

## Project No. 4122

Proposed Construction of a Single Level  
Basement and Alterations at;

10 Antrim Grove, London, NW3 4XR

## Structural Design Philosophy



**S. R. MASTERS**  
B.Sc.(Hons), C.Eng., M.I.Struct.E., M.B.Eng.

**December 2012**

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## **INTRODUCTION TO MMP DESIGN**

MMP Design Limited was formed as a private limited company in 1988 by one of the current Directors. Since then it has developed into its present form as a firm of consulting engineers with expertise in Structural and Civil Engineering Services.

Within the Company experience has been gained in a range of projects from structural surveys through refurbishment to multi-million pound developments and the Directors have experience in residential, retail, commercial, community care and educational projects. The Company also has commitment to all types of work including Design and Construct projects.

The Company philosophy is to provide the fullest and most cost effective service to Clients. The Directors have a direct involvement with each project taking on the day to day control in order to provide the best possible service and the experience of the principals in the construction processes ensures that the objectives of buildability and cost effectiveness are met.

With regard to the Company's association with retro-fit basements, we have been working within this field since 1999 and during that time have had a direct involvement in the design of more than 630 such schemes.

## **MMP DESIGN DIRECTORS**

Steven R. Masters - BSc(Hons), C.Eng., M.I.Struct.E., M.B.Eng.

Philip Seastram - BSc(Hons).

Andrew J. Stone - BSc(Hons), C.Eng., M.I.C.E., M.I.H.T., Eur.Ing.

## **EVIDENCE OF COMPETENCE & RESOURCES**

### **Details of Organisation**

Name: MMP Design  
Address: First Floor Unit 6  
Union Park  
Packet Boat Lane  
Uxbridge UB8 2GH  
  
Contact: S. R. Masters

### **Nature of Organisation**

Consulting Civil, Structural and Highway Engineers

### **Incident/Accident Record**

None recorded

### **Membership of Professional Bodies**

S. R. Masters - BSc(Hons),C.Eng.,M.I.Struct.E.,M.B.Eng.  
A. J. Stone - BSc(Hons),C.Eng.,M.I.C.E.,M.I.H.T.,Eur.Ing.

### **Professional Indemnity/Liability Insurance**

PI is in place to cover our duties under CDM with cover limited to £1,000,000 and the liability period limited to 6 years. Details are available upon request.

### **Details of Persons to be Employed**

S. R. Masters & A. J. Stone – Chartered Engineers & Project Leaders  
P. Seastram – Project Leader & Designer  
M. Kruz – Designer  
N. King & S. Barrow – CAD Operators

### **Familiarity with Construction Processes**

The Directors have extensive experience in underpinning and retro-fit basement construction and have been instrumental in the development of some of the working practices adopted by the leading basement constructors.

### **Awareness of Relevant Health & Safety and Fire Regulations**

Within the Company we have documentation relating to these matters which are regularly updated and circulated among the Directors and members of staff.

### **Health & Safety Practices**

A copy of the Company's Health & Safety Policy is available upon request.

## **Management Systems**

A Project Director is responsible for the design and resourcing of the project. Generally projects are undertaken in house with occasional external draughting only where necessary. Communications are by way of verbal and/or written instructions. All work is checked before leaving the office.

## **Resources**

The Company comprises three working Directors together with full time and part time technical assistance sufficient to meet the design requirements for this project.

## **Technical Facilities to Support the Designer(s)**

SCALE Structural Design suite  
Staad/QSE Structural Analysis suite  
Members of BSI  
Members of TRADA  
Members of BRE

## **Method of Communication Design Decisions**

Design decisions are communicated verbally and confirmed in writing or by drawing revisions. All drawings are issued to relevant parties as required by the Lead Consultant and/or the Client.

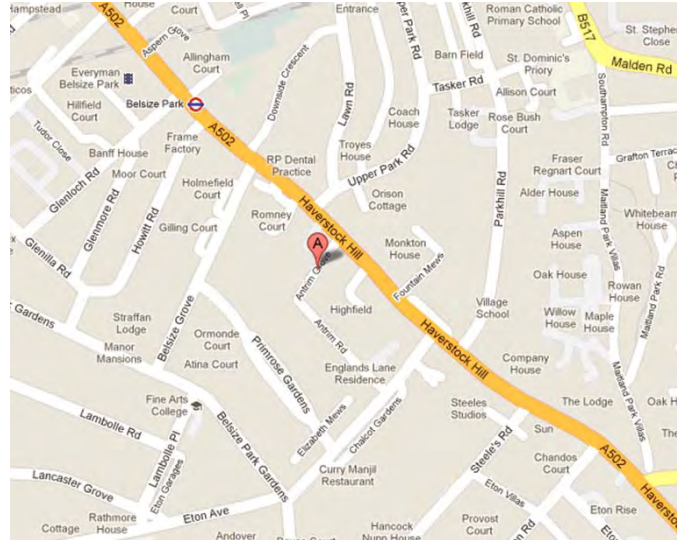
## **Remaining Risks**

Remaining risks will be communicated in writing to the appropriate Authority.

## **THE SITE AND THE PROPOSED DEVELOPMENT**

The property occupies a gently sloping site, the slope upward from the front to the rear and shares a party wall with No. 8 Antrim Grove, to the right when viewed from the street.

It is proposed to add a single level basement beneath the existing building footprint and most of the front and rear gardens, extending to approximately 4.0m below the level of the existing ground floor.



## **EXISTING STRUCTURE**

The existing structure is an early 20<sup>th</sup> century semi-detached property originally comprising three storeys, the uppermost storey within the tile covered pitched roof and to the rear a small single storey flat roofed area.

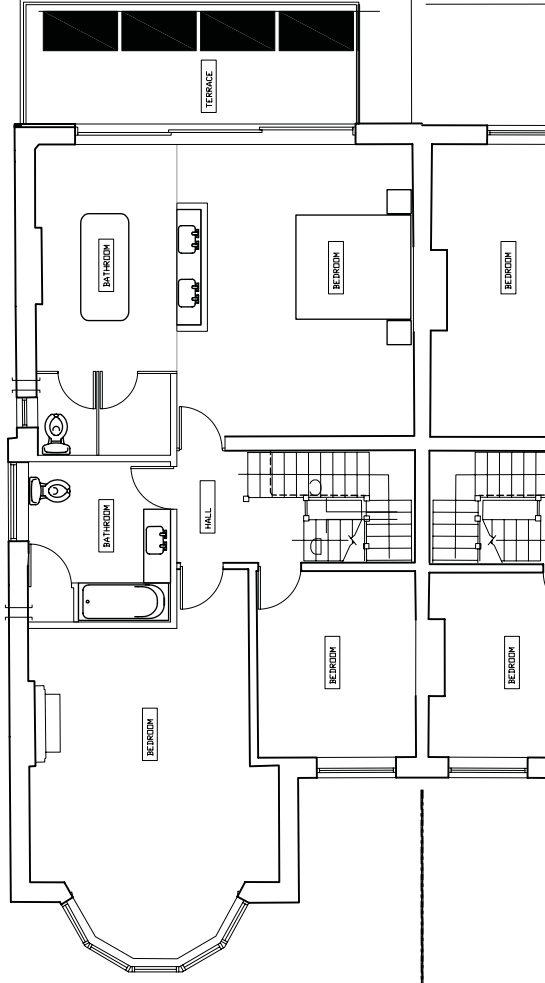
The external and party walls are of solid masonry which likely extend down to a corbelled brick and concrete footing; the internal load bearing walls are also of masonry except at the second floor level where they are of timber studwork.

The ground floor within the rear annexe comprises a ground bearing concrete slab whilst the remainder of the ground floor and the upper floors are of suspended timber.

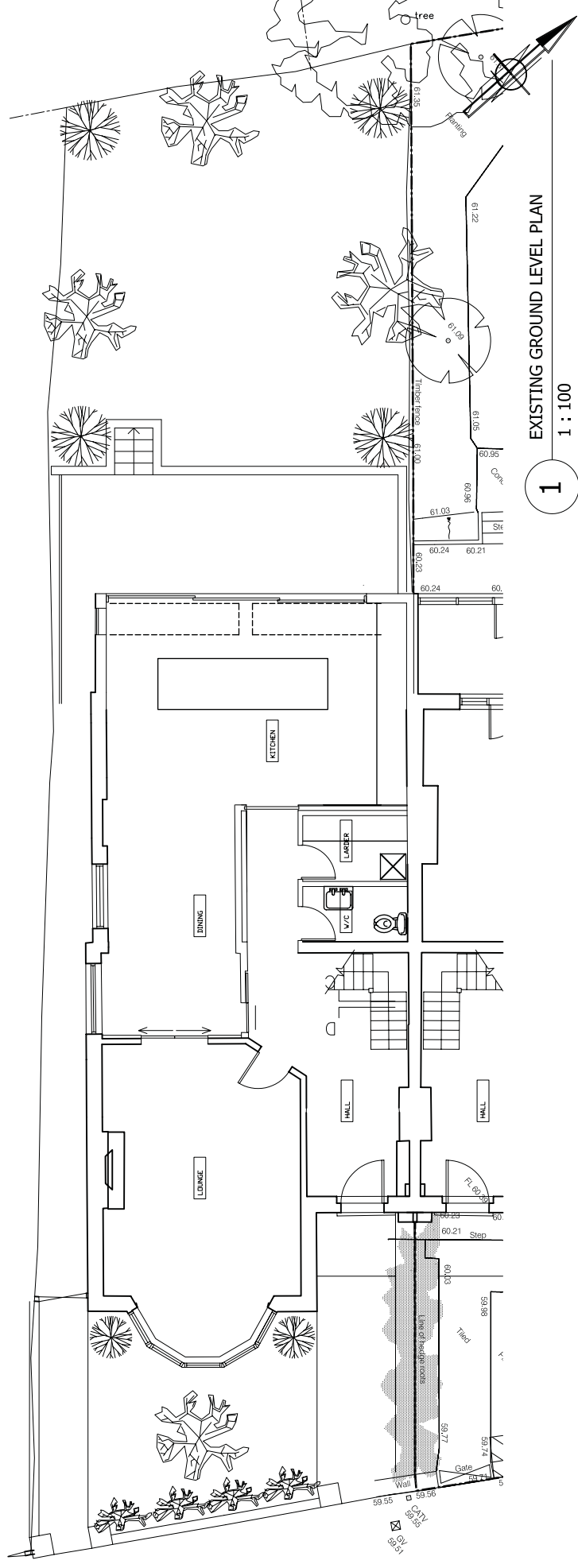
The property has experience extensive alterations over the years and the single storey area to the rear is an extension.

Plans showing the existing floor layouts are attached.

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2  
EXISTING FIRST FLOOR PLAN  
1 : 100



1  
EXISTING GROUND LEVEL PLAN  
1 : 100

EXISTING PLANS

DATE  
JAN 2012

SCALE  
1 : 100  
@A3

DWG NO  
1115

DWG NO/REV  
101/-

LOCATION  
10 Antrim Grove, Belsize Park  
London NW3 4XR

DRAWING TITLE

B  
chitecture  
11A Belsford Road London NW2 8AT  
t: 0203 706 417 e: bel@bchitecture.com

## **SOIL CONDITIONS & FOUNDATIONS**

A site investigation was carried out by Site Analytical Services Limited on 7<sup>th</sup> March 2011 and their report reference 11/17630 is attached. Generally the investigations confirmed the presence of firm to stiff London Clay to depth and no significant standing water.

In the absence of a site specific site investigation we have looked to BS.8002, BS.8004 and the Reinforced Concrete Designers Handbook (by Charles E. Reynolds and James C. Steedman) for a suggested range of parameters to be adopted for the design. For the soil profile previously described the guidance suggests an Angle of Internal Friction of 20-40° and an allowable Net Bearing Pressure (with no addition for depth of embedment) of 75-150 kN/m<sup>2</sup>.

Hence the following parameters will be adopted.

$$\phi = 30^\circ \text{ (so } K_a = 0.333) \text{ and } \delta = 18 \text{ kN/m}^3$$

$$\text{Allowable bearing stress at GL} = 75 \text{ kN/m}^2$$

$$\text{Allowable bearing at Basement Level} = 75 + \text{soil removed, say} = 140 \text{ kN/m}^2$$

These parameters have been confirmed by previous testing regimes carried out over a period of more than 10 years and are accepted by the checking authorities of no less than 13 London Boroughs. They represent the long term condition which when combined with the design being based on active earth pressures results in a much simplified but rather conservative approach.

It should be noted that the nature of the construction of a basement ensures that the front lightwell excavation is formed first in order to gain access to the working area; in effect a substantial and full depth trial pit is formed before any foundation works are commenced. Should the conditions encountered vary in any way from those described above then the design will be re-visited before any underpinning works are commenced.

## **WATER**

As previously described, the soil type anticipated at this site is London Clay and no significant water presence is anticipated. The Clay has a relatively low permeability to water and in essence presents an almost complete barrier but there can be some permeation albeit extremely slowly and there is also the possibility of some faster flow through fissures or localised zones of more granular material which could cause an occasional build up against the new basement wall.

It is for these reasons that water will be assumed with the level being 0.75 x the retained depth or at 1m below GL, whichever is the worst condition.

It is commonly accepted that increasing the size of an existing cellar as we are proposing has little or no effect on the flow of local water in relation to adjoining properties. In fact even if mobile water was forced to find an alternative route as a consequence of the basement construction, any increase in the level of that water is likely to be significantly less than the natural variations associated with seasonal changes and rises in levels from extreme rainfall events. We concur with these views.



## **HEAVE & SETTLEMENT**

The underpinning process involves transferring the foundation loads to a lower level and inevitably this leads to some settlement. Some movement will also be caused by the sequential transfer of load between different parts of the structure but the careful control of the underpinning process and sequence will keep such movements to a practicable minimum. Particular care will be taken in the vicinity of the more vulnerable parts of the existing fabric.

The depth to the London Clay and the modest dimensions of the site are such that the heave of the Clay is unlikely to exceed a few millimetres or to have any discernible effect outside the site boundaries. Any movement that does occur will be further mitigated by the necessarily slow rate of the excavation and construction.

At the lower level of course, the basement floor slab will be used to resist these heave forces and by supporting the slab with the deeper underpinning and the internal column foundations, the resulting upward movement is used to counteract the increased settlements expected due to the increased dig depth.

## **EFFECTS ON ADJACENT STRUCTURES**

Outside of the basement area the change of vertical stresses in the ground may result in limited upward movements but the underpinning of the party wall may also cause some very minor settlements and horizontal movements towards the new basement.

In addition the underpinning operations may cause localised settlements of the party walls only which might result in cracks forming at the junctions of the walls of the adjoining property where they abut the party wall. It should be stressed however that any anticipated movements are expected to be minimal as they are generally suppressed by the stiffness of the structures above and those adjoining.

It is our experience that the potential for damage will be limited to the party wall but this can be mitigated by appointing a suitably experience Contractor familiar with propping techniques and sequential operations and by the Designer giving the necessary consideration to the risk by specifying measures to ensure that significant damage is avoided. This would typically be in the form of transitional underpins where we consider the structure above to be particularly vulnerable but otherwise by ensuring that the foundation transitions occur at inherently strong intersections of the more robust load bearing walls.

As a result we anticipate that should any damage occur it will be classified as Category 0 in the Category of Damage Chart, CIRIA C580. Category 0 is Negligible; hairline cracks of less than 0.1mm.

However, there will always be some movement as it can never be completely avoided and there are occasions where unforeseen conditions beneath the property which were not or could not be detected by the pre-construction investigations will result in more extensive damage. From our experience of designing almost 600 retro-fit basement the chance of such an occurrence is less than 2% and even then the damage would be classified as Category 1 in the Category of Damage Chart. Category 1 is Very Slight, fine cracks less than 1mm that can be easily treated during normal decoration.



## **Basement**

The remaining load bearing structure will be underpinned in a traditional 'hit and miss' method to achieve the increased headroom required. The underpins comprise a vertical stem which is immediately beneath the existing wall and a base which usually has a toe and a nominal heel. The heel size is determined by ignoring the earth pressure and considering the maximum vertical load on the wall only, using this to find a minimum foundation width based on the soil bearing capacity.

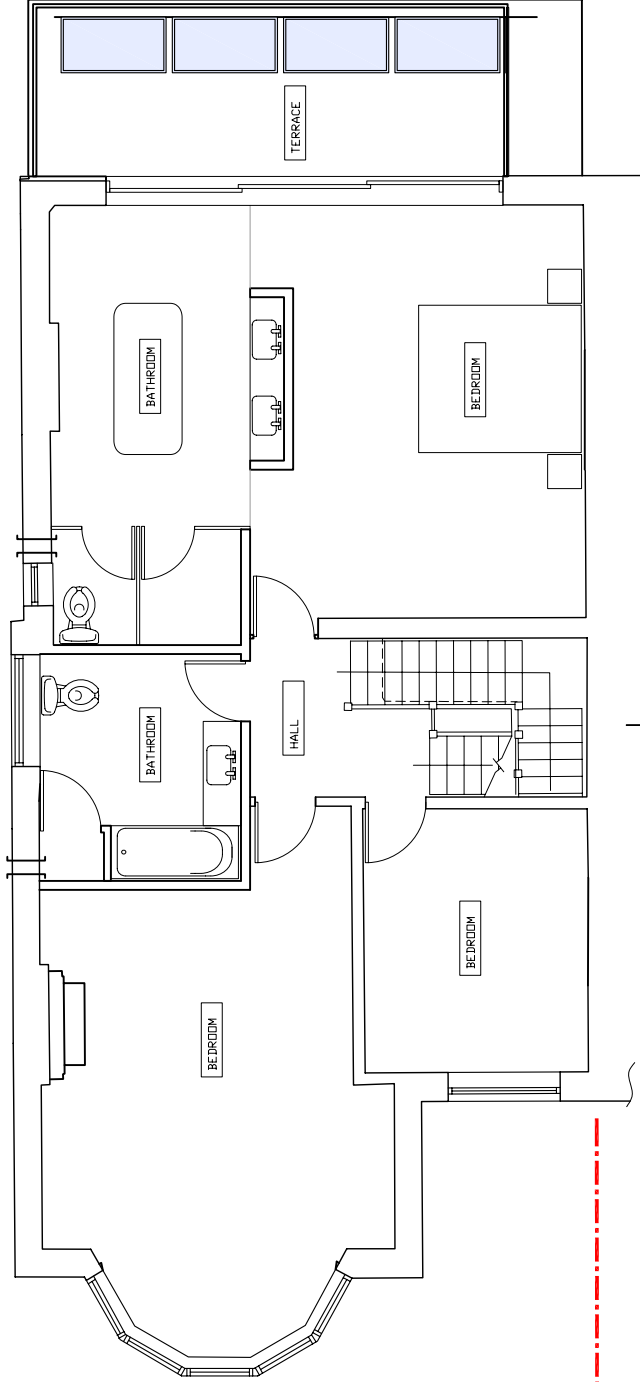
The toe of the base is then determined by considering the minimum vertical dead load on the wall along with the maximum pressure from the retained soil and with the wall assumed to be acting as a cantilever. In calculating the toe size, the maximum allowable bearing pressure is not exceeded and a minimum factor of safety against overturning of 2.5 is achieved.

The toe and/or stem will only be reinforced when the underpin stem is subjected to tensile stresses due to the pressures from the retained material. This usually only occurs where the London Clays are present or where the retained depth of soil is large.

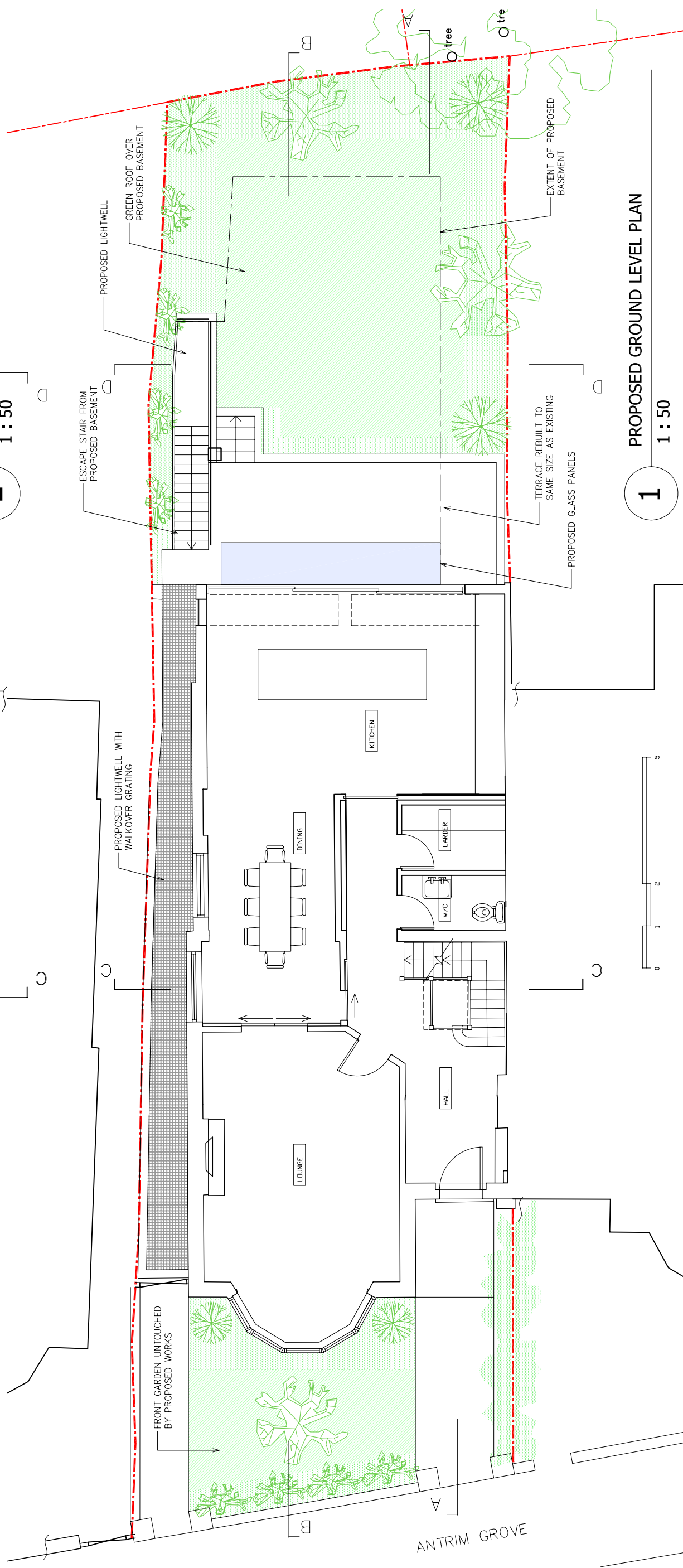
To check the stresses in the underpin stem, the overturning moment taken about the basement slab is used. However, the design of the toe and the overall stability is based on the overturning moment taken about the underside of the underpin base.

We assume the soil/stem interface to be friction free as ultimately this provides the most onerous design.

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2  
FIRST FLOOR PLAN  
1 : 50



1  
PROPOSED GROUND LEVEL PLAN  
1 : 50



PROPOSED PLANS

DRAWING TITLE

10 Antrim Grove, Belsize Park  
London NW3 4XR

LOCATION

Bchitecture  
11A Beresford Road London N2 8AT  
t 07932 796 407 e Bchitecture@gmail.com

DATE

APR 2010

SCALE

1:50 @A1  
1:100@A3

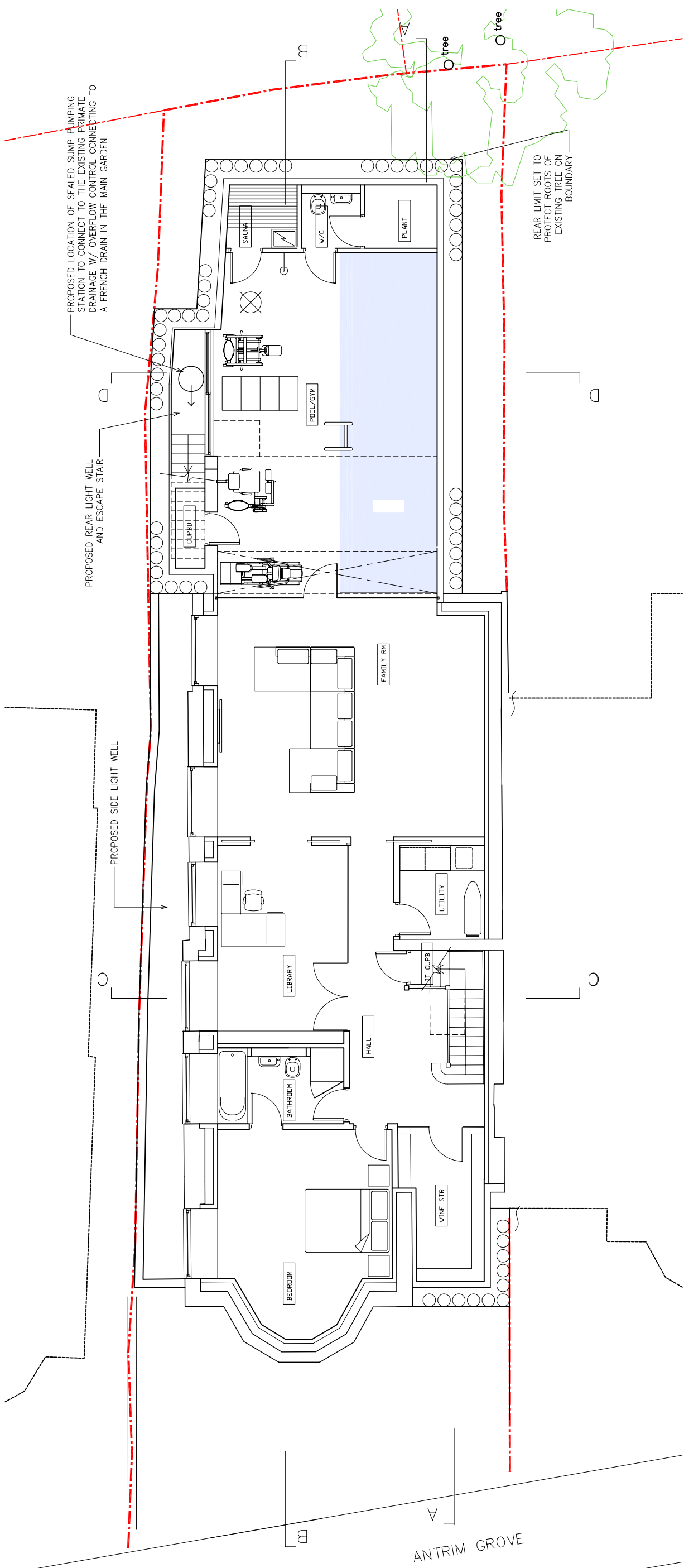
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DWG NO/REV

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PROPOSED BASEMENT LEVEL PLAN

1 1:50

Bchitecture  
11A Beresford Road London N2 8AT  
t 07932 796 407 e Bchitecture@gmail.com

LOCATION  
10 Antrim Grove, Belsize Park  
London NW3 4XR

DRAWING TITLE  
PROPOSED PLANS

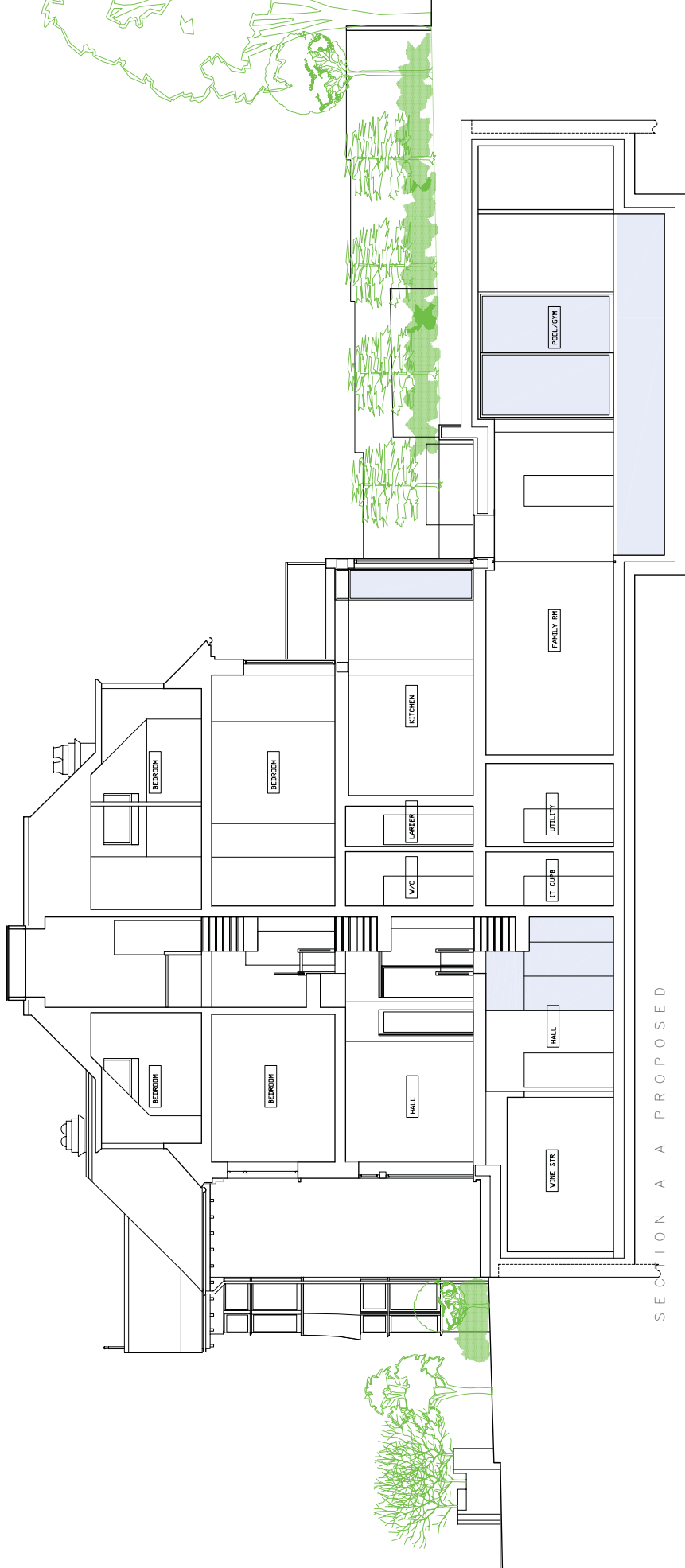
DATE  
APR 2010

SCALE  
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JOB NO  
1007

DWG NO/REV  
110/F

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SECTION A A PROPOSED

PROPOSED SECTION A-A

1 : 50

1



DWG NO/REV

115/D

1007

JOB NO

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1:100@A3

SCALE

DATE

APR 2010

PROPOSED SECTIONS

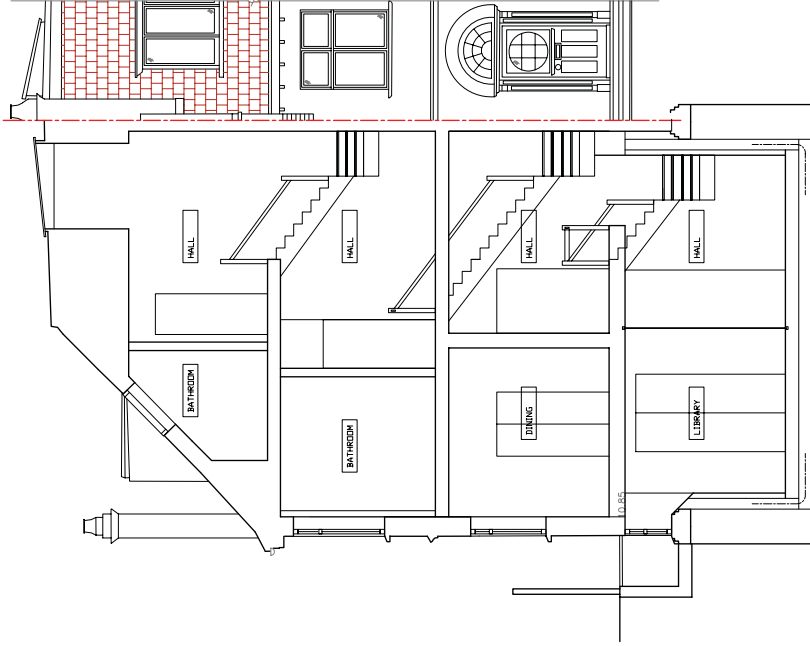
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10 Antrim Grove, Belsize Park  
London NW3 4XR

LOCATION

Bchitecture  
11A Bessford Road London N2 8AT  
t 07932 796 407 e Bchitecture@gmail.com

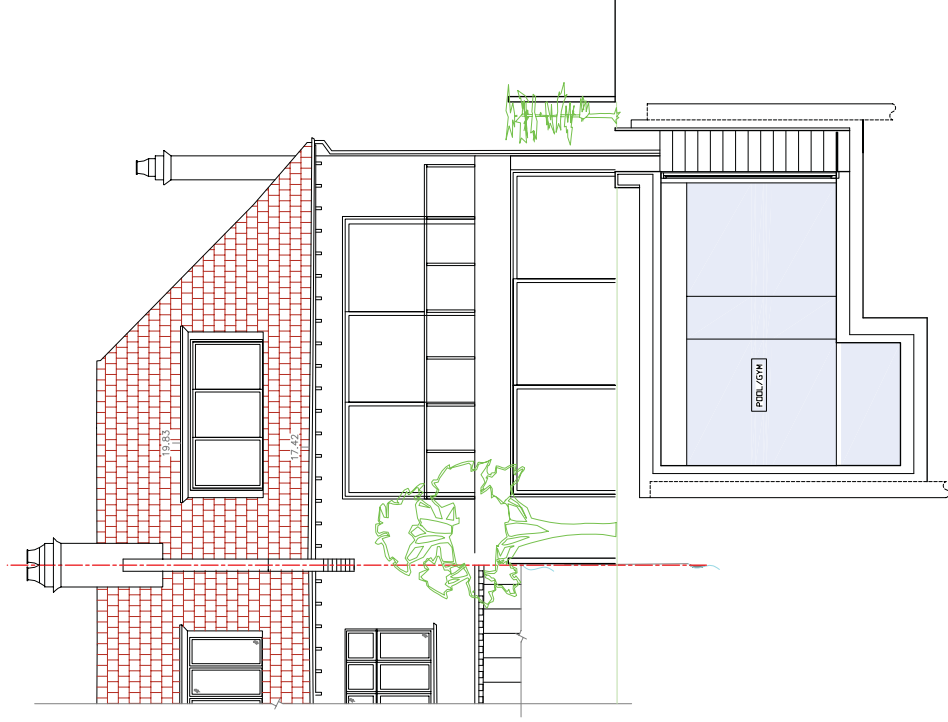
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PROPOSED SECTION C-C

1

1 : 50



PROPOSED SECTION D-D

2

1 : 50



## **DESIGN CRITERIA**

### **Highway Loads**

Where the proposed basement retaining walls are adjacent to the public highway, additional surcharge loads are considered and are taken as either of the following, whichever produces the more onerous design conditions.

- a... a uniformly distributed load of  $2.5 \text{ kN/m}^2$ , applied from within the garden and assuming private vehicle parking is possible,
- b... a uniformly distributed load of  $10 \text{ kN/m}^2$ , applied from the highway and/or footpath,
- c... a point load of 40 kN (a typical wheel load), applied over an area  $0.3\text{m} \times 0.3\text{m}$  and assumed to act at a point 0.6m from the property boundary, out toward the highway.

### **Existing Brickwork**

#### **Above Ground Floor**

Assuming minimum 10.5 N bricks in 1:1:6 cement/lime mortar, from CP.111 the basic compressive strength =  $0.95 \text{ N/mm}^2$   
Hence under a concentrated load, bearing strength =  $1.5 \times 0.95$ , say  $1.4 \text{ N/mm}^2$

#### **Below Ground Floor**

Assuming minimum 10.5 N bricks in 1:1:6 cement/lime mortar, from CP.111 the basic compressive strength =  $0.95 \text{ N/mm}^2$   
Allow no enhancement under a concentrated load.  
Hence bearing strength = say  $0.95 \text{ N/mm}^2$

### **Typical Underpinning Sequence**

6	1	4	7	2	5	8	3	6	1	4	7
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### **General**

Concrete is grade  $\text{C35 N/mm}^2$  using Sulphate Resisting cement unless otherwise directed.  
Reinforcement is grade  $500 \text{ N/mm}^2$   
Mortar is Class (iii).



## **DESIGNERS RISK ASSESSMENT**

### **Excavations**

Care must be taken to prevent sides of excavations from collapsing.

### **Suspended Floors**

The use of suspended insitu reinforced concrete ground slabs is expensive and impractical due to the extent of formwork required and the thickness of slab required.

Precast beam and block floors provide reduced weight and quick installation with holes and cutting for designed services carried out on site at the time of installation. However, during installation, and indeed before the floor is screeded, safety netting or air bags shall be provided to prevent injury due to operatives falling between the joists.

In-situ concrete slabs cast onto a profiled steel permanent shuttering provides a suitable alternative to the beam and block and removes the need for the netting or air bags. However, the manufacturer should always be consulted about temporary span propping that may be required prior to the concrete achieving it's design strength.

### **Masonry Walls**

A 150mm minimum thickness is required for design load resistance and height to thickness ratios. However the blocks tend to be too heavy to manhandle and so load bearing blockwork walls will be specified as 215mm thick and formed from 100mm thick blocks laid on their side.

### **Steel Beams**

Where possible, large span beams will be spliced to minimise manhandling. Other ways of minimising the weight of steel sections is to specify two channels bolted back to back in lieu of a single UB or UC section. However, there will be occasions where neither option will be practical and/or possible and the Contractor will be made aware of such situations.

### **Hazards & Risks Which Cannot be Designed Out**

<u>Potential Hazards</u>	<u>Action Required</u>	<u>Risk Assessment</u>
Falls from Height	Works being carried out - provide hand rails and access scaffolding to all openings.	Medium
Falling Debris	Works carried out above public access - provide toe boards, netting and protection fans.	High
Materials Storage	Existing roofs and floors are not to be used for storage of materials without reference to the Engineer or for supporting access scaffolding.	High

<u>Potential Hazards</u>	<u>Action Required</u>	<u>Risk Assessment</u>
Lifting of Steelwork	Steel sections to be lifted using mechanical means where unable to be manually lifted.	High
Erection of Steelwork	Contractor responsible for providing method statement for erection procedure, including any temporary bracing.	Medium
Lifting of Timber	Timber rafters and joists to be lifted using mechanical means where unable to be manually lifted.	High
Fixing of Timber	Timbers to be fixed in accordance with good building practice.	Medium
Reinstate Existing Roof Finishes	Method statement to allow for temporary waterproofing if required.	Low
Use of Cutting Equipment – Flame or Disc.	Fire risk - use suitable protective methods – remove inflammable materials.	High
Painting	Touch up steelwork with primer – take precautions against vapour inhalation, eye and skin contact and fire. Wear protective clothing.	Low
Excavation	Take precaution against collapse of excavation and hazards of persons falling in.	High
Precast Concrete units	Lift into position using mechanical assistance. Storage at ground level in a safe manner.	Medium
Insitu Concrete Construction	Take precautions to prevent skin/eye contact. Protect public and site staff from falling objects and spillage. Ensure adequate care when fixing reinforcement.	Medium

<u>Potential Hazards</u>	<u>Action Required</u>	<u>Risk Assessment</u>
Formwork/Falsework	Design temporary works in a manner that makes allowances for all loadings, including accidental loads. Ensure adequate vertical and diagonal bracing. Supports not to be removed until period specified.	Medium
Forming new Openings in Walls	Provide temporary works to support wall and loads above opening. Install new support lintel and reinstate prior to removal of temporary supports.	Medium

## **SEQUENCE OF OPERATION**

- The extent of the underpinning work is shown on the MMP Design drawings.
- Upon removal of the existing ground floor the external walls shall be fully propped using a proprietary system design and installed by an appointed specialist.
- The underpinning operations are to be carried out strictly in accordance with the sequence shown on the drawings.
- All concrete to be C35N/mm<sup>2</sup> @ 28 days.
- Each pin must not exceed 1000mm in length.
- A minimum of 24 hours must elapse after completion of dry-packing to one bay and the excavation of the next.
- At least the full width of the existing foundation must be replicated lower down and onto an acceptable bearing strata.
- Excavations are to be kept free of water and the sides of excavations are to be supported as necessary.
- Underpinning in each section should commence as soon as possible after an agreed formation depth has been achieved.
- Building Control will be given 24 hours notice to inspect and approve the required formation level and suitable bearing strata of the first pin. Any variations in the nature of the sub-strata will be notified immediately.
- The soffit of the exposed foundations is to be cleaned off prior to concreting.
- As indicated on the attached drawing the concrete is to be poured to a level approximately 75mm below the existing footings and allowed to cure for a minimum period of 24 hours. The void is then to be filled using a semi-dry cement and sand mix (in a 1:1 proportion) and rammed home to ensure a uniform transfer of load.
- As underpinning work is carried out against already completed bays, the concrete surface of the adjacent section should be hacked off and keyed to form a good key prior to the new concrete being cast. Starter bars will be drilled and inserted.
- Any supports to the excavations are to be removed progressively as concrete operations proceed so that no voids exist.
- All workmanship and materials must be approved by the BCO.