be used:

- BS EN 1997-1: 2004 Eurocode 7: Geotechnical design – Part 1: General rules.
- BS EN 1997-2: 2007 Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing.
- BS EN 1992-1-1: 2004 Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings.
- NA to BS EN 1992-1-1: 2004 UK National Annex to Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings.
- BS EN 1996-1-1: 2005 Eurocode 6: Design of masonry structures – Part 1-1: General rules for reinforced and unreinforced masonry structures.

- NA to BS EN 1996-1-1: 2005 UK National Annex to Eurocode 6: Design of masonry structures – Part 1-1: General rules for reinforced and unreinforced masonry structures.
- BS EN 1993-1-1: 2005 Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings.
- NA to BS EN 1993-1-1: 2005 UK National Annex to Eurocode 3: Design of steel structures Part 1-1: General rules and rules for buildings.

4.0 Design Principles

4.1 The existing masonry walls which carry the stability of the house are not being altered. The reinforced concrete retaining walls will be designed to carry the lateral loading applied from the side with additional surcharge. The lateral earth pressure exerts a horizontal force on the retaining walls. They will be checked for resistance to overturning this process.

4.2 New concrete retaining walls will be constructed to hold back the excavated earth in the basement. They will be designed to support the lateral load pressures from the earth and water on the unexcavated side of the walls. These walls will be pinned by a reinforced concrete slab at the base and the top to prevent sliding and overturning.

4.3 Where required new steel beams supported by existing brick walls, existing floors and new floors will bear on concrete padstones cast in-situ into the existing brick walls to reduce the bearing stresses on the existing brick walls to acceptable levels. Where these stresses are significant, new columns will be designed for them. In the case of party walls, the embedment of the padstone will be no more than half the thickness of the brick wall. Please see attached notes for bearing details.

4.4 In this design, stock bricks in traditional lime mortar are assumed with a basic compressive strength of 0.42N/mm2. Under a concentrated load, the allowable compressive strength is taken as 1.5 times the basic compressive strength. For beams directly onto the existing concrete foundation, then padstones will not be required.

5.0 Ground Floor Structure

5.1 As contained in the report above the existing structure is to be retained, the rear and side may be affected by the new excavation. The existing ground floor structure comprises of timber joists supported by the exiting brickwork. An investigation would need to be done to identify the extent of strengthening works to the existing structural members. The new ground floor structure will be constructed in timber floor joists and reinforced concrete which will tie all the retaining walls together.

5.2 New beams are not considered 'restrained' unless there is a mechanical connection to the top flange (or within 75mm of it). Hence the timber floor joists do not restrain the compression flange and must be taken into account in the calculations.

5.3 The exact structural layout of any existing ground floor is often unknown although sometimes the general direction of the span of the joists is. There usually is a foundation under each load-bearing and/or masonry ground floor level wall as well as sleeper walls supporting nominal floor joists. Therefore, the new ground floor support structure will therefore need to replicate this arrangement. All main beams will then be designed assuming worst ground floor loading case.

5.4 The concrete suspended ground floor slab thickness and fixing is unknown. The further investigation is required. The Contractor will investigate and report the findings to the Engineer.

5.5 The following design loads have been used in calculations are:

Domestic Floor Loads:	Dead (Concrete)	4.80 kN/m^2
	Dead (Timber)	0.65 kN/m^2
	Live (includes parttion)	2.50 kN/m^2
Domestic Roof Loads:	Dead (Flat)	1.00 kN/m^2
	Dead (Sloping)	1.20 kN/m^2
	Live	0.75 kN/m^2
Wall Loads:	External Brickwork (330mm thick)	7.00 kN/m^2
	External Brickwork (215mm thick)	4.60 kN/m^2
	Internal Brickwork (100mm thick)	2.20 kN/m^2
	Internal Blockwork (100mm thick)	1.40 kN/m^2
	Timber Stud Wall	0.50 kN/m^2
	Plaster	0.20 kN/m^2

Deflections of new steel beams will be limited to the following parameters:

Dead and Live Loads (unfactored):	span / 250
Live Loads (unfactored):	span / 360
Dead Loads only (unfactored) for beams supporting existing masonry:	span / 500

6.0 Basement Design

6.1 The existing superstructure may have to be transitionally underpinned in the traditional '1 to 5' sequence to ensure no more than 20% of the entire load is underpinned at any one time. The underpins to be excavated should not exceed 1m in width. A vertical stem will be cast directly under the existing wall and will be no less than the width of the existing wall. Where the wall is a designated party wall, the rear face of the stem will not encroach into the adjacent property.

6.2 The new basement will be designed as a series of hit and miss retaining walls no more than 1m apart. The other option would be a series of bored piles to retain the earthwork and foundations adjacent to the existing structure, boundary walls and garden earthwork. As the proximity to the existing structures are quite close and may be subject to vibrational damage, the hit and miss excavation sequence may be more appropriate. Both options will be discussed with a contractor.

6.3 The underpins and new retaining walls will be analysed and designed as cantilevered retaining walls for temporary and permanent conditions. The vertical loads applied to the underpins will be calculated in accordance with the loading from the walls of the superstructure.

6.4 In the temporary condition, the loads from the upper floors and the roof will be ignored as it will produce a minimum value for the overturning and sliding checks for the underpins. Only soil pressures and surcharges will be calculated and the underpins and retaining walls checked for resistance as free standing cantilevers.

6.5 In the permanent condition, the loads from the upper floors and the roof will be added to increase bearing capacity of the underpins. For the retaining walls, garden use loading will be added. Along with the soil pressures and the surcharges, hydrostatic pressures and lateral pressures will be included in the calculation. The basement will be designed to be fully submerged under the water table. The ground floor structure and the basement slab will restrain the underpins against overturning and sliding and as such can be designed as a propped cantilever.

6.6 Surcharge on the underpins and retaining walls:

Concrete Slab:	4.00 kN
Internal Live Loads:	2.50 kN/m^2
Garden:	5.00 kN/m^2
Highway:	10.0 kN/m^2

6.7 If the underpins or retaining walls fail the temporary checks, they will be designed with either downstands or heels to counter the moment resistance, failing which, a propping reinforced concrete beam will be added on top of the surrounding walls to hold the underpin laterally in place or temporary works will be specified to hold the underpin in place till the permanent condition.

7.0 Geology and Hydrology Conditions

7.1 Local knowledge of the area backed up by the British Geological Maps suggests the underlying soil to comprise of London Clay Formation (clay, silt and sand).

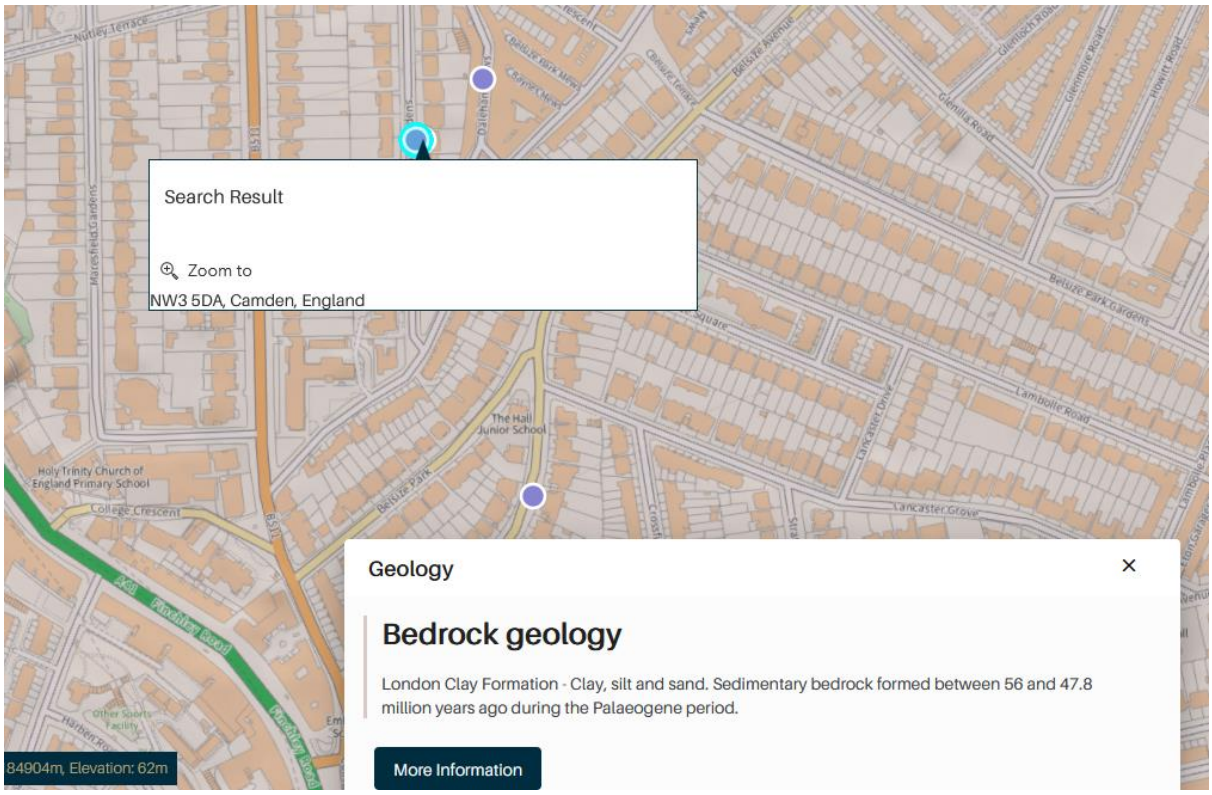

Figure 1 Soil profile from the British Geological Society

7.2 The water table level on the nearby site was recorded at 7.4m below ground level and therefore should not interfere with the proposed construction of the basement. The uplift forces from the water pressure can be easily counteracted by the self-weight of the basement structure itself and if necessary the addition of tension piles should further reinforce it.

7.3 Clay, silt and sand in particular London clays are considered to suit the proposed type of construction and can easily assume a bearing capacity of 120kN/m2 which have been assumed in the design of the structure at this stage. We have designed and constructed similar basements using the proposed typical basement underpinning and retaining wall techniques.

7.4 The local area is flat and there are no ponds, streams or other water surfaces on or immediately adjacent to the site. The local area is predominantly residential properties intersected by highways and will either be discharged into local drainage system or infiltrated by green permeable areas or gardens. The proposal does not materially alter the existing surface water flow path.

7.5 The detailed design of the basements will take into considerations the recommendations of the a specific and intrusive ground investigation report which will be carried out with the planning approval of the project. Structural inspections will be carried out to ensure that adequate temporary works are placed during the excavation below the ground level to address any deformation of the wall and bracing of adjacent foundations. A de-watering specialist will be brought on board to deal with the safe removal of water from the site without the removal of fines in the event of flooding from ground water.

7.6 Once the construction process is completed, an internal waterproofing system that is compliant with BS.8102:2009; "Protection of below ground structures against water from the ground" such as the DELTA Cavity Drained System will be installed. This will comprise of the MS-500 for the newly formed basement walls and MS-20 for the basement slab installed in conjunction with a dual V3 sump pump station to keep the basement waterproof. A basement waterproofing consultant will confirm the specification.

8.0 Flood Risk Assessment, Drainage and SuDS

8.1 The flood zone map from the Environmental Agency shows that the site falls in a Flood Zone 1, which has a low probability of flooding from rivers and the sea and therefore poses a very low risk of flooding. Any further mitigation against potential risk of flooding to the proposed development are not required at this stage.

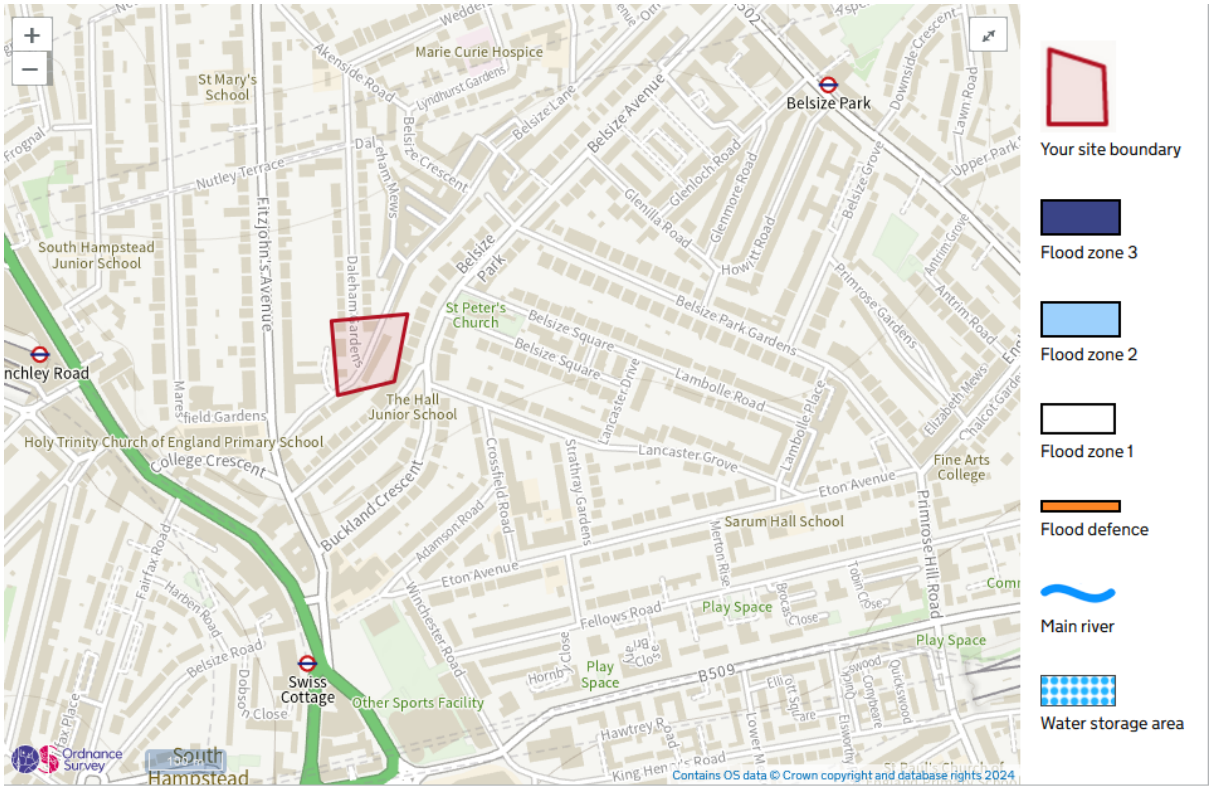

Figure 2 Flood Zone Map. Environment Agency.

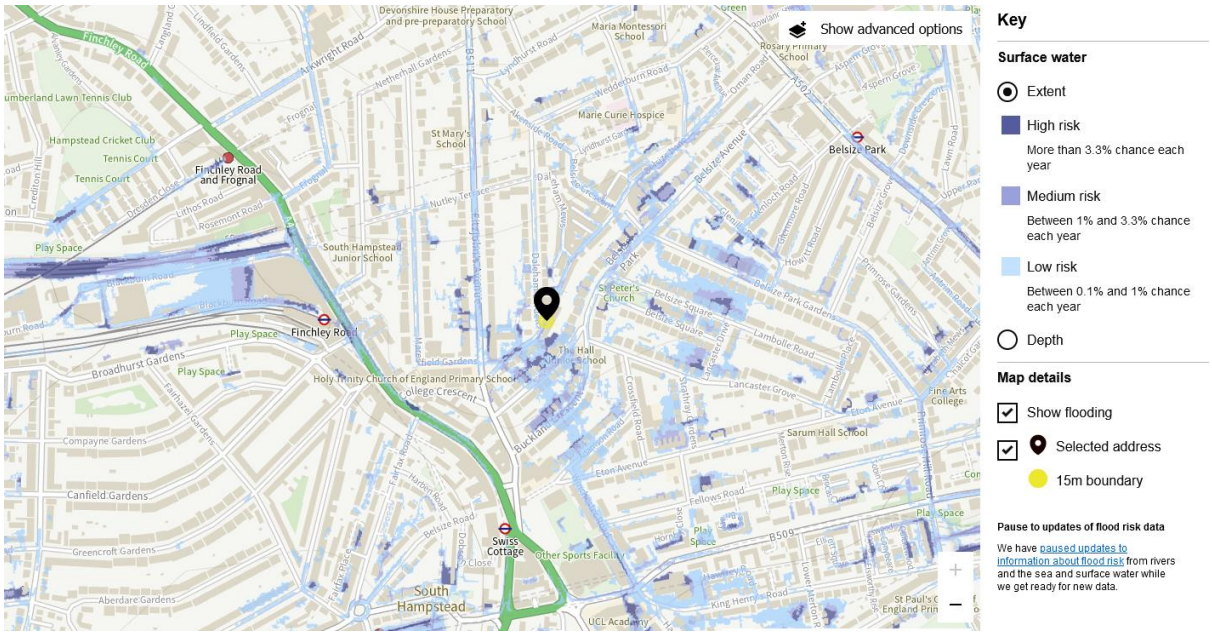

Figure 2 Surface Water Map. Environment Agency.

8.2 The proposed development shows a high risk of surface water flooding. High risk means that this area has a chance of flooding of greater than 3.3% each year. This is caused during times of heavy rainfall when the local combined sewer system is unable to deal with the volume and rate of flow. Detailed modelling suggests that areas of West Hampstead, Hampstead Town and South Hampstead are at a higher risk of surface water floods, with some risk in Highgate and Gospel Oak.

8.3 The property is already connected to a combined drainage system and an existing drainage system will be maintained so as not to increase any further surface runoff into the basement drainage system. Care must be taken to locate and ensure the existing soakaway for the property is relocated if within 5m of the new proposed basement construction so as to not affect the existing infiltration of the garden. All existing SuDS systems are to be maintained and a green roof above the basement proposal is recommended to maintain the infiltration area of the existing garden. There will still be a significant proportion of the garden retained for infiltration.

8.4 Careful consideration has been taken to design a drainage plan that requires the use of sump pump for both the ground water and surface water runoff. In the permanent state, the Dual V3 pump from DELTA membrane systems will be able to deal with the surface run off in a lightwell catchment area. This design will be submitted to DELTA to ascertain the most effective design for the pumps.

8.4 In the temporary state, during the construction of the basement, a dewatering specialist may be engaged to keep the surface runoff as well as the ground water constantly pumped into the existing gravity-fed drainage system until the sump pumps are installed if required.

8.5 The pumps will be serviced and commissioned every 6 months to ensure that the pumps, alarms and backup systems are fully operational and in working condition. A recommendation to register with the EA flood warning service, "Floodline" will be advised to the Building Owner so that the occupants can be prepared in the event of a possible flood.

8.6 An internal waterproofing of the basement will be achieved by the installation of a propriety cavity membrane system that will be used in conjunction with the drainage sump pumps. The DELTA MS-500 and DELTA MS-20 systems both conform to the BS 8102:2009 *Code of Practice for Protection*

of Below Ground Structures against Water from the Ground and will prevent the ingress of additional ground water and mitigate flooding.

8.7 The design also considers have an upstand over the entrance of the lightwells to prevent further surface runoff from entering the basement drainage area. All utilities services such as fuse boxes, metres, main cables, gas pipes, phone lines and sockets will be positioned as high as practical. Central heating pipe work shall be easily accessible in the event of a possible flood.

9.0 Potential Ground Movement on Site and Adjoining Properties

9.1 The proposed basement under the garden will be designed using robust engineering principles and a sequential retaining wall construction method. Our design philosophy along with this tried and tested method of construction mitigates the amount of potential ground movement and so minimises the effects of settlement to the adjacent structures.

9.2 The proposed structural design and method of construction of the basement has been developed with a view to ensuring structural safety, and that if constructed in accordance with this documents the works will be considered satisfactory. The designing structural engineer will be part of the project review team and will be frequently invited to observe the construction at regular intervals.

9.3 Where required to safely work with existing structures, the underpinning method involves transferring the foundation loads to a lower level and as such might lead to noticeable settlement. This settlement can be mitigated by provided an experienced contractor is appointed who undertakes the works using good practice and in accordance with the proposed structural design.

9.4 The contractor must follow all agreed method statements, install all necessary temporary vertical and lateral supports required. The contractor will be required to submit for approval – prior to construction – method statements, risk assessment plans and proposed temporary support details. Monitoring of the proposed basement and adjacent structures will need to be taken by the contractor.

9.5 The principal designer anticipates that should any damage occur, it will be classified as Category of Damage 1: "fine cracks which can be easily treated using normal decoration; typical crack widths up to 1mm", which can be taken to represent 'aesthetic' damage (BRE Digest 251: "Assessment of Damage in Low – Rise Buildings", Table 1).

9.6 The method of construction has been developed with a view of ensuring structural safety and if constructed in accordance with this document, the works should be completed with no adverse impact on the structural integrity of the neighbouring properties, other adjacent structures, adjoining land and gardens or the adjoining Public Highway.

10.0 Potential Impact on Existing and Surrounding Utilities, Infrastructure and Man-Made Cavities

10.1 Any local services on the property will be maintained during construction and re-routed if necessary. The exact location will not be known until the works commence, however, their impact will be negligible if maintained. If it is necessary to relocate or divert any utilities, the contractor will be 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 determine whether to grant approval. There will be no man-made cavities (e.g. tunnels) in the vicinity of a proposed basement.

11.0 Potential Impact on Drainage, Sewage, Surface and Ground Water Levels and Flows

11.1 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, therefore there will be no significant increase in discharge to the existing drainage and sewer system. The basement drainage will need to be on a separate drainage system connected to pumps linking to the existing drainage.

11.2 If there is a need to link the existing systems to the pump, a suitable pump must be installed to carry the increase in capacity. The pump installer is to provide a drainage plan if required. Surface water will not be altered as the proposed works are underground. Borehole data from the soil report confirm that the new basement will be formed above the ground water level, thus there will be a negligible impact on ground water flows and levels.

12.0 Potential Impact on Trees and Surrounding Vegetation

12.1 If required, the arboriculturist will provide the specification for root barriers that would prevent the roots growing too close to the basement structure and exerting a lateral pressure on them. Should that not be feasible, the basement may have to be design with the root protection area in place. The rest of the rear garden will remain unexcavated, thus allowing new trees and shrubs to be planted, if so desired. A landscaping plan will be provided by others.

13.0 Slope Instability

13.1 The site is located on ground that is relatively flat and so slope instability can only be initiated in the temporary condition as the basement is being built. This would be due to a collapse during the excavation of a partially formed underpin. This would be highly unlikely due to the construction sequence and the implementation of temporary works as discussed in this document.

14.0 Structural Design Criteria

14.1 For the design, concrete with a characteristic compressive cylinder strength of 32 N/mm^2 with minimum cement content of $300kg/m^3$ maximum aggregate size of 20mm and a w/c of 0.45 and reinforcement with a strength of 500 N/mm^2 was taken. The sizes and spacing of the reinforcement has been specified in the calculations sheet.

14.2 The cover specified for the toe is 50mm, while for the stem, wall and downstand, the cover specified is 35mm. The specified mortar is class (iii). The connections of the steelwork, whether beam to beam or beam to column, unless specified, will generally comprise of end plates with a minimum of M16(8.8mm) bolts.

14.3 The geotechnical engineer has advised to use the Aggressive Chemical Environment for Concrete (ACEC) Classification is **AC-1** with a Design Sulphate Class for the site of **DS-1**.

15.0 Designers Risk Assessment

Potential Hazard	Action Required	Risk Assessment
Falls from Height	Provide hand rails and access scaffolding to all openings	Medium
Falling Debris	Provide toe boards, netting and protection fans	High
Material Storage	Existing floors and roof not to be used for storage of materials	High
Lifting of Steelwork	Large span sections to be spliced to minimise handling or to use mechanical means where practical.	High
Erection of Steelwork	Contractor responsible for erection procedure including any temporary bracing.	Medium
Excavation	Take precaution against collapse of excavation and hazards of persons falling in.	High
Insitu Concrete Construction	Take precaution to prevent skin/eye contact. Protect public and site personnel from spillage.	Medium
Formwork/Falsework	Design temporary works to allow for accidental loading. Supports not to be removed until specified.	Medium
Forming New Openings in Walls	Provide temporary works to support wall and loads above openings. Install new support lintels and reinstate prior to removal.	Medium
Reinstate Existing Ground Floor	Provide temporary works to support floor till permanent structures are in place.	Medium

16.0 Construction Methods

16.1 The proposed basement development will be managed and constructed by a competent contractor with the appropriate experience and expertise in basement construction and working in restricted sites. The contractor will undertake the proposed basement in accordance with the Considerate Constructor's Scheme standards, ICE Demolition Protocol and GLA's best practice guidance documents.

16.2 As the property is located in a residential area, the contractor will employ appropriate measures of construction to minimise noise and nuisance to the neighbours as far as reasonably practicable. The contractor shall obtain the necessary licences and approvals for the noise notices from the relevant authority.

16.3 The contractor shall obtain all necessary licences and approvals for the necessary parking bay suspensions, yellow line dispensations, temporary platforms, skips and disposal of specified wasters from the relevant authority.

16.4 The contractor shall ensure all plant and/or materials temporarily stored on the public Highway/foot path does not cause any obstruction or hazard to the general public. A conveyor belt will be set up at the rear of the property to convey the spoil from the excavation to the skip placed on the road for disposal. The basement will be excavated by hand and spoil removed to a licensed facility. Ready mixed concrete will be delivered to site by road. The ready mix trucks will park in a designated bay on the road outside the property and the concrete will be pumped to the required location.

16.5 Excavation will commence at the rear of the property, with access from the garden. See typical construction sequence for a typical underpin. The underpins to form the basement may require horizontal propping until completion of the basement slab. Any existing foundations found will be broken out and removed from site to make way for the new basement construction.

16.6 The existing walls of the existing building will be temporarily supported using steel beam needles at regular centres, as necessary. Temporary concrete pad foundations may be required beneath the props, or the props may be supported on the concrete bases of underpins already constructed, wherever the location allows.

16.7 New concrete pad foundations and strip foundations will be constructed, where specified on structural drawings as well as new steel beams and columns. These will be supported on the underpins or on new foundations. Padstones will be specified to spread the load on the existing masonry down to acceptable levels. The top of new steel beams will be dry-packed to the underside of the existing walls above, and the existing walls repaired and made good where required.

16.8 When all underpins to the existing property and new retaining walls have been completed, bulk excavation to the whole site will be carried out. Horizontal propping across the site, if required by design, will be installed at a high level and again approximately 500mm above the proposed basement level once the bulk excavation is down to that level. Propping should be done via a proprietary system such as RMD Superslim Soldiers or similar. Excavation can then be carried down to formation level.

16.9 The drainage for the foul and ground water will then be embedded in the slab. The pumps will discharge the foul / ground water into the existing sewer system to the front of the property. The

reinforcement for the slab should then be installed to the structural drawings. The new ground bearing slab will then be constructed.

16.10 Once the new basement slab has gained sufficient strength, the horizontal propping across the site will be removed. After the new basement slab has cured, a cavity drain membrane compliant with British Standard "BS 8102: Protection of below ground structures against water from the ground" will be laid to the slab and the walls.

16.11 A layer of insulation will be placed on top of the membrane and finally a layer of screed will be laid to form the finished basement floor. For the case of encountering water, the contractor must use suitable methods to ensure that the de-watering process does not undermine the structural process and that it does not cause any loss of fine soil particles.

17.0 Typical Underpinning Sequence

2	**4**	**1**	**3**	**5**	**2**	**4**	**1**	**3**	**5**

18.0 Underpinning and Retaining Wall Specifications

18.1 All works should be carried out in accordance with Engineer's drawings and specifications and to the approval of the Building Control Inspector and/or Local Authorities. The contractor shall be responsible for the safety of the underpinned/retained structure and retained soil and should provide all necessary shoring, strutting and bracing requirements to ensure its safety and stability at all times.

18.2 The contractor should produce a method of works and drawings marked up to show the proposed sequence of retaining walls and/or underpinning a minimum of 14 days before work commences. Any excavations are to be inspected by the Engineer and/or Building Control Inspector before the underpins or retaining walls are cast.

18.3 The walls to the perimeter of the new basement shall be cast as new retained walls in reinforced concrete according to the structural drawings. The walls shall take the vertical loads from the roof slab and horizontal loads from the earth and water. The bays of the retaining walls and underpins shall be excavated in short sections not exceeding 1m in width. The sequence of the retaining wall/underpinning should follow the above sequence or be as such that any given stems will be completed, drypacked and a minimum period of 48 hours lapsed before an adjacent excavation shall commence to form another underpin.

18.4 In the event that the existing foundations to the walls are found to be unstable, sacrificial steel jacks shall be installed underneath the foundation to prop the bottom few courses of brickwork. These steel jacks shall be left in place and shall be incorporated into the concrete stem. In the event that the ground is unstable, lateral propping shall be required to the rear of the excavation and to the sides of the excavated working trench. The front or side faces of the excavation shall be propped using trench sheets or plywood, timber frames and Acrow props, as appropriate.

18.5 Sacrificial back shutters shall be used to the rear face of the excavation (i.e. underneath the wall). These shutters shall be 12.5mm thick GTEC Aqua Board or 12.5mm thick Knauf Aquapanel Cement Board or similar approved. Cementitious grout shall be poured behind the back shutters to fill up the voids behind those shutters. The excavation for an underpin section shall be dug in a day, and the concrete to the base shall be poured by the end of the same day. The concrete stem shall be poured the following day. This shall be poured up to within 50-75 mm of the underside of the existing wall foundations.

18.6 24 hours after concreting the stem of the retaining wall/underpin, the gap between the concrete and the underside of the existing foundation shall be drypacked with a 1:1 sharp sand / cement mix with "Combex 100" expanding admixture in accordance with its instructions. 24 hours after drypacking, any protrusions of the foundation into the site shall be saw-cut and trimmed back flush with the face of the wall above using hand tools to avoid causing any damage to the foundation.

18.7 A minimum of 48 hours shall be allowed before adjacent sections are excavated to form a new retaining wall / underpin. Adjacent wall sections shall be connected using T16 dowel bars on each face at 400mm vertical centres, front face and rear face staggered, 800mm long with 400mm embedded in each underpin. Dowel bars may be driven into the soil prior to concreting a wall section, or alternatively drilled and resin fixed after concreting the section. Corner pins to have similar dowel L-shaped bars.

18.8 The minimum concrete cover to reinforcements shall be 35mm for top faces or front faces of retaining walls / underpins. Where the bottom face is cast against a concrete blinding or rear face against a sacrificial back shutter, the minimum concrete cover used shall be 50mm. If they are cast against the earth, then the minimum concrete cover should be 75mm.

19.0 Quality Control and Defective Works

19.1 Where in the opinion of the Engineer, any finished Works or materials or workmanship in any part of the Works fails to comply with this specification, that part of the Works will be classed as defective. All work classified as defective shall be cut out and removed from the Works and replaced or otherwise dealt with in an approved manner. For the repair of concrete damaged by shrinkage and repair with Colebrand or a similar approved system may at the discretion of the Engineer be used, the costs of such works are to be met by the Contractor.

19.2 In setting out and construction of excavations and filled areas the Contractor shall allow for settlement and heave whether caused by consolidation of fill, settlement of foundations, heave in excavations or change in volume of materials after excavation. Formation levels shall be within zero and -25mm of the levels shown on the drawings. Other earthworks levels shall be within zero and -100mm of the levels shown on the drawings.

20.0 Appendix

Attached	Typical Underpinning Method
	DELTA Dual V3 Sump Pump Station Technical Data
	DELTA MS500 & MS20 Technical Data

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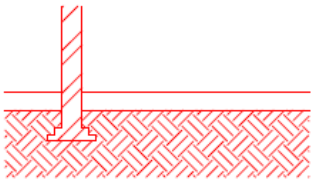
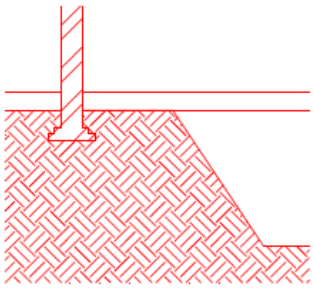
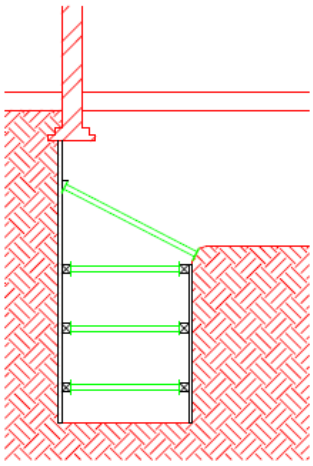
21.0 Typical Underpinning Method



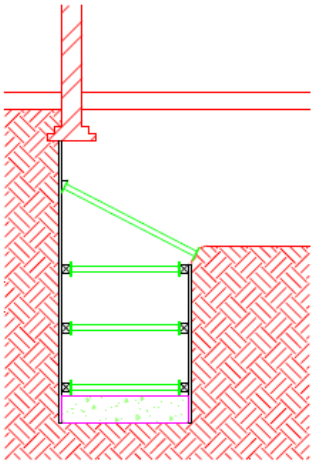
STAGE 0
EXISTING CONDITION



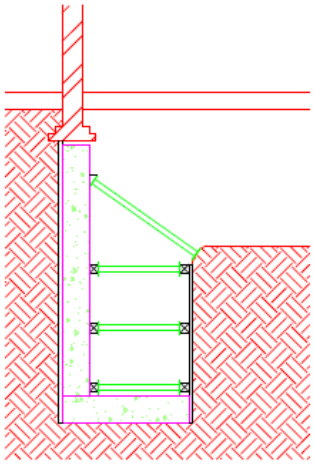
STAGE 1
GENERAL LEVEL REDUCTION



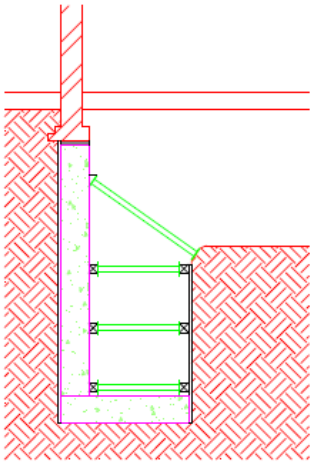
STAGE 2
EXCAVATE TO FORM UNDERPIN; PROVIDE
EXCAVATION SUPPORT IF NECESSARY



STAGE 3
CONSTRUCT BASE OF UNDERPIN



STAGE 4
CONSTRUCT STEM OF UNDERPIN



STAGE 5
DRYPACK GAP BETWEEN TOP OF UNDERPIN
& UNDERSIDE OF EXISTING FOUNDATION,
TRIM - OFF ANY PROJECTING FOUNDATION