CONSTRUCTION METHOD STATEMENT

11 Fitzjohns Avenue, NW3 5JY

Project Number: 3032

Revision B

Prepared by Patrick Tebble

9 March 2017

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BLUE ENGINEERING

11 Fitzjohns Avenue, 3032

9 March 2017

STRUCTURAL ENGINEER'S CONSTRUCTION METHOD STATEMENT

INDEX

This document is to be read in conjunction with all other planning documents submitted including drawings 3032-400,401,402,403,404,405,406,407 & 408

Reviewed and approved by

David Coles BEng (Hons) CEng MIStructE
Partner at Blue Engineering

1.0 EXISTING CONSTRUCTION AND GROUND CONDITIONS

1. The property comprises a late Victorian detached house, of traditional solid load-bearing masonry construction, providing accommodation on ground and three upper floors. The elevations are dark faced brickwork with traditional sliding sash windows, all beneath a traditional tiled roof. The property includes a paved front area and large rear garden, including a single storey rear addition with a pitched trussed roof attached to the original main body of the property. The rear addition is of modern cavity wall construction.

2. The proposed works are to excavate and construct a full height basement for residential use under the existing footprint of 11 Fitzjohns Avenue including the rear addition. All the boundary walls are to be retained. In addition to the basement, the proposed works include the complete refurbishment of the house, with an additional upper floor supported on new structural beams.

3. A full geotechnical investigation and interpretive report has been prepared, full details in document LBH4424gma Ver1.2:

    a. The strata below the property is made ground to a maximum depth of 1.0 mbgl underlain by London Clay to final borehole depth of 15.0 mbgl. All substructure will bear onto London Clay, with a design maximum allowable bearing pressure of 150 kN/m^2

    b. The N-value of the clay at founding depth was recorded as being 10 – 12.

    c. Groundwater was not encountered in either of the boreholes, perched water was encountered around the base of existing footings in Trial Pit Nos 5a and 7 at a depth of 1.6m. This was likely due to standing water found externally adjacent to the existing footings. The substructure is to be designed as a fully sealed structure in accordance with BS 8102:2009 to inhibit any groundwater ingress.

4. A walk round and visual inspection of the property was undertaken. The findings were the property appears to be in good condition with no signs of movement, recent or otherwise noted.

5. A number of trial pits have been excavated in order to determine the depth and form of existing foundations. The majority of the footings extended to 1.0m below finished floor level bearing onto the clay via a concrete and hardcore blinding. The external walls had three corbels whilst the internal walls had two.

6. The closest tube line is approximately 500m south-west of the property. The tube line runs south and is approximately 500m away at its closest point.

7. 11 Fitzjohns Avenue appears on early historic maps (1896) and is anticipated to date from the late 1800s. Through the 19th and 20th centuries a number of changes have been made to the surrounding area, however, very few changes have been made to the property itself.

8. Drainage and Flooding

   a) Drainage on the site will be handled by the existing drainage systems. New external hard standing areas are required to be permeable. If this is not possible, infiltration trenches will be installed in accordance with BS 8582.

   b) The property is situated in an area with a chance of flooding less than 0.1 percent a year (Flood Zone 1). No flood defences are required on site.

   c) The existing combined sewer runs in front of the property. Foul waste will be pumped from basement level to ground level with a sump pump to an inspection chamber, depressurised, and then run under gravity to an existing manhole to join the existing sewer.

   d) To our knowledge, there are no shared utilities running through or underneath the property.

2.0 SEQUENCE OF WORKS

Traditional reinforced retaining wall construction is to be used to provide the proposed substructure to 11 Fitzjohns Avenue. This is to be implemented below all existing perimeter walls to the main body of the property. Sections of internal walls are to be underpinned early on in the construction sequence with steel beams installed spanning between them in order to provide support to the existing retained load bearing masonry walls. Towards the rear of the property tension piles, continuous flight auger (CFA), will be required in order to resist uplift forces due to hydrostatic pressure. Below outlines a proposed sequence of works for both the retaining wall and CFA pile construction.

Reinforced Concrete Retaining Wall Construction

The ground under the property will be excavated and the ground internally battered back. To ensure that the load transfer from any wall into the ground does not change during the construction, the ground will be battered back at a minimum of 45° from the horizontal plane.

The retaining walls will be in the form of L-shaped reinforced concrete 1.0m wide bays with the stem to provide both restraint against lateral loading and support to the existing brickwork walls over. Where the basement is to support the new multiple storey cavity wall extension the thickness of the wall will be 300mm to match the wall construction over. The walls beneath existing masonry will be a minimum of 325mm thick to match the wall construction over. The additional thickness of the stem suitably reinforced with high yield steel bars will resist the lateral forces subjected to the wall.

Throughout the underpinning process the ground conditions will be continuously assessed by a competent person to determine the means and method of supporting any face of temporary excavation. Battering back, stepping and benching will all be used to ensure that the ground is stable. Where this is not possible due to site restraints the introduction of sacrificial plywood sheets supported by acrow props will be used to retain the ground.

The sequence of the underpinning is to be confirmed by the contractor although possible sequencing will be given as part of the structural drawings. The sequencing will be such that any underpin will be completed, dry packed and a minimum period of 48 hours lapsed before adjacent excavation works are undertaken.

The walls have sections excavated in a “hit and miss” sequence to a founding depth below the existing foundation. The toe then the stem will be cast in a two stage sequence with reinforcement lapped up in the toe to ensure that both elements are tied in together. Horizontal steel dowels are to be cast into the toe and stem and left a minimum 400mm proud to tie adjacent pins together.

The maximum width of any pin is to be 1.0m to minimise the risk of undermining the structure over. This method is carried out until all of the walls have been underpinned.

Continuous Flight Auger Tension Pile Construction

Prior to the piling platform being installed the ground surface must be prepared subject to the specific requirements of the piling rig. All underground obstructions must be removed and services be diverted. Any soft spots found in the subgrade must be excavated and backfilled in a compacted layer using granular fill.

Piles will be bored in a sequence so as not to damage any already constructed piles. The auger shall be advanced though soils within a casing so as to prevent the collapse of soils during the boring process. All borings shall have water and loose material removed before depositing concrete. On completion of the borehole the reinforcement cage is to be installed and the concreting is to take place as soon as practicably possible. No boreholes are to be left open overnight.

The head of each pile shall be trimmed to the specified cut off level as shown on the drawings. Pile reinforcement is to be left clean and straight or bent as the drawings dictate.

The ground is to be excavated to the required substructure level in preparation for the installation of the basement slab. Care is to be taken to avoid damage to the piles during the excavation. The basement slab is then to be cast as specified by Blue Engineering.

All piling work is to be carried out in accordance with the ICE Specification for Piling and Embedded Retaining Walls (SPERW).

Drawing 2532-200 shows a plan of the basement and gives a possible underpinning sequence to be carried out by the contractor, underpinning bays will not exceed one meter in width. This drawing also shows the sections at each of the boundaries. Drawings 3032-400 and 3032-403 give a possible sequence in which the basement can be excavated and constructed.

3.0 IMPACTS ON SURROUNDING STRUCTURES

The proposed methods of construction are well tested and are proven forms of retaining structures. The contractor undertaking the works will have suitable experience and all necessary insurances and will follow current standards and good building guides. Providing the works are carried out correctly, movement to the existing building and to all surrounding structures should be no greater than described as ‘very slight’ under CIRIA C580 Category 1. Procedures, should any movement occur, will be covered by party wall agreements between the relevant parties. No visible change to the adjacent pavement or road is expected. Given the founding depth and bearing strata anticipated, any settlement would be considered immediate and no long term movement is expected.

4.0 UNDERPINNING SPECIFICATION

The underpinning legs are to be constructed in the stages indicated on the drawing. Should the contractor wish to undertake the works in different stages this must be agreed with the Structural Engineer prior to undertaking the works.

The excavation works are to be undertaken carefully so that the existing footings are not disturbed. Excavations are to be temporarily supported as necessary.

When excavating for an underpinning leg, if any deviation is found in the nature of the bearing strata, or if obstacles or obstructions are encountered, the facts are to be reported to the Engineer.

All underpinning legs should have keys formed in them for bonding into succeeding legs as indicated on the Engineer's drawing.

A minimum of 48 hours after concreting a leg of underpinning, the footings above may be pinned up.

The pinning concrete is to be driven into place using a hand held hammer and a 75 mm square hardwood drift against a substantial timber, secured on far side of footing.

Concreting and pinning-up must be completed before starting to excavate the next section of underpinning in the sequence.

Underpinning legs should preferably be concreted on the same day as they are excavated. If it is necessary to leave them open overnight temporary works and timbering are to be used to ensure that all is secure. On no account are underpinning legs to be left open over the weekend.

Pinning concrete shall be approximately 75 mm thick pea-shingle concrete 1:1:5:3 mixing using 5 mm - 10 mm coarse aggregate and "Cebex 100" expanding admixture by Messrs Fosroc UK Ltd in accordance with their instructions.

The water content in the pinning concrete is to be the minimum necessary to ensure hydration of the cement and the consistency should be such that the wetted mix will just bind under strong hand pressure.

Materials and Workmanship are to comply with BS 8110.

Concrete for reinforced concrete structures, including ground bearing slabs, is to be designated mix RC35 to BS 5328, unless noted otherwise on the drawings.

Ready mix concrete is to be used unless otherwise allowed by the Structural Engineer. This must be obtained from a plant which holds a current Certificate of Accreditation under the Quality Scheme for Ready Mix Concrete. Details of cement type, aggregate grading and sources, with chloride and sulphate content of mixes to be submitted to the Structural Engineer for their approval prior to ordering any concrete.

Do not place concrete when the ambient air temperature is less than 5°C.

5.0 CONTROL OF NOISE, DUST AND VIBRATION

In compliance with paragraph 4.3 of Camden Planning Guidance: Basements and Lightwells, CPG4; the mitigation of noise, vibration and dust has been considered to ensure they are kept to acceptable levels for the duration of the works.

The primary receptors have been identified as the immediate neighbours, nos. 9 and 13. There is also potential for local residents and pedestrians to be affected by the proposed works. The site is in a residential area, existing ambient noise and vibration levels are considered to be relatively low.

A 'Prior Consent' for construction works will be applied for through Section 61 of Control of Pollution Act 1974 before works commence. The result of which will be to agree and confirm working methods; noise levels and noise mitigation methods; start and projected end date of works; and community liaison and communications.

Noise and Vibration

1. Works will be carried out according to a stated schedule, production of which is the responsibility of the contractor, and conducted between the hours of 8am and 6pm Monday to Friday, or as agreed with The Council of The Borough of Camden.

2. Contractor will develop a Liaison and Consultation Strategy involving the following:
   a) Identifying all stakeholders, and consulting with them **before** commencing works.

   b) Maintaining a dialogue and information exchange with all interested parties throughout the proposed works.

   c) Responding to complaints and resolving where practical.

   d) Ensuring neighbours and interested parties are kept informed of works as they progress and are consulted where necessary.

3. Noise will be kept within the legal limits as defined in the Environmental Protection Act 1990.

4. All works will be carried out in accordance with BS 5228-1:2009 and BS 5228-2:2009. All works will employ Best Practicable Means as defined by Section 72 of the Control of Pollution Act 1974 to minimise the effects of noise and vibration. All means of managing and reducing noise and vibration, which can be practicably applied at reasonable cost, will been implemented.

5. The impact of vibrations on adjacent properties have been considered in compliance BS 7385-1:1990 and BS 7385-2:1993. Contractor to familiarise themselves with both documents.

6. The following general measures will be taken:
   a) The employment of only modern, quiet and well-maintained equipment complying with the EC Directives and UK Regulations set out in BS 5228-1:2009.

   b) Avoidance of unnecessary noise such as loud radios, shouting and engines idling between operations by effective site management.

   c) Careful handling of materials and waste such as lowering rather than dropping items.

d) Operating the site as a closed site, that is:

i. Having all windows and doors closed during noisy operations.

ii. Retaining the building front façade and roof during construction.

iii. Installing insulation in the windows and other opening to reduce the amount of noise escaping the site.

7. The following specific measures will be taken during each stage of the construction:

a) Demolition of corbels:

i. Corbels will be cleanly disk cut back and carefully broken away from masonry. Percussive breaking techniques will not be used.

b) Concrete demolition and removal:

i. In compliance with the expectations of The Council, concrete is to be demolished using non-percussive breaking techniques (e.g. mechanical concrete pulverisers, hand-held concrete crunchers, diamond saw-cutters and drills and hydraulic bursting equipment).

ii. Any air compressors required are to be located within the site, behind hoarding and if necessary in purpose built acoustic enclosures.

iii. Concrete will be levered from position and broken up off-site.

iv. Where appropriate, structural breaks will be cut between adjacent properties as soon as possible to reduce noise and vibration transfer.

c) Excavation:

i. The site will be excavated manually, causing minimal noise or vibration.

ii. The conveyors will not be operated outside normal working hours and will be switched off when not in use. Conveyors will be well maintained with well-oiled rollers in good working order and be located as far away from neighbouring properties as practicable.

iii. Lorries removing the spoil will only operate within normal working hours and will have their engines switched off while waiting. Further information regarding the movement of vehicles in and around the site is provided in the CTMP.

d) Piling:

i. If piling is required on site, fully silenced modern bored or hydraulically-jacked piling rigs will be used with careful operation of the rig so as to minimised disturbance.

ii. Where practicable, a transmission pathway will be cut by introducing a trench around the piling site.

e) Concrete construction:

i. RC underpinning and contiguous piling will be used to form the retaining structure of the basement.

ii. Contractors will carefully plan and coordinate with concrete suppliers, subcontractors and any other parties involved in the pour to ensure the concrete pours can be done within normal working hours. Contractor is required to conduct an assessment of potential disruptions to the concrete pour and to include contingency measures to ensure works will not overrun.

f) Steelwork and reinforcement:

i. All fabrication and cutting of steelwork will be carried out off-site. Where not possible, contractor will erect a mobile acoustic screen or enclosure as appropriate.

ii. Reinforcement bars will be cut to length prior to site delivery. Hydraulic or pneumatic tools will be used in preference to angle grinders when trimming reinforcement bars.

g) Water

i. If necessary a submersed pump will be used to remove any water from basement level. This is to be located within the excavation itself so as to provide best possible acoustic screening from neighbouring properties.

Dust and Emissions

1. As defined in the Mayor of London's Best Practice Guidance on The control of dust and emissions from construction and demolition, November 2006, section 4.1 the site is classified as a low risk site, fitting the following criteria:
   a) A development less than 1,000 square metres of land.
   b) A development of ten or less properties.
   c) There is potential for emissions and dust to have an infrequent impact on sensitive receptors.

2. Contractor will follow good housekeeping practices with site being regularly swept to avoid the build-up of dust, and where possible washed down with wet methods. This will include the immediate pavement/road area outside the property as well as any hoardings, fences, barriers or scaffolding.

3. Dust will be minimised by effective site planning, including doing the following:
   a) Where practicable prefabricated materials will be utilised to minimise the need for dust generating activities.
   b) Erecting effective barriers around dusty activities.
   c) Covering stockpiles of sand and any other dust generating materials/activities.
   d) Planning the site layout as so dust generating activities and/or machinery are located away from sensitive receptors.
   e) Sealing or completely enclosing cement, sand, fine aggregates and other powders to limit the amount of debris that can be blown from site.

4. In regard to construction traffic:
   a) Idle vehicles to switch off engines.
   b) Vehicles to be effectively washed or cleaned before leaving site.
   c) Construction materials entering or leaving the site to be covered.

5. During demolition works:
   a) Equipment with dust suppression (i.e. water spray) or a dust collection facilities will be used.
   b) Specific dust suppression equipment will be used where substantial levels of dust are generated.
   c) Covering of skips, chutes and conveyors, completely enclosing if necessary, and minimising drop heights.

6. Contact details for the Site Manager from the site will be displayed clearly on the site boundary so that local residents and businesses are able to contact the contractor to raise any issues that they may have and report complaints.

Contractor will provide a method statement and temporary works design which is to be approved by the Engineer, taking into account noise, dust and vibration. Contractor to notify the Engineer of any deviation from the above processes or procedures.

APPENDIX 1 – SCHEME DRAWINGS

11 Fitzjohns Avenue, NW3 5JY

Project Number: 3032

Revision A

9 March 2017

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Date	07.10.16	09.03.17																	
Issue	1	2																	

Drawing Number	Document Title	Scale	Paper Size	Revision															
400	CMS - Foundation Plan	1:100	A3	P1	P2														
401	CMS - Basement Plan	1:100	A3	P1	P2														
402	CMS - Sections	1:50	A3	P1	P2														
403	CMS - Sequence of Works	1:50	A3	P1	P2														
404	Trial Hole Results	1:20	A2	P1	P2														
405	CMS - Loading Plan	1:100	A3	P1	P2														
406	CMS - Foundation Plan - Rear House	1:100	A3		P1														
407	CMS - Basement Plan - Rear House	1:100	A3		P1														
408	CMS - Sections - Rear House	1:50	A3		P1														
-	Construction Method Statement	-	A4	A	B														

Distribution — Issue (E denotes electronic issue)

Zen Developments	E	E																	
LBH Wembley	E	E																	

Revision prefixes: P — Preliminary T — Tender C — Construction R — Record

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Title: Document Register

Issue: 2

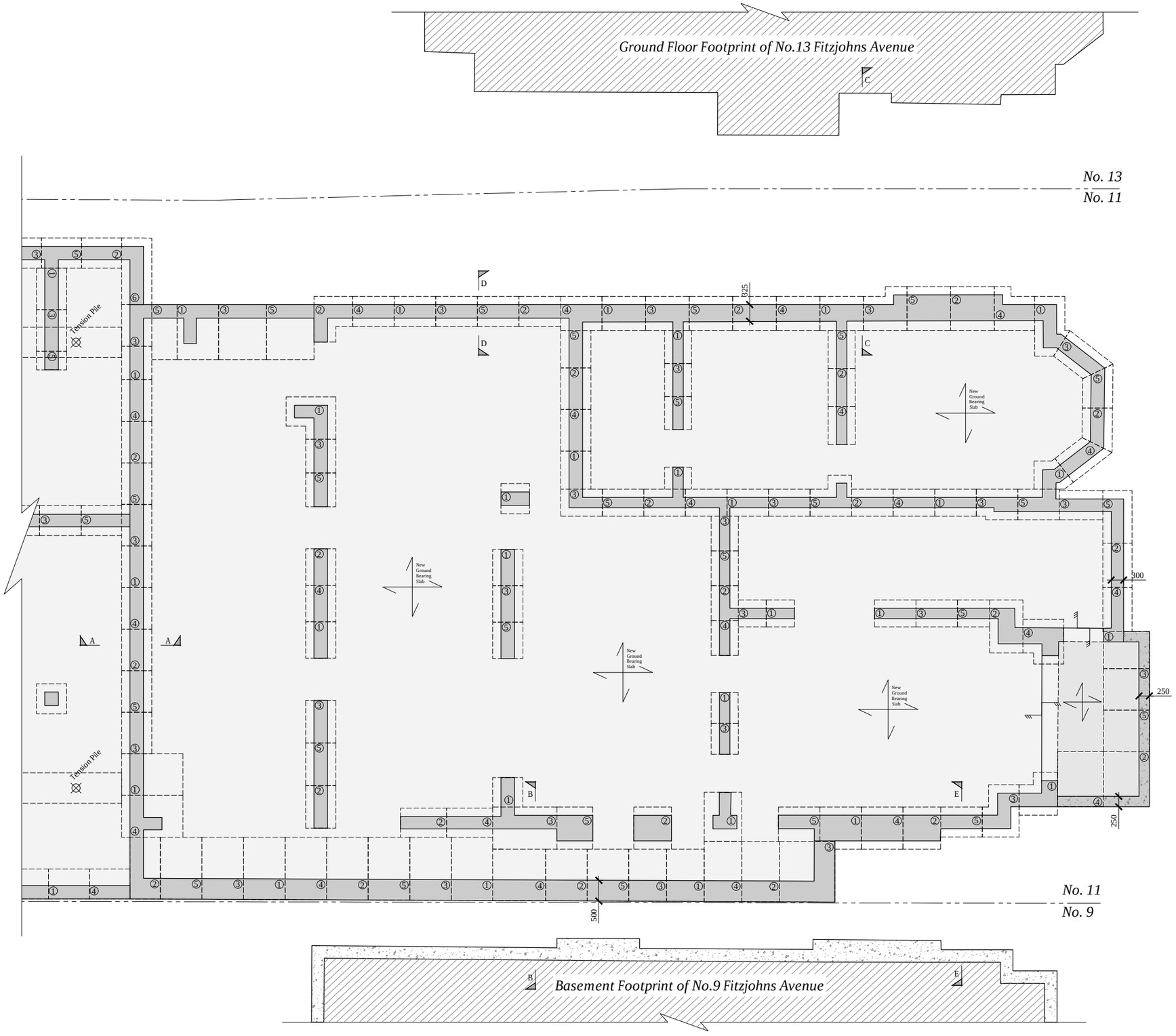
Project: 11 Fitzjohns Avenue

Job No: 3032

By: AJ

Sheet: 1 of 1

Date: 09.03.17



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Drawing History

Rev	Date	Description	Drawn	Checked
P1	07.10.16	For Comment	CW	PT
P2	09.03.17	For Comment	AJ	PT

Title
CMS - General Arrangements - Foundation Plan

Project
11 Fitzjohns Avenue, NW3 5JY

Client
Zen Developments

Job No.
3032

Drawing No.
400

Revision
P2

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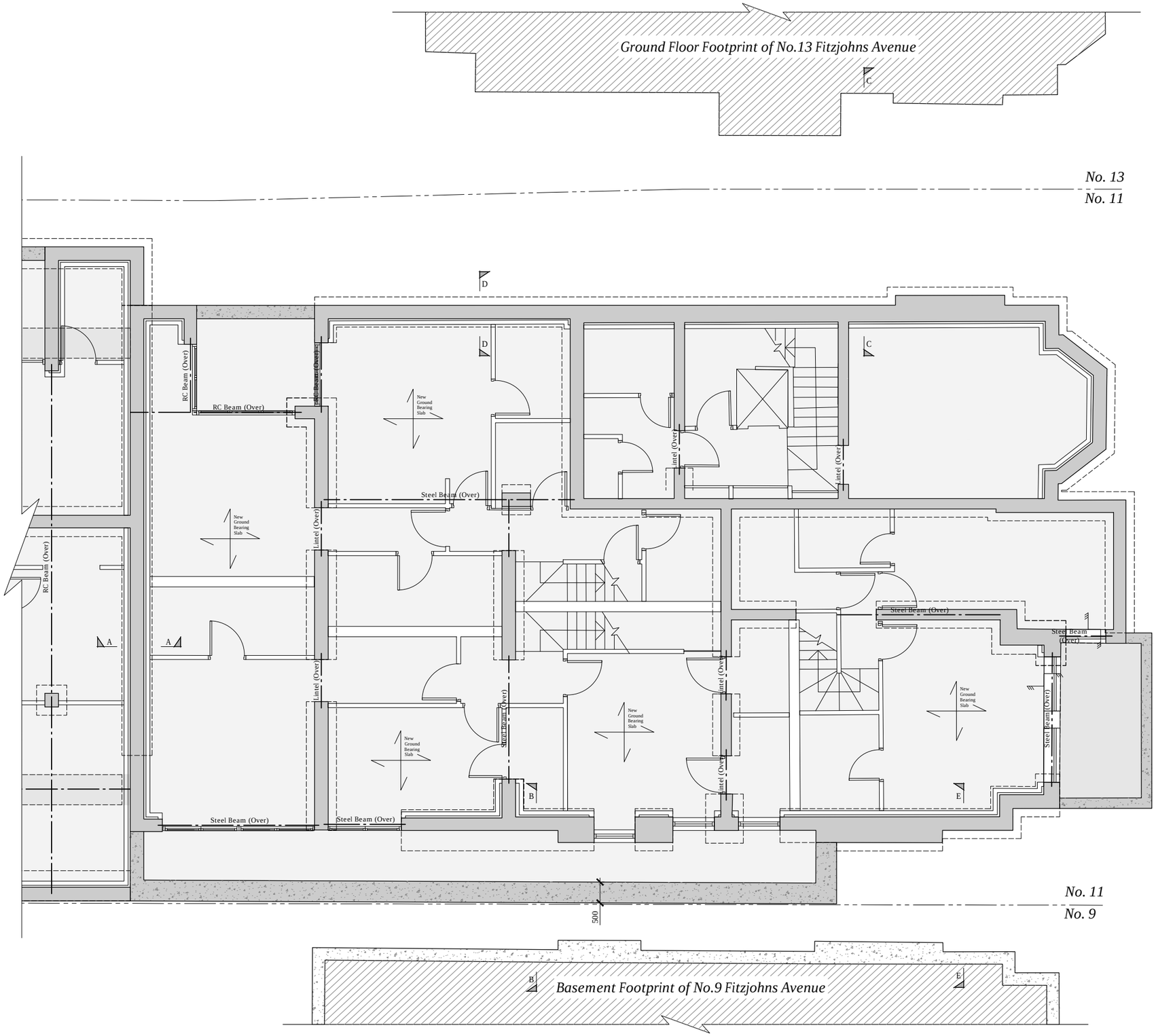
1:100 at A3



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Drawing History

Rev	Date	Description	Drawn	Checked
P1	07.10.16	For Comment	CW	PT
P2	09.03.17	For Comment	AJ	PT

Title
CMS - General Arrangements - Basement Plan

Project
11 Fitzjohns Avenue, NW3 5JY

Client
Zen Developments

Job No.
3032

Drawing No.
401

Revision
P2

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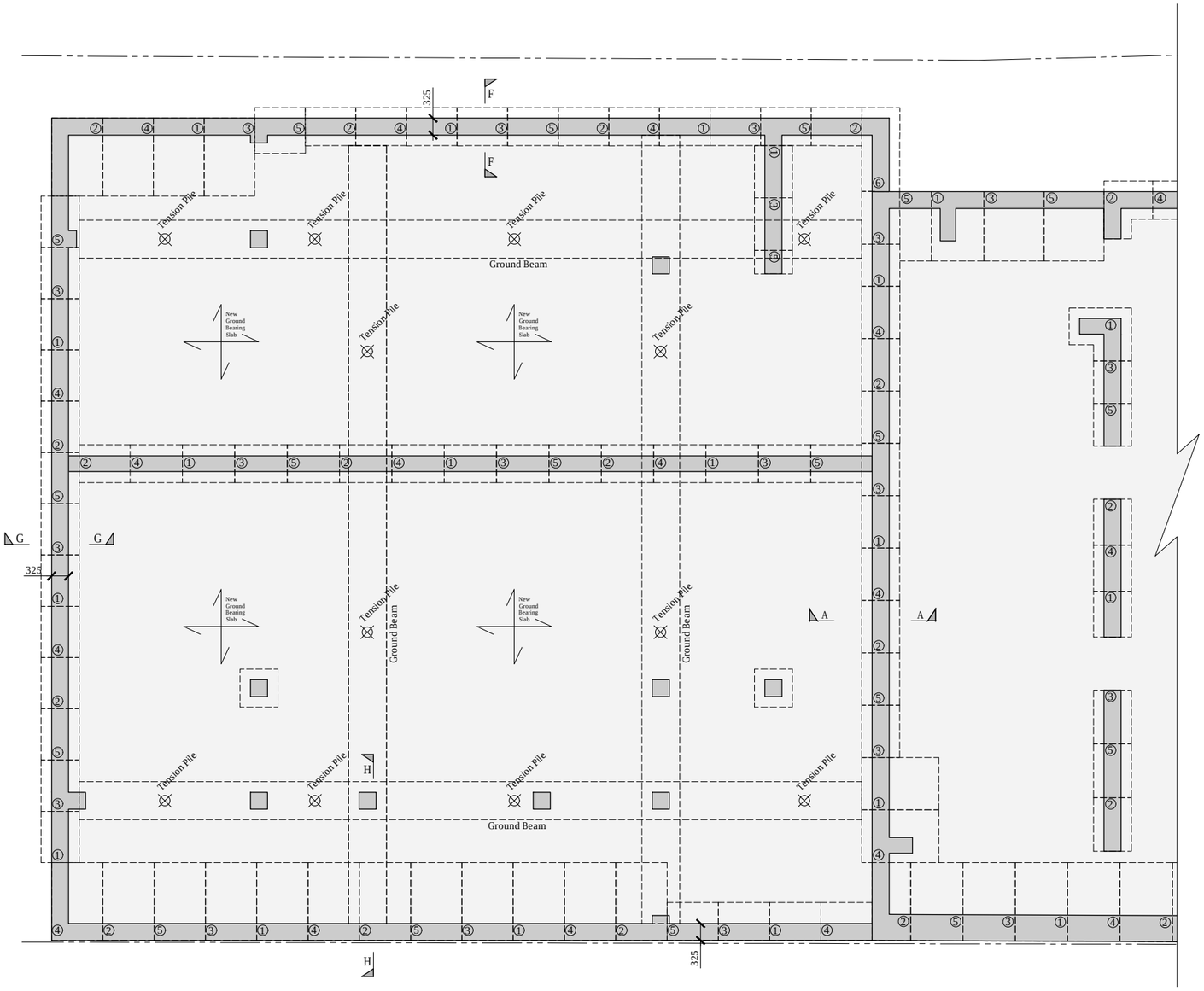
A3



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Title
CMS - General Arrangements - Foundation Plan

Project
11 Fitzjohns Avenue, NW3 5JY

Client
Zen Developments

Job No.
3032

Drawing No.
406

Revision
P1

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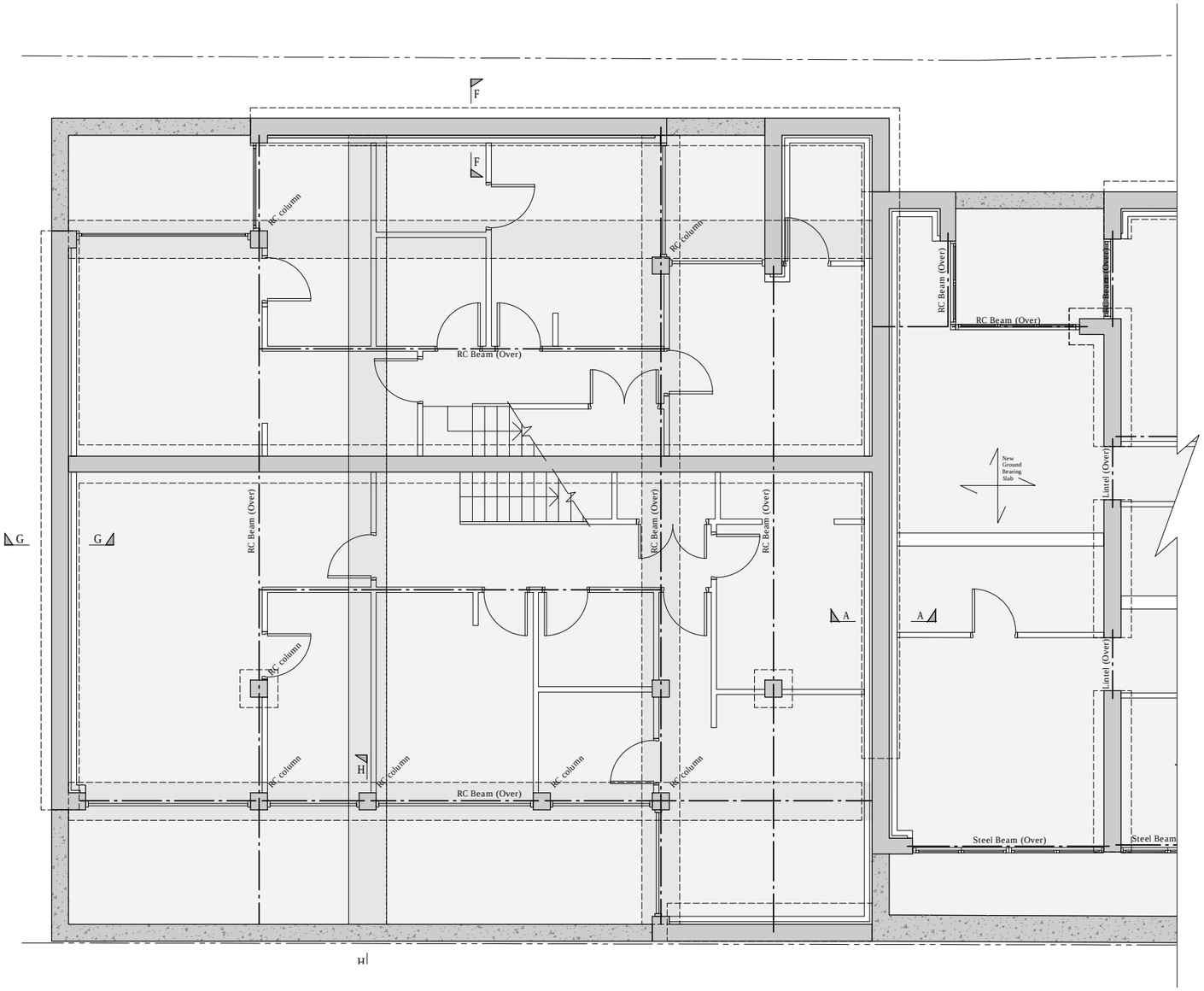
1:100 at A3

A3



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Rev	Date	Description	Drawn	Checked
P1	09.03.17	For Comment	AJ	PT

Title
CMS - General Arrangements - Basement Plan

Project
11 Fitzjohns Avenue, NW3 5JY

Client
Zen Developments

Job No.
3032

Drawing No.
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Revision
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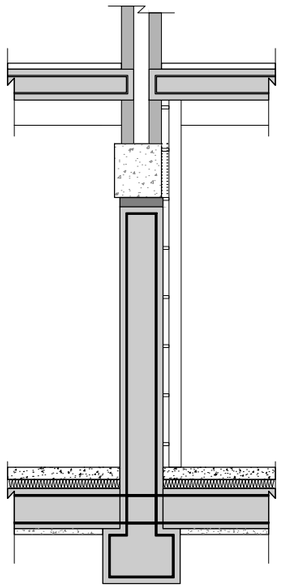

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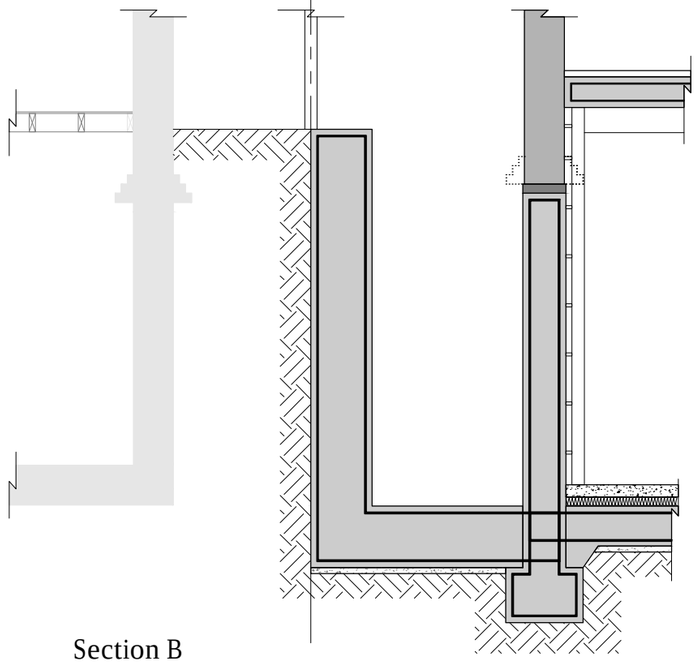

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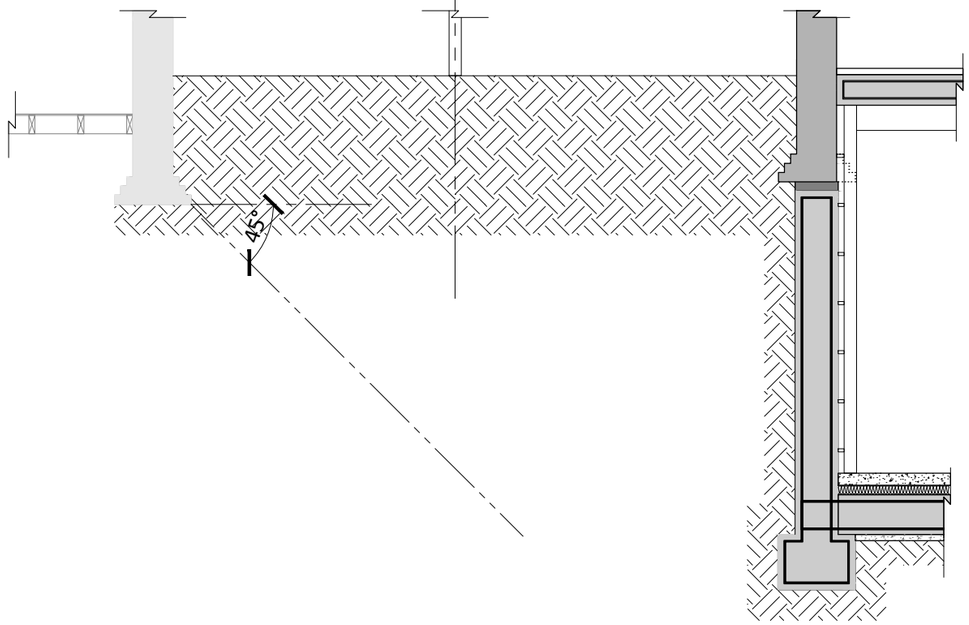

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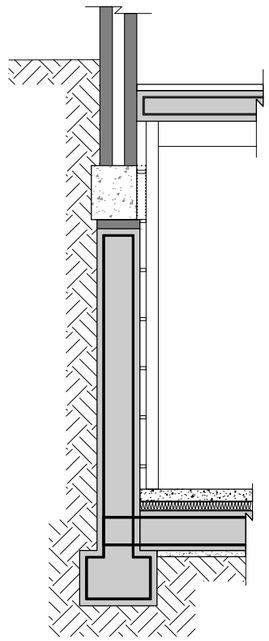

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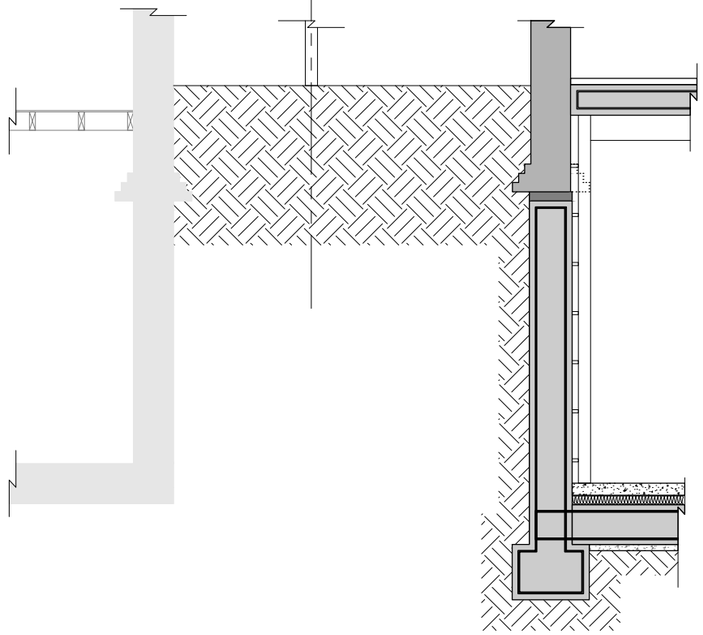

Section E
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A3

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Rev	Date	Description	Drawn	Checked
P1	07.10.16	For Comment	CW	PT
P2	09.03.17	For Comment	AJ	PT

Title
Construction Method Statement - Sections

Project
11 Fitzjohns Avenue, NW3 5JY

Client
Zen Developments

Job No.
3032

Drawing No.
402

Revision
P2

Scale
1:50 at A3

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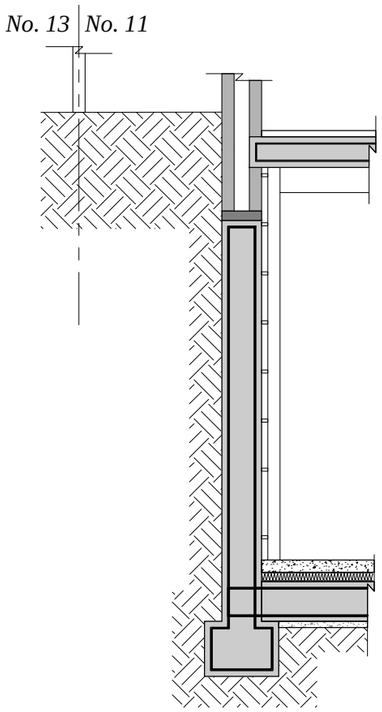

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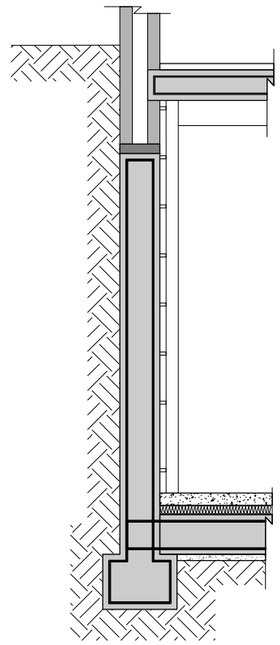

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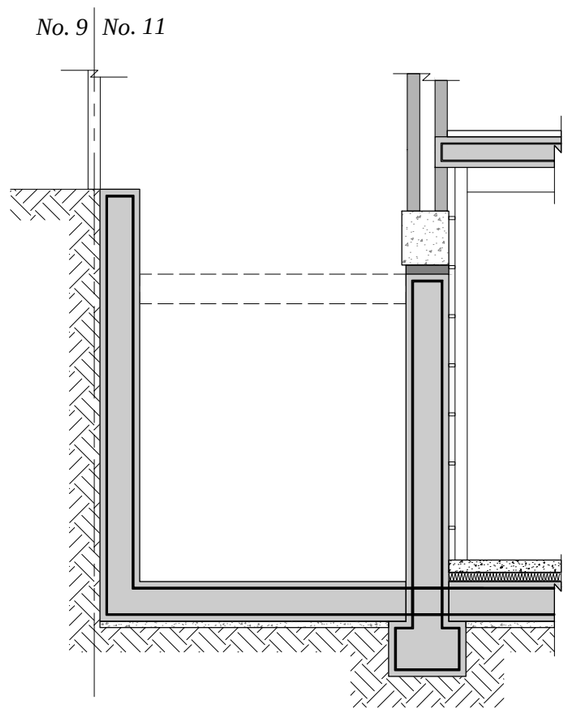

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Title
Construction Method Statement - Sections

Project
11 Fitzjohns Avenue, NW3 5JY

Client
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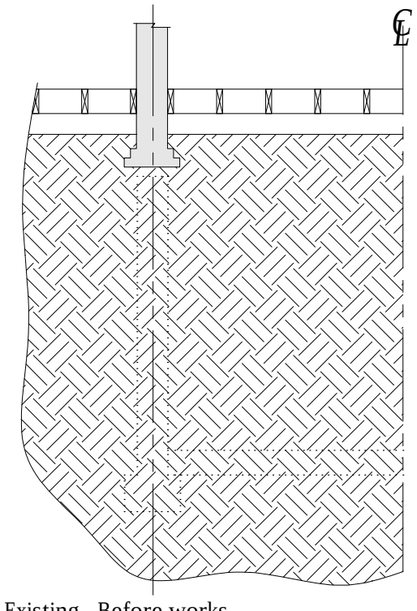
Job No.
3032

Drawing No.
408

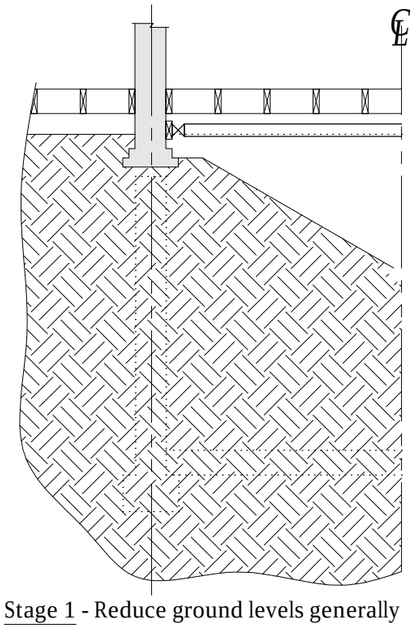
Revision
P1

Scale
1:50 at A3

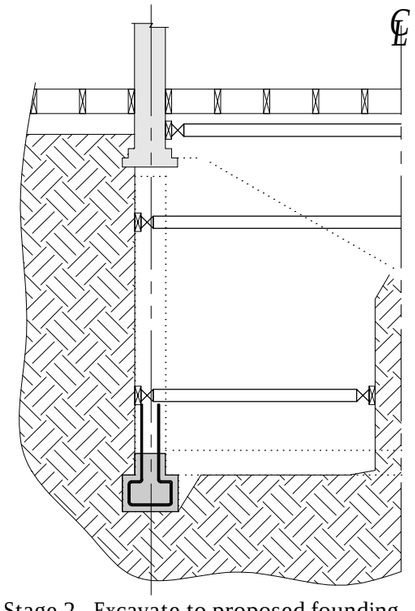
A3



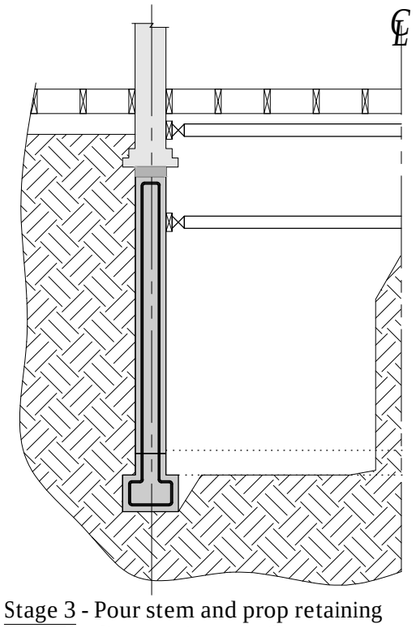
Existing - Before works commence



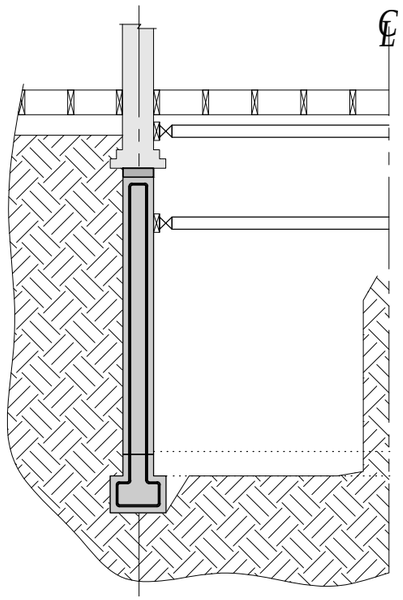
Stage 1 - Reduce ground levels generally throughout and install props between party walls



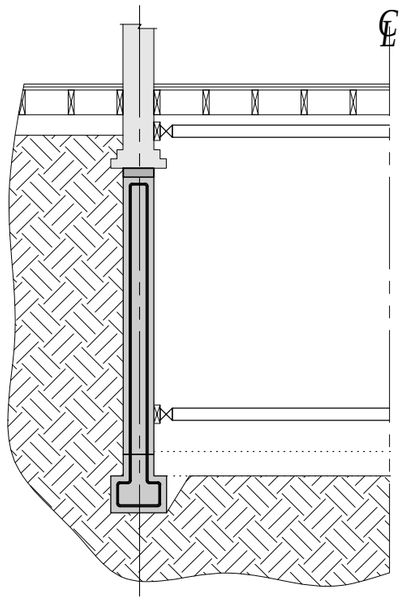
Stage 2 - Excavate to proposed founding depth. Prop any loose material as required. Pour base of retaining wall and form kicker



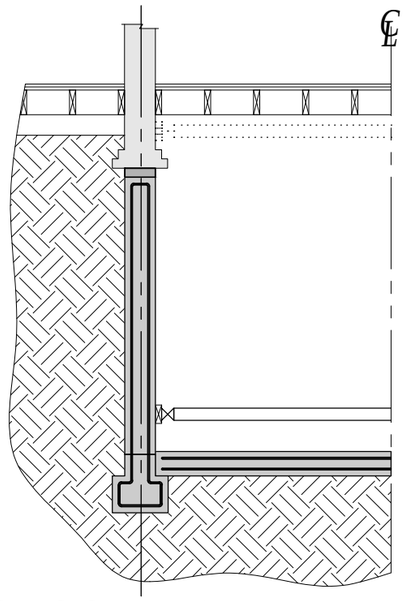
Stage 3 - Pour stem and prop retaining wall off adjacent pins or soil as appropriate



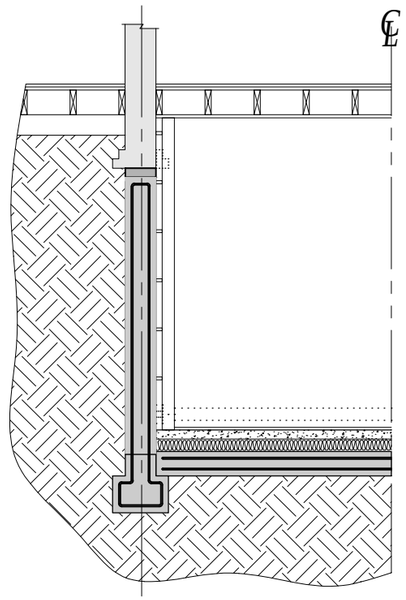
Stage 4 - Tightly dry pack between stem of underpin and underside of existing foundation. Repeat stages 2-4 for all pins



Stage 5 - Reduce level of central soil from front of property to back, lower props as excavation permits



Stage 6 - Once levels fully reduced cast slab throughout with dowels into retaining pins, remove high level props



Stage 7 - Once all concrete has cured, remove remaining props and demolish any existing foundations projecting internally. Install waterproofing system, internal insulation, screed, etc. Basement structural works completed

A3

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Drawing History

Rev	Date	Description	Drawn	Checked
P1	07.10.16	For Comment	CW	PT
P2	09.03.17	For Comment	AJ	PT

Title
Construction Method Statement - Sequence of Works

Project
11 Fitzjohns Avenue, NW3 5JY

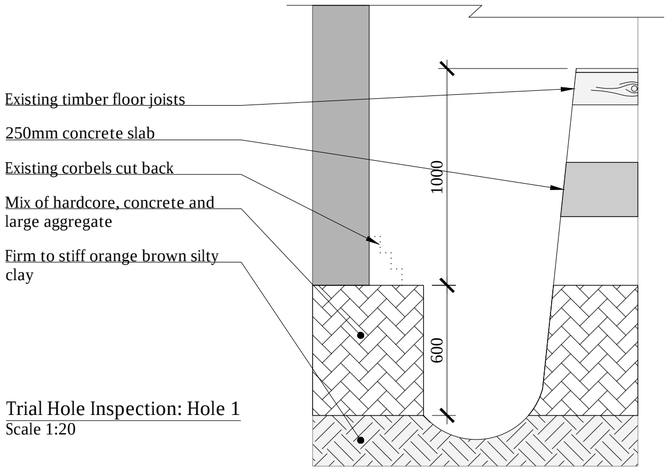
Client
Zen Developments

Job No.
3032

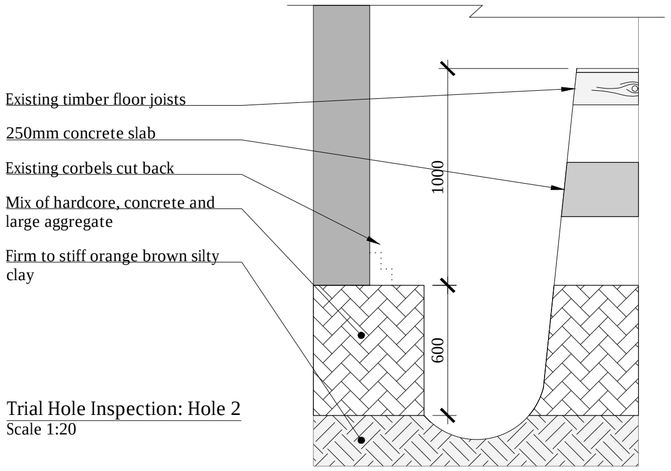
Drawing No.
403

Revision
P2

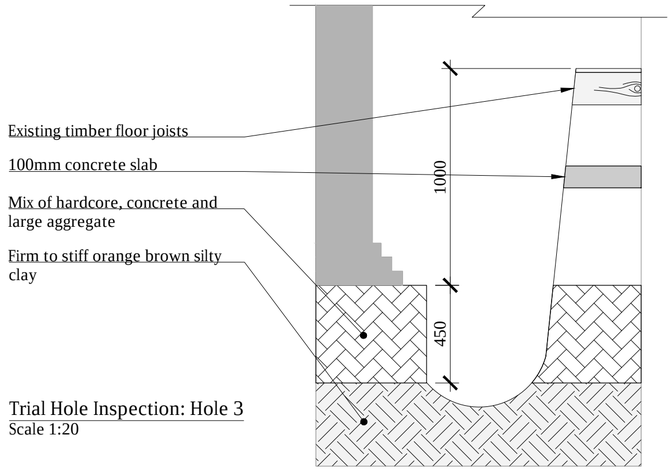
Scale
1:50 at A3



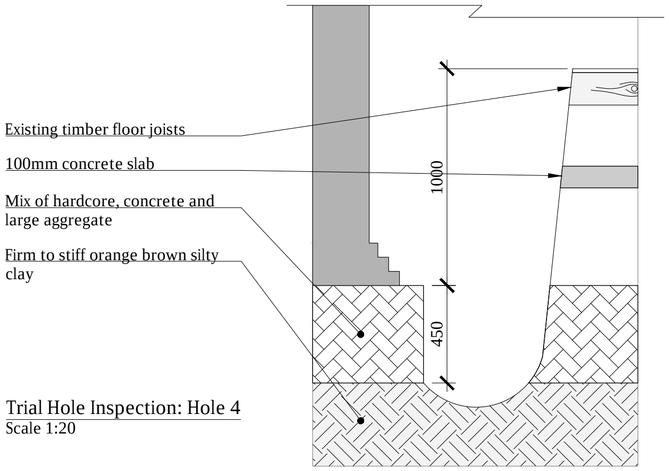
Trial Hole Inspection: Hole 1
Scale 1:20



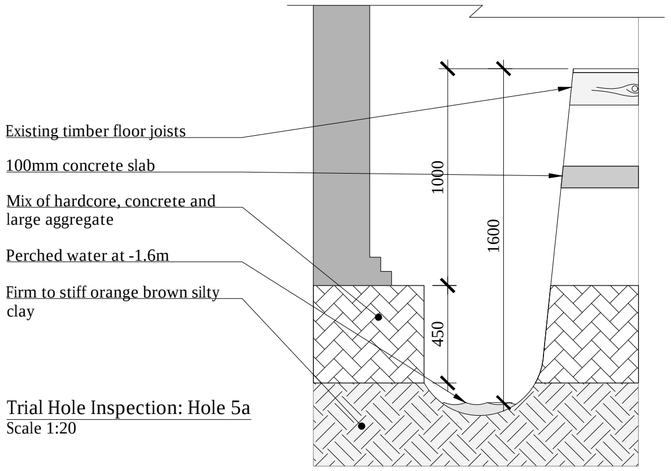
Trial Hole Inspection: Hole 2
Scale 1:20



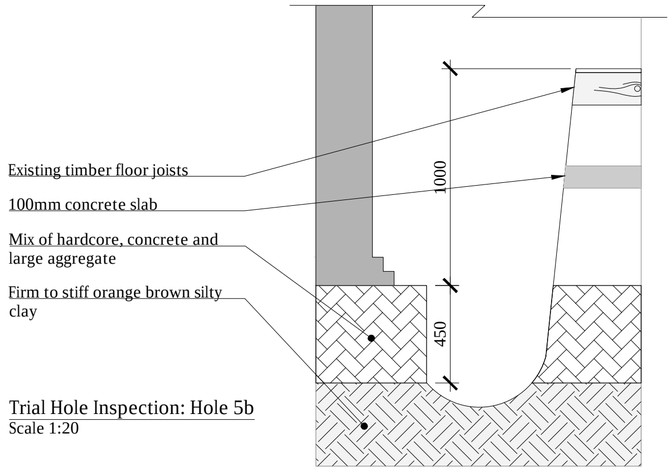
Trial Hole Inspection: Hole 3
Scale 1:20



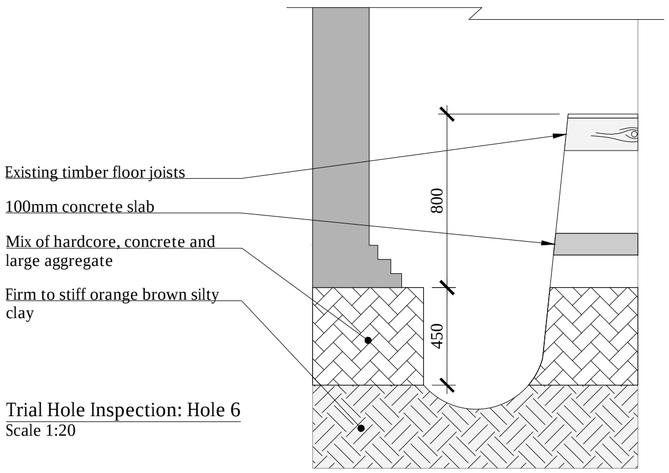
Trial Hole Inspection: Hole 4
Scale 1:20



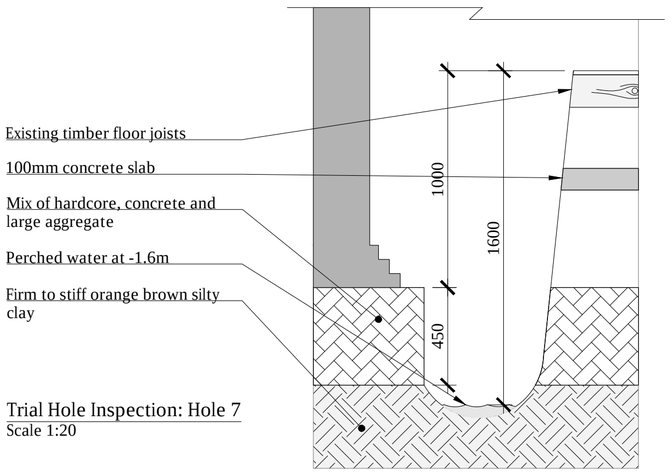
Trial Hole Inspection: Hole 5a
Scale 1:20



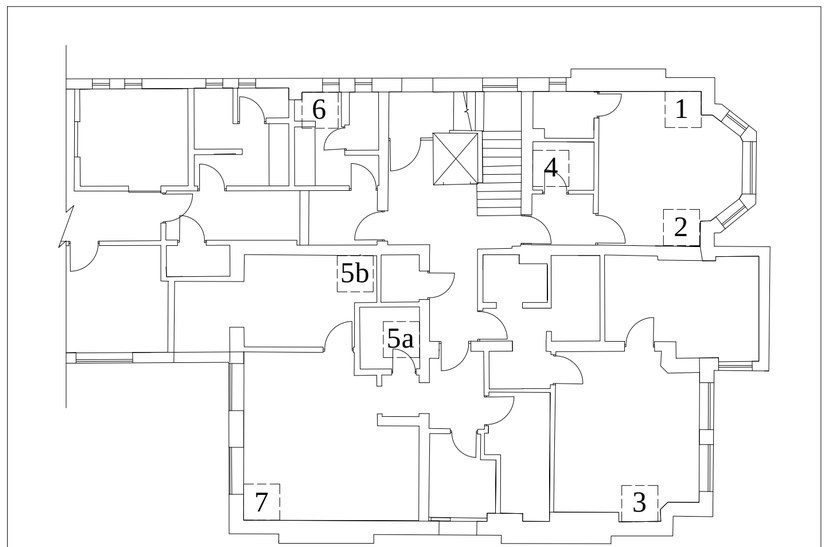
Trial Hole Inspection: Hole 5b
Scale 1:20



Trial Hole Inspection: Hole 6
Scale 1:20



Trial Hole Inspection: Hole 7
Scale 1:20



Trial Hole Locations on Ground Floor

A2

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Drawing History

Rev	Date	Description	Drawn	Checked
P1	07.10.16	For Comment	CW	PT
P2	09.03.17	For Comment	AJ	PT

Title
Trial Hole Results

Project
11 Fitzjohns Avenue, NW3 5JY

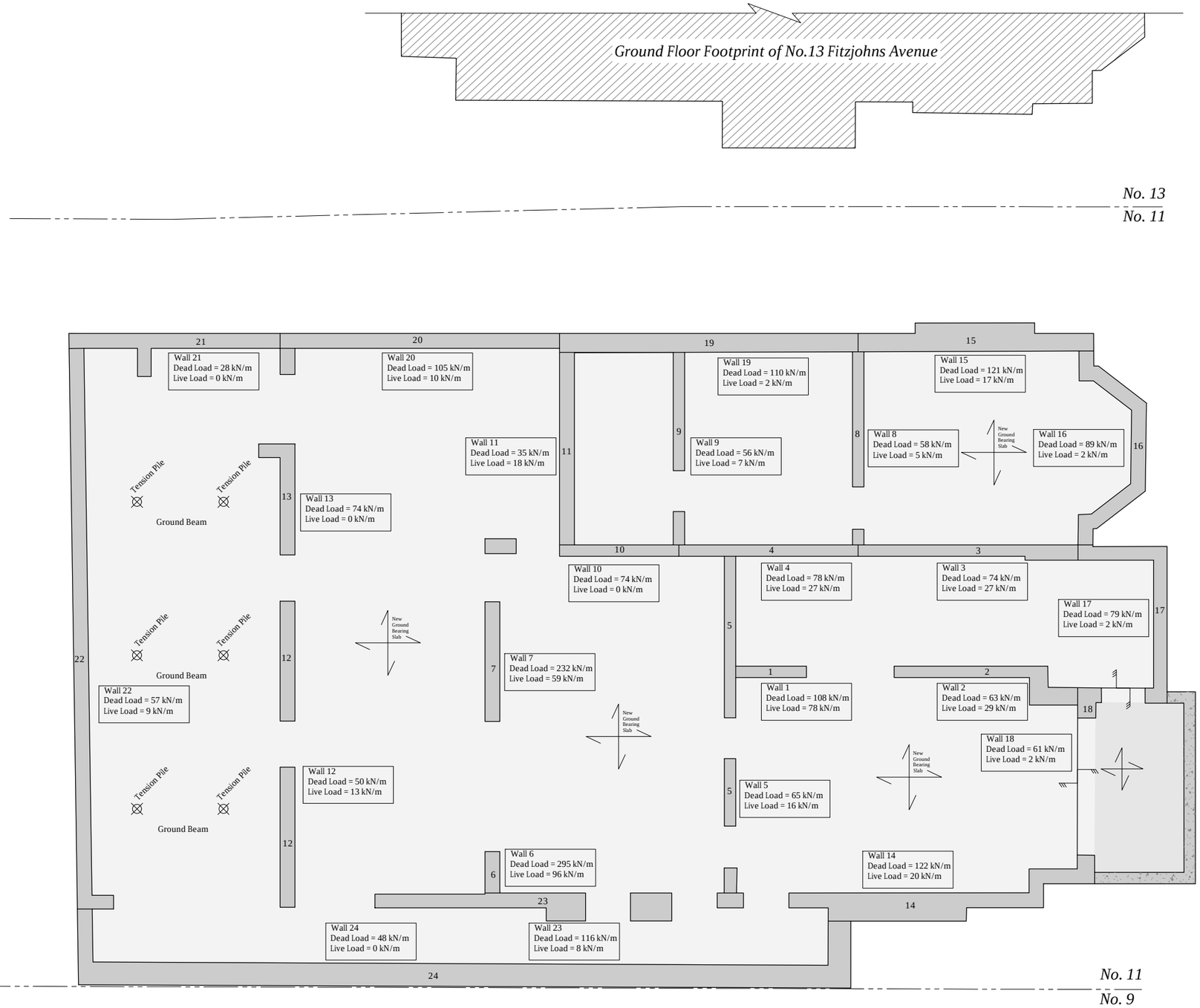
Client
Zen Developments

Job No.
3032

Drawing No.
404

Revision
P2

Scale
1:20 at A2



All loads are UNFACTORED (SLS)

All loads are line loads applied at basement formation level

Contact Blue Engineering for further clarification if required

A3

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Drawing History

Rev	Date	Description	Drawn	Checked
P1	07.10.16	For Comment	CW	PT
P2	09.03.17	For Comment	AJ	PT

Title
Construction Method Statement - Loading Plan

Project
11 Fitzjohns Avenue, NW3 5JY

Client
Zen Developments

Job No.
3032

Drawing No.
405

Revision
P2

Scale
1:100 at A3

APPENDIX 2 – PRELIMINARY CALCULATIONS

11 Fitzjohns Avenue, NW3 5JY

Project Number: 3032

Revision A

9 March 2017

BLUE ENGINEERING

STRUCTURAL CALCULATION PACKAGE

11 Fitzjohns Avenue, NW3 5JY

Project Number: 3032

Prepared by Patrick Tebble
9 March 2017

Checked By James Nevin

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Partnership No: OC366872 – Registered in England | VAT No: 119 413 233

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BASEMENT DESIGN – GLOBAL DESIGN

It is proposed to construct a full footprint basement below the main body of the property as well as the rear structure. The subterranean structure is to extend out to the rear building and to one side of the superstructure, it will be formed from traditional reinforced concrete underpins. The ground investigation showed that the basement is to be founded in stiff dark brown London Clay (SPT N-value of 10-12). Although water was not found in either of the boreholes, for the purposes of design a worst case ground water level of -1.0mbgl has been taken.

Depth of basement: 3700mm Below Ground Level

The relevant geotechnical properties have been outlined below (provided by LBH Geo):

$\Phi' = 25°$	$K_a = 0.41$	$K_p = 2.5$	$K_o = 0.58$	Surcharge = 10 kN/m^3
$c' = 5$ kN/m^2	$\gamma_{bulk} = 19.5$ kN/m^3	$\gamma' = 9.5$ kN/m^3	$\gamma_w = 10$ kN/m^3	

Uplift:

In the event that the ground water table were to rise above the level of the basement, the displaced water will exert an uplift force to the structure. The substructure is to be formed through traditional underpins and so the dead load of the property will provide resistance against uplift. Towards the rear of the proposed basement the dead load of the structure will not be sufficient to resist the uplift and so tension piles will be required. For proof of concept a preliminary calculation for these has been given below, the detail pile design will be to specialist contractor design. For the purposes of the global check the front and rear basements have been treated separately.

Uplift due to displaced water (front):

2.7m (depth of water table) * 321m^2 (area) * 10.0 kN/m^3		**= 8667 kN**
	Factored = 11877 * 1.1	**= 9534 kN**

Dead load of front of property:

Existing perimeter masonry walls @ 19.0 kN/m^3 @ 492.4m^2 panel area @ 0.325m width	= 3040.6 kN
New cavity walls @ 19 kN/m^3 @ 0.2m width @ 231.7m^2	= 880.5 kN
Concrete retaining walls @ 25.0 kN/m^3 @ 0.325m width @ 3.7m height @ 76.0m length	= 2284.8 kN
Internal concrete walls @ 25.0 kN/m^3 @ 0.325m width @ 8.2m length @ 3.7m height	= 246.5 kN
Concrete slab @ 25.0 kN/m^3 @ 0.325m depth @ 290m^2 total area	= 2356.2 kN
Ground floor concrete slab @ 25.0 kN/m^3 @ 0.25m depth @ 54.4m^2 area	= 340 kN
75mm of screed on basement slab @ 25.0 kN/m^3 @ 0.075m thickness @ 234.4m^2	= 421.9 kN
Internal blockwork walls @ 20.0 kN/m^3 @ 0.215m width @ 47.7m length @ 3.4m height	= 697.4 kN
Timber ground floor @ 1.0 kN/m^2 @ 212.4m^2 total area	= 212.4 kN
Timber floor and flat roofs construction @ 1.0 kN/m^2 @ 727.8m^2	= 727.8 kN
Timber roof @ 1.0 kN/m^2 @ 193.3m^2	= 193.3 kN
Internal masonry walls @ 19.0 kN/m^3 @ 0.215m width @ 16.6m length @ 10.0m height	= 678.1 kN
Internal masonry walls @ 19.0 kN/m^3 @ 0.1m width @ 12.3m length @ 3.0m height	= 70.1 kN
Soil over kicker @ 10.0 kN/m^3 @ 1.6m^2 area @ 35.7m length	= 571.1 kN
Unfactored Total	**= 12719 kN**
Factored Total (0.9)	**= 11448 kN**

Total Resistance to Uplift (Factored)	**= 12719*0.9**	**= 11448 kN**	
Total Uplift (Factored)	**= 8667*1.1**	**= 9534 kN < 11448 kN**	**Therefore OK**

Uplift due to displaced water (front):

2.7m (depth of water table) * 251m^2 (area) * 10.0 kN/m^3		**= 6777 kN**
	Factored = 6777 * 1.1	**= 7455 kN**

Dead load of front of property:

Existing perimeter cavity walls @ 19.0 kN/m^3 @ 4.0m average height @ 0.2m width @ 34.5m	= 524.4 kN
Concrete retaining walls @ 25.0 kN/m^3 @ 0.325m width @ 3.7m height @ 60.2m length	= 1809.8 kN
Internal concrete walls @ 25.0 kN/m^3 @ 0.2m width @ 15.2m length @ 7.2m height	= 547.2 kN
Concrete slab @ 25.0 kN/m^3 @ 0.325m depth @ 226m^2 total area	= 1836.3 kN
Ground floor concrete slab @ 25.0 kN/m^3 @ 0.25m depth @ 197m^2 area	= 1231 kN
75mm of screed on slabs @ 25.0 kN/m^3 @ 0.075m thickness @ 423m^2	= 793 kN
Timber roof @ 1.0 kN/m^2 @ 163m^2 total area	= 163kN
Timber mezzanine @ 0.75 kN/m^2 @ 61m^2	= 45.8 kN
Unfactored Total	**= 7521 kN**
Factored Total (0.9)	**= 6769 kN**

Preliminary Tensile capacity of pile:

Detailed design of tension piles is to be carried out by a specialist contractor, Blue Engineering to provide Pile Specification to allow for the design.

For the purposes of a proof of concept a preliminary calculation for tensile capacity of the piles due to negative skin friction has been provided below.

Clay deposits were struck at -1.0m below ground level (above which is made ground).

Maximum Limiting Shaft Friction	= 140 kN/m^2
Adhesion Factor	= 0.5
Global factor of safety	= 3.0

Tensile capacity of 10.0m deep pile	= [surface area of pile]*[adhesion factor]*[maximum limiting shaft friction]/3.0	
	= 10.0m*pi*0.30*0.5*140/3 = 220 kN	
Number of piles	= 12	
Total resistance of piles	**= 12*220**	**= 2638 kN**

Total Resistance to Uplift (Factored)	**= (7521+2638)*0.9**	**= 9143 kN**
Total Uplift (Factored)	**= (6777)*1.1**	**= 7455 kN**

Uplift of 7455 kN < 9143 kN therefore the global uplift stability check has been satisfied.

SLIDING:

The retaining walls and basement slab will be designed as to ensure lateral loads due to earth pressures can be transferred from one side to another where equal and opposite pressures will provide resistance to movement. Therefore, the basement is in equilibrium and sliding will not occur.

Overturning:

The basement will be constructed in an underpinning sequence, battering back ground and using props to ensure that overturning of individual pins will not occur. Therefore, the basement is in equilibrium and overturning will not occur.

Ground Heave:

The overburden relief has been calculated to be approximately 40 kN/m^2. An initial heave of 50% is expected during the construction works, the remaining 50% will be resisted by the weight of the structure and the piles acting in tension, which is less than the uplift due to displaced water. Therefore, the design is adequate providing that the global uplift stability check has been satisfied.

Typical Loading on Underpin to front

Height = 3700mm

Lateral pressures at varying depths:

@ All levels

Q_k:	Surcharge: 10kN/m^2 * 0.41 * 1.0m	= 4.1 kN/m

@ Bottom of retaining wall (-3.7m BGL) – Water Present

G_k:	Effective earth pressure: 10kN/m^3 * 0.41 * 3.7 m * 1.0 m	= 15.2 kN/m
G_k:	Pore water pressure (PWP): 10kN/m^3 * 1.0m * 3.7 m	= 37.0 kN/m

Vertical Nodal Loading:

Gk:	**(no.9 & 7 side)** Existing masonry @ 19.0 kN/m^3 @ 0.325m width @ 13.0m height	= 80.3 kN
	(no.9 & 7 side) Timber roof @ 1.0 kN/m^2 @ ½ of 4.0m span	= 2.0 kN
	(no.9 side) Timber floor @ 1.0 kN/m^2 @ ½ of 4.8m span @ 5 floors	= 12.0 kN
	(no.7 side) Timber floor @ 1.0 kN/m^2 @ ½ of 4.2m span @ 5 floors	= 10.5 kN
Qk:	**(no.9 & 7 side)** Timber roof @ 0.75 kN/m^2 @ ½ of 4.0m span	= 1.5 kN
	(no.9 side) Timber floor @ 1.5 kN/m^2 @ ½ of 4.8m span @ 5 floors	= 18.0 kN
	(no.7 side) Timber floor @ 1.5 kN/m^2 @ ½ of 4.2m span @ 5 floors	= 15.8 kN