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Structural Engineering Report for Proposed Basement Construction and Refurbishment

15 Belsize Park Mews
London
NW3 5BL

Client: Electron Holdings Management Limited

Prepared: Aug 2023
Project No. 23066
Ref: AMA-23066-REP-01
Rev 02 (Jan 2024)

Prepared by: Christos Christou BEng (Hons) CEng MIStructE

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Revision	Prepared by	Checked by	Date	Status
00	CAC	RR	17/08/23	Final

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Contents

1. Introduction

AMA Consulting Engineers have been appointed by Electron Holdings Management Limited to prepare the supplementary information required to accompany the planning application for the proposed basement and refurbishment of No. 15 Belsize Park Mews. The main purpose of this report is to address issues such as:

- The existing building.
- Existing site drainage.
- The proposed structure below ground.
- The proposed structure above ground.
- Proposed site drainage.
- Method of construction and sequencing of construction works.
- Temporary works suggestions.

A Stage 1 and Stage 2 Basement Impact Assessment has been carried out by Jomas (report ref: P5188J2818/SC) and includes the following:

- Desk study.
- Site Setting & Historical Information
- Geological Setting & Hazard Review
- Hydrogeology, Hydrology and Flood Risk Review
- Screening and Scoping Assessment
- Basement Impact Assessment

Below is an extract of the executive summary from the Jomas report. Reference should be made to the main report [Appendix 7] for detailed information and analysis.

Desk Study

Site History:

On the earliest available maps (1871-74), the site is shown as vacant and appears to be situated within farmland associated with Belsize Farm. An underground railway and associated ventilation shaft are shown ~100m north of site. Two ponds were shown within 250m and a culverted stream is shown 300m west of site.

By the maps dated 1894/96, the site has been developed into residential mews property resembling the present-day layout. The surrounding area has undergone large-scale residential development with the previously identified ponds, and culverted stream no longer shown. No significant observational changes then occur to the site until the most recent map dated 2023.
The surrounding area has been utilised predominantly for residential use, with little significant industrial use.

Site Setting:

The British Geological Survey indicates that the site is directly underlain by solid deposits of the London Clay Formation. The underlying London Clay Formation is identified as an unproductive stratum. There are no water networks or surface water features reported within 250m of the site. The site is located within an EA Flood Zone 1. The site is not within an area with a RoFRaS rating. The site is not within an area benefiting from flood defences.

Groundsure states that the site is at negligible risk of both surface water and groundwater flooding.

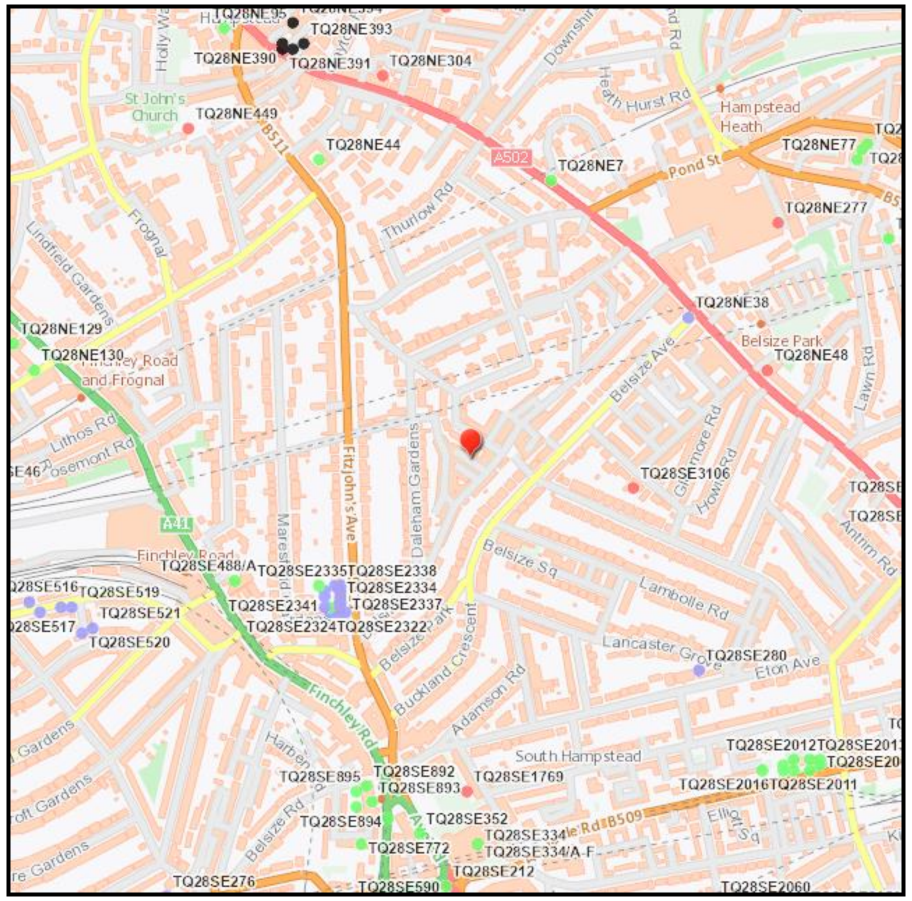

Fig 1: Extract from BGS

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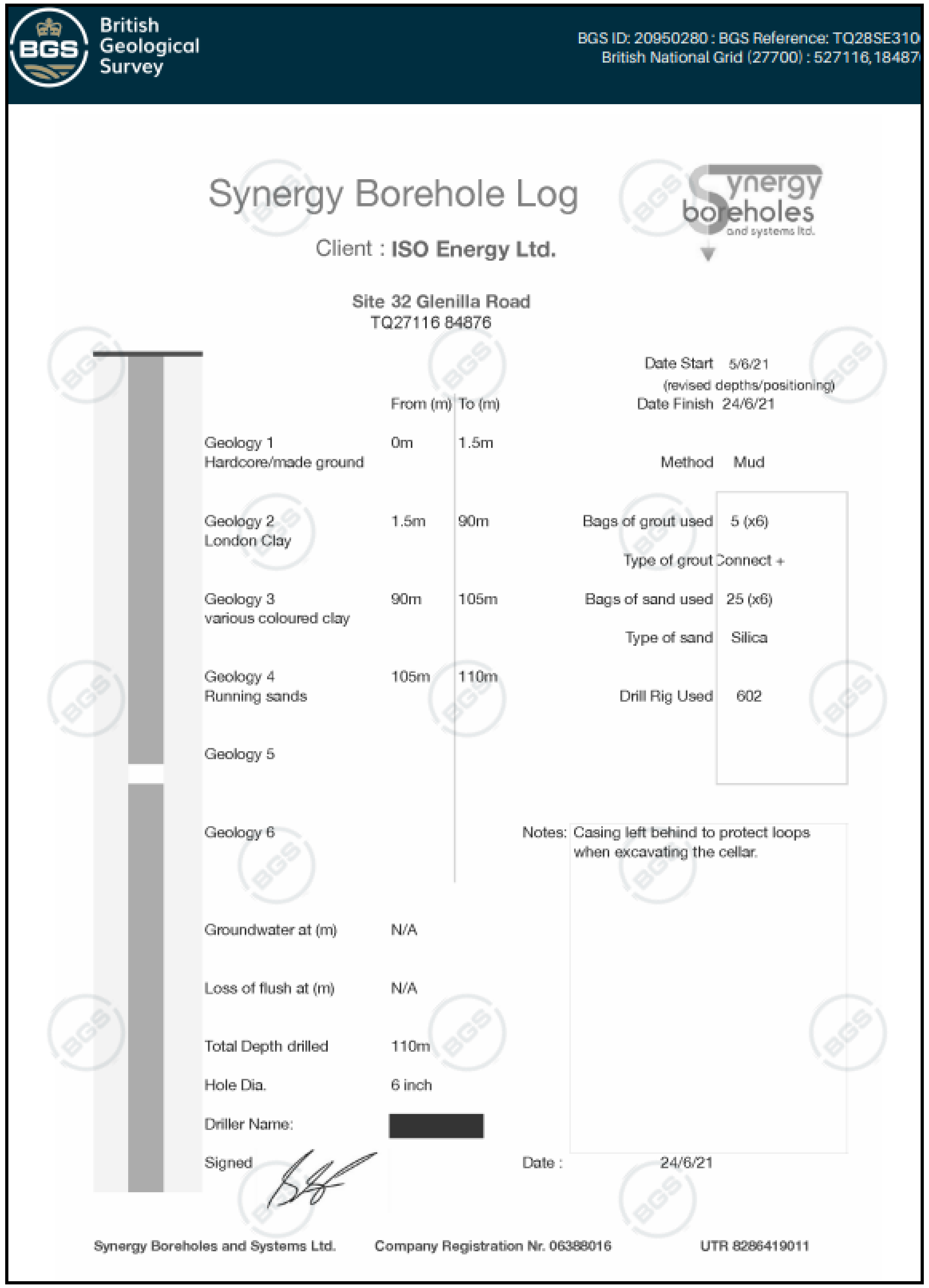
British Geological Survey

BGS ID: 20950280 : BGS Reference: TQ28SE310
British National Grid (27700) : 527116,18487

Synergy Borehole Log

Client : ISO Energy Ltd.

Site 32 Glenilla Road
TQ27116 84876

Date Start 5/6/21
(revised depths/positioning)
Date Finish 24/6/21

	From (m)	To (m)
Geology 1 Hardcore/made ground	0m	1.5m
Geology 2 London Clay	1.5m	90m
Geology 3 various coloured clay	90m	105m
Geology 4 Running sands	105m	110m
Geology 5		
Geology 6		

Method	Mud
Bags of grout used	5 (x6)
Type of grout	Connect +
Bags of sand used	25 (x6)
Type of sand	Silica
Drill Rig Used	602

Notes: Casing left behind to protect loops when excavating the cellar.

Groundwater at (m)	N/A
Loss of flush at (m)	N/A
Total Depth drilled	110m
Hole Dia.	6 inch
Driller Name:	[redacted]

Signed

Date : 24/6/21

Synergy Boreholes and Systems Ltd. Company Registration Nr. 06388016 UTR 8286419011

Fig 2: Extract from BGS nearest Borehole Record

Potential Geological Hazards:

The Groundsure data identified a moderate risk of shrink swell clays beneath the site due to the underlying London Clay Formation.

The presence of London Clay Formation may be a source of elevated sulphate associated with disseminated pyrite noted by BGS to be within this deposit. If such levels are noted, then sulphate resistant concrete may be required.

It is recommended that a geotechnical ground investigation is undertaken to inform foundation design.

Screening & Scoping

Land Stability:

The site, as with the surrounding area, is generally flat. The Groundsure report has noted that there is a "very low" risk of land instability issues for the site.

Surface Flor and Flooding:

The proposed development will comprise a basement within the existing footprint of the building, which itself covers the entire site footprint. Therefore, the proposed development will not cause a significant change in surface water run-off.

Basement Impact Assessment

Preliminary Impact Assessment:

The overall assessment of the site is that the creation of a basement for the existing development will not adversely impact the site or its immediate environs, providing measures are taken to protect surrounding land and properties during construction.

The proposed basement excavation will be within 5m of a public highway. It is also laterally within 5m of neighbouring properties.

Unavoidable lateral ground movements associated with the basement excavations must be controlled during temporary and permanent works so as not to impact adversely on the stability of the surrounding ground and any associated services.

During the construction phase careful and regular monitoring will need to be undertaken to ensure that the property above, is not adversely affected. This may mean that the property needs to be suitably propped and supported.

From the studies that have been undertaken so far, and subject to the findings of an intrusive investigation, it is concluded that the construction of the basement will not present a problem for groundwater. The proposed development is not expected to cause significant problems to the subterranean drainage.

In addition to the desk study Jomas have carried out the following reports:

Ground Investigation & Basement Impact Assessment - Ref P5188J2818/SC
Ground Movement Assessment (Buildings Damage) – Ref P5188J2818/SC
Ground Movement Assessment (Highways Damage) – Ref P5188J2818/SC

The outcome of reports has been considered when preparing this report, the proposed design and the proposed monitoring strategy.

2. Existing Structure

15 Belsize Park Mews is a 2-storey mews building constructed late 19th century. The building comprises a ground floor, a first floor and a flat roof. The site is fairly level throughout.

During the design development stage, a series of trial holes and site were carried out to determine the nature of the existing foundations and structure. The existing structure as a hole is in good condition with no visible signs of movement or cracking.

Foundations:
The foundations are most likely to be of a shallow nature and are a mixture of brick corbelled foundations and mass concrete foundations.

Ground Floor:
The ground floor is a concrete slab built on to the underlying ground (ground bearing slab).

First Floor:
The first floor is of a traditional timber joist construction spanning on to the internal loadbearing wall.

Roof:
The roof is a flat roof and is of a traditional timber joist construction spanning on to the internal loadbearing wall.

External and Party Wall:
The external and party walls are constructed with solid 9” brick walls.

The existing layouts can be found in Appendix 1.

3. Existing Site Drainage

The existing site drainage is gravity fed to the public sewers. The public sewers are combined foul and surface water. This was noted on site. There is 1 manhole on the public highway outside the property.

The manhole in the courtyard connects to the public sewer on the mews.

The existing drainage layouts along with the Thames Water Asset Location Search can be found in Appendix 2.

4. Proposed Structure

The current proposals include the removal of the internal loadbearing walls and floors. The existing property is small size and so the removal of these elements helps with providing access and egress for the construction of the basement in the temporary case.

The formation of the basement is to be carried out using a traditional underpinning technique. The underpins will provide vertical support to the existing party walls and foundations as well as lateral resistance to ground and water pressures. The underpins have been designed as vertical propped cantilevers and are rigidly fixed to the basement slab. The ground floor is to be formed using reinforced concrete and will help act as a prop to the underpin walls. In the temporary case underpins have been designed as un-propped.

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The basement slab has been designed as a stiff raft to reduce the risk of differential movement. The raft acts to distribute the vertical load evenly over the entire area to limits the applied load on the ground. The vertical loads from the upper floors are transferred directly on to the raft via the internal loadbearing elements (walls and columns).

The structural scheme considers similar future development of the neighbouring properties and so the underpins and the raft takes into consideration the different loading scenarios to ensure that such developments have no adverse effects.

The ground floor, first floor, second floor and roof are to be with suspended timber joists spanning on to steel beams and loadbearing walls. To avoid unnecessary disturbance to the neighbours the scheme avoids the insertion of structure into the party walls at the upper levels. Instead, vertical elements such as walls and columns are used.

The proposed layout and proposed structural scheme can be found in Appendix 3 and 4.

5. Proposed Drainage

The proposed drainage strategy considers the use of the existing manhole at the front of the property on Belsize Park Mews. All foul water is to be diverted to this manhole at its existing level and so the manhole does not need to be deepened. The foul water from the basement is to be internally pumped to the ground floor along with the cavity drainage system.

The proposed drainage strategy can be found in Appendix 5.

6. Movement Monitoring

Prior to the commencement of the works for the construction of the basement, survey targets are to be securely fixed to the party wall at 1m above the existing ground floor level.

The targets are to be placed in at least the following locations: at the junction of the front wall/party walls, the rear wall/party walls and at approximately 2m centres between the front and rear walls as indicated on the drawing. At least 1 'control/benchmark' target will be located at the front highway to allow the relative position and level of the targets to be measured.

The relative positions will be checked weekly during excavation and construction of the basement.

The results will be logged and plotted to an exaggerated vertical scale to highlight evidence of any movement.

Trigger values and required actions are as follows:

Green Limit 2.5mm (plan and level), or cracking in adjacent properties of >1mm Action – Movement Monitoring to be increased to min. of weekly visits.
Amber Limit 5mm (plan and level), or cracking in adjacent properties of >2mm Action – General Photographs of the site to be issued to the Surveyors and Engineers for immediate review. Project Engineers and Surveyors to meet on site within 10 working days to review the construction and agree further action. Movement Monitoring to be increased to min. weekly visits.

Red Limit 8mm (plan and level), or cracking in adjacent properties of >5mm Action – All works to stop. All open excavations to be backfilled to within 1.0 metre of adjoining owners' property ground level at closest boundary. Project Engineer and Surveyors to be informed immediately and to ideally meet within 48 hours, but no later than 6 working days, to determine how to complete the basement structure.

Refer to AMA sketch SK11 in Appendix 9 for further details.

7. Construction Technique and Methodology for Basement Construction

The works proposed to the basement require careful thought and planning prior to construction in order to aid the contractor. The works are to be undertaken by a competent contractor who has experience with the type of work being proposed.

The lowering of the basement will be undertaken with a traditional underpinning technique. Preliminary discussions have been carried out with specialist basement contractors and their proposals have been incorporated within the proposal.

The following construction sequence is suggested for the lowering of the basement [Appendix 6]:

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a. Undertake the demolition of the internal walls, first floor joists and ground floor slab installing temporary propping.
b. All concrete to be bagged and placed on the ground floor over a designated area ready to be loaded on to a 'grab and load' skip. All bags to have a maximum of 20kg weight.
c. Once area is clear undertake traditional underpinning in numbered sequence (1m maximum bay) as noted below:
    i. Concrete underpinning to be carried out in maximum bay lengths of 1000mm
    ii. The engineer and building inspector are to be notified when excavations are ready to receive concrete and their approval obtained before concrete is placed.
    iii. The excavations are to be kept dry at all times, and the bottom 100mm is to be removed immediately before concrete is placed.
    iv. The concrete is to be placed within 75mm of the underside of the existing foundation.
    v. After 24 hours the gap is to be packed and well rammed with sand and cement drypack and left for 24 hours.
    vi. Install a timber earth propping to ensure temporary lateral stability during the works.
    vii. Commence with excavations on the next bay in sequence.
d. During the underpinning works the excavated earth is to be bagged and placed on the ground floor over the designated area ready to be loaded on to a 'grab and load' skip.
e. Once all underpinning is completed the bulk excavation of the earth can commence to new the formation level starting from the rear of the property and working towards the front. During this the props are to be re-aligned so that they are propped on the new earth formation level.
f. During the bulk excavation the excavated earth is to be bagged and placed on the ground floor over the designated area ready to be loaded on to a 'grab and load' skip. All bags to have a maximum of 20kg weight.
g. Once the bulk excavation has been completed the new basement slab is to be cast removing all props after 72 hours.

8. Conclusion

The construction of the basement is to be undertaken by a competent contractor who has experience with projects of this nature. With the methodology and sequencing suggested, along with good practice and well design temporary supports, the construction of the basement will have no adverse effect on the existing buildings.

Detailed drawings, specification and method statement will be prepared in advance of any works being carried out on site. The final method statement and sequencing will be done with the input of the chosen contractor.

Regular site visits will to be carried out during the works to ensure that he works are being carried out in accordance with the design.

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Appendices

1. Existing Layouts
2. Existing Drainage
3. Proposed Layouts
4. Proposed Structure
5. Proposed Drainage
6. Construction Sequence
7. Stage 1 & 2 BIA_Report
8. Outline Retaining Wall Calculations
9. Outline Movement Monitoring Strategy

Appendices 1 – Existing Layouts

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01 Location Plan
1:500@A3

Site Boundary

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0 5 10 15 20 25m

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P01	14.02.23	For Information	NP

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Drawing Title:			Project Name:		Client	
Location Plan			15 Belsize Park Mews, MW3 5BL			
Project No:	Drawing No:	Rev:	Scale:	Status	Date:	Drawn:
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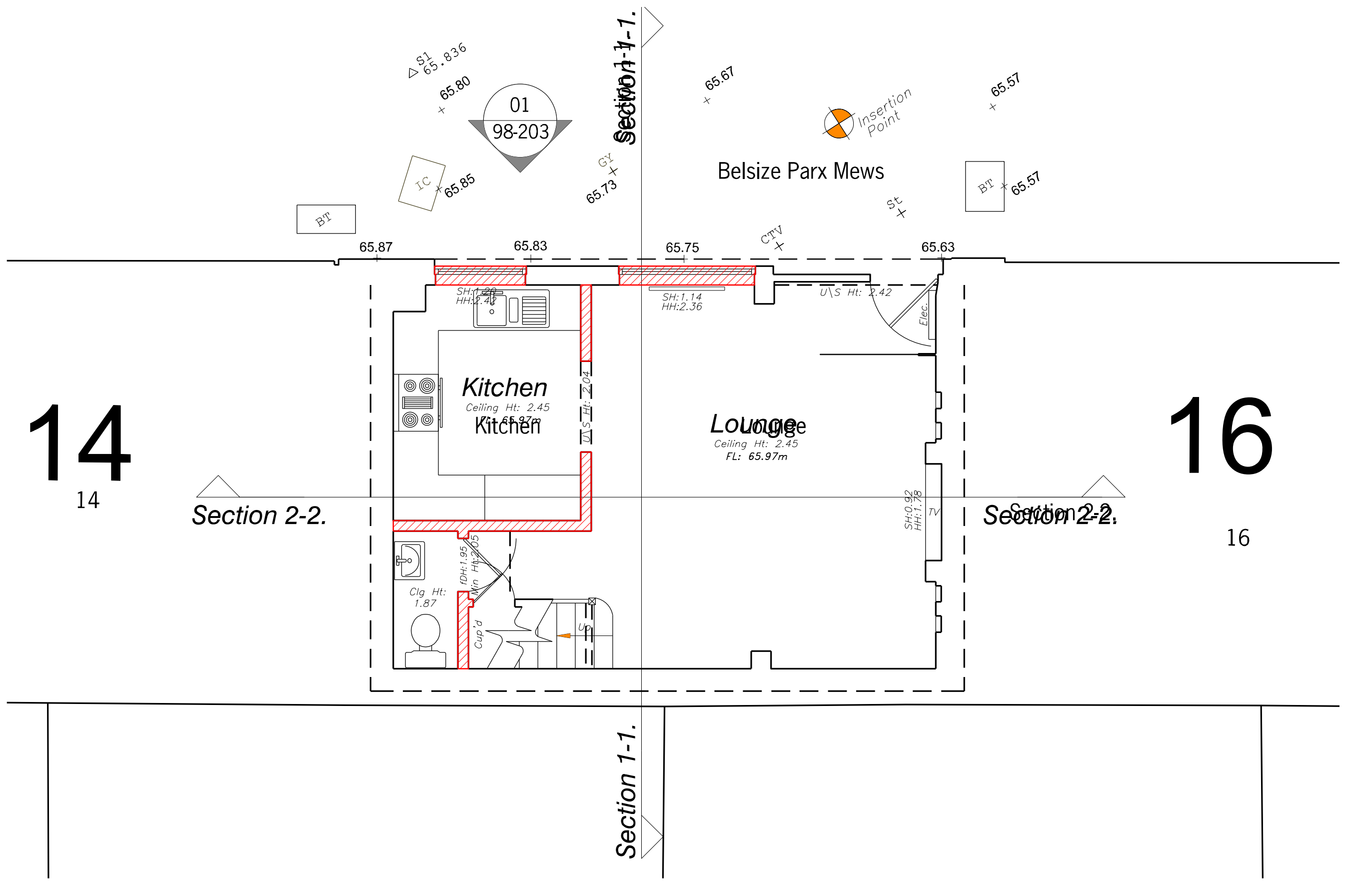

01 Existing Ground Floor Plan
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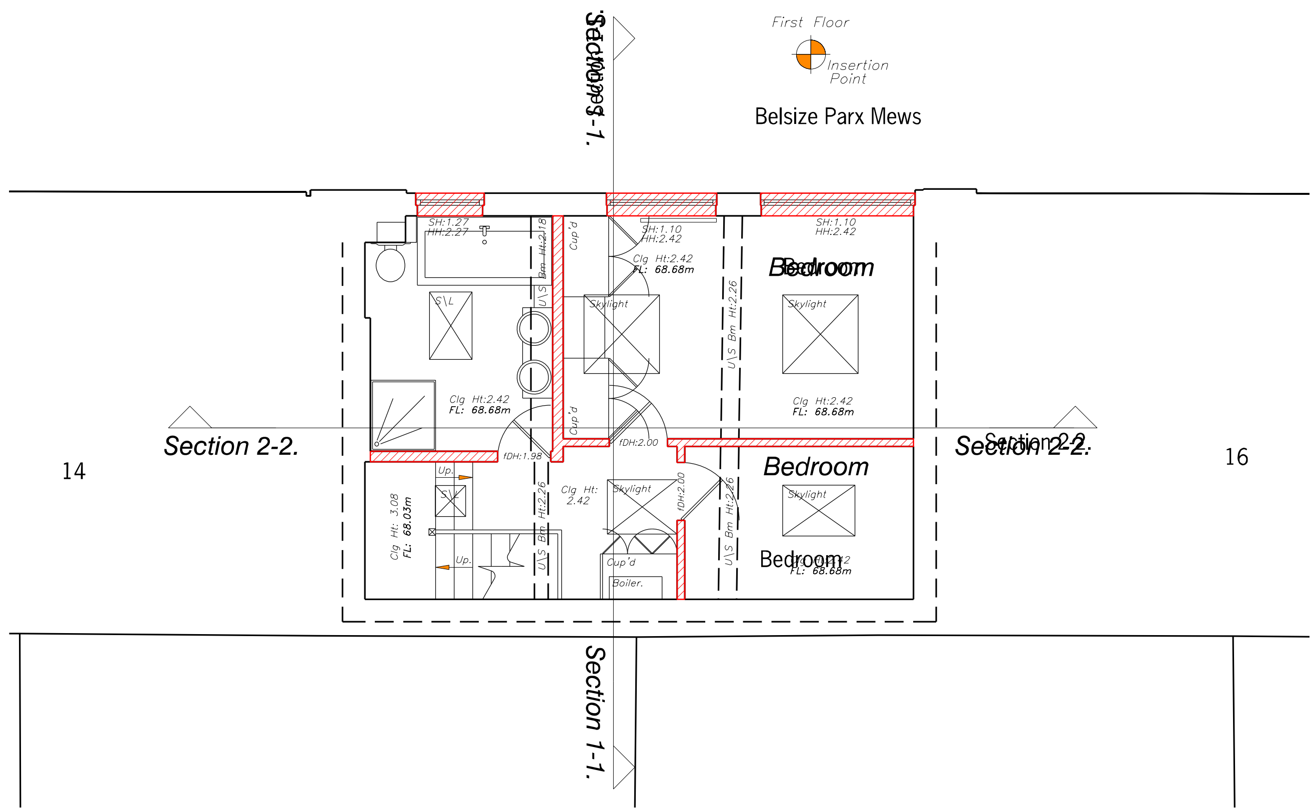

02 Existing First Floor Plan
1:100@A3

03 Existing Roof Plan
1:100@A3

Key:

To be demolished

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0 1 2 3 4 5m

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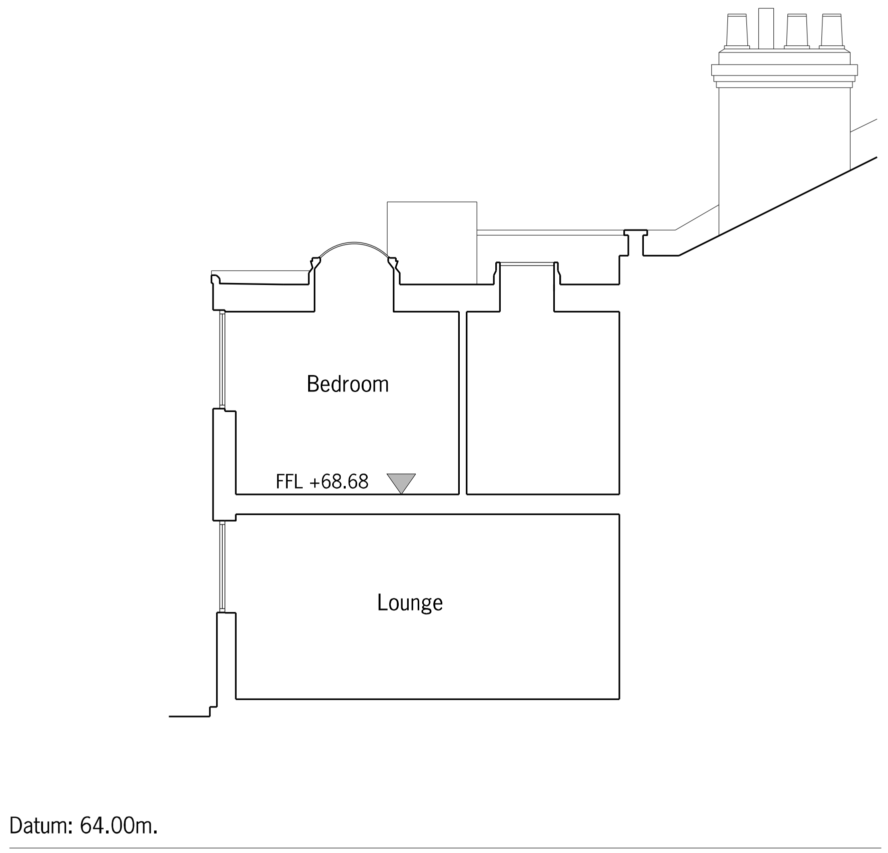

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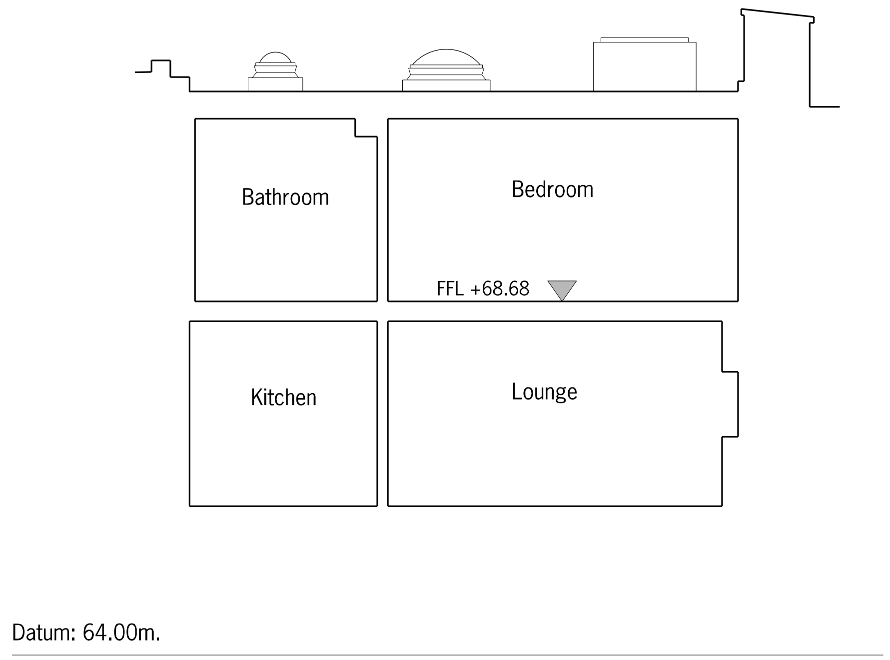

02 Existing Section 2
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03 Existing Front Elevation
1:100@A3

0 1 2 3 4 5m

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P01	09.01.23	For Information	TN

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Drawing Title:			Project Name:		Client	
Existing Elevation and Sections			15 Belsize Park Mews NW3 5BL			
Project No:	Drawing No:	Rev:	Scale:	Status	Date:	Drawn:
2211	98-210	P01	1:100@A3	PLANNING	09.01.23	TN

Appendices 2 – Existing Drainage

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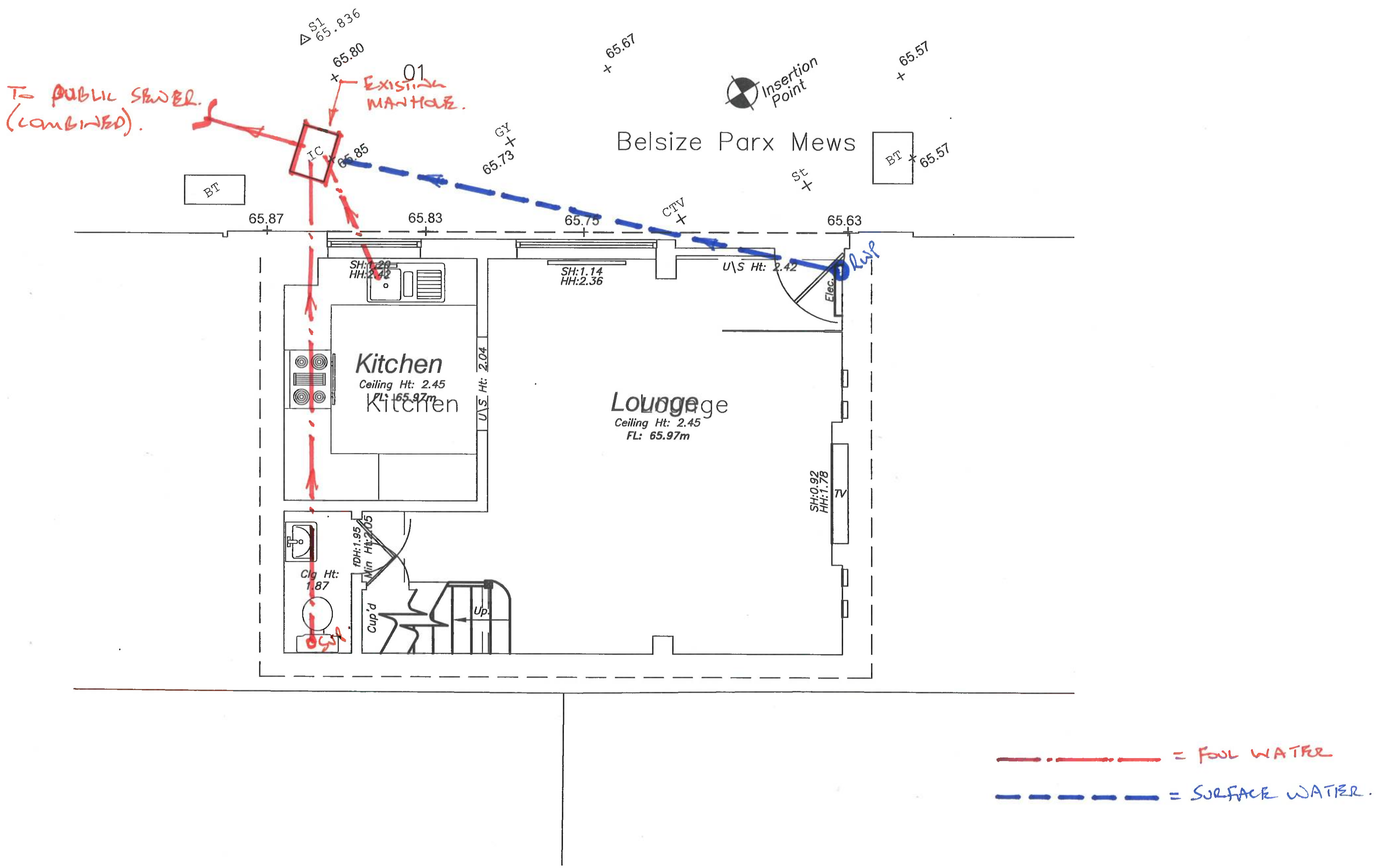

ALL TBC DURING FULL STRIP OF BUILDING

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Project: 15 Belsize Park Mews London, NW3 5BL	Project Nº: 23066	Date: Aug 2023	Drawn: CAC
		Scale @A3: 1:50	Engineer: CAC

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Appendices 3 – Proposed Layouts

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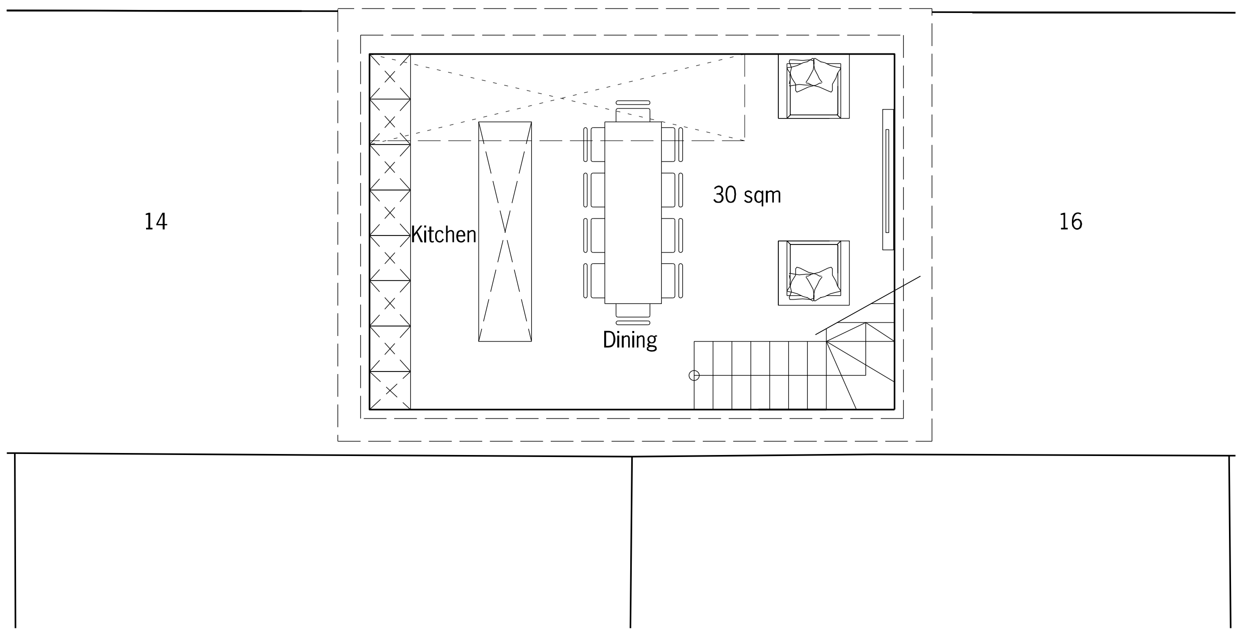

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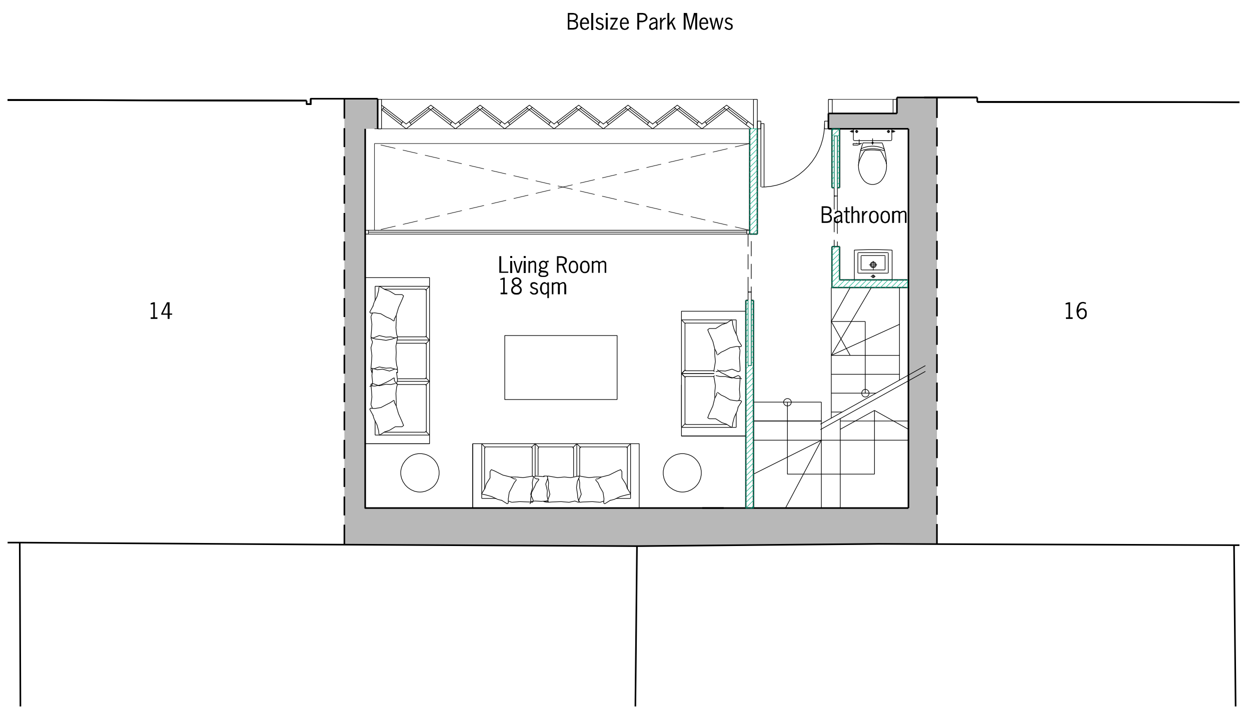

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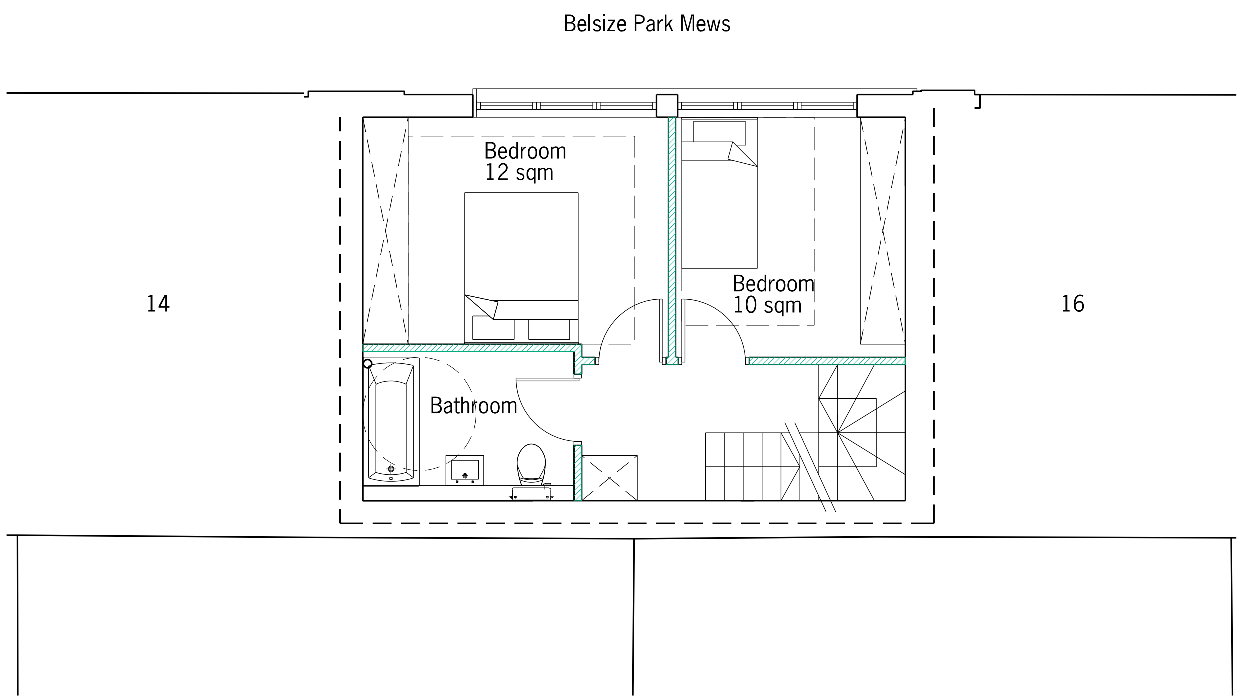

03 Proposed First Floor Plan
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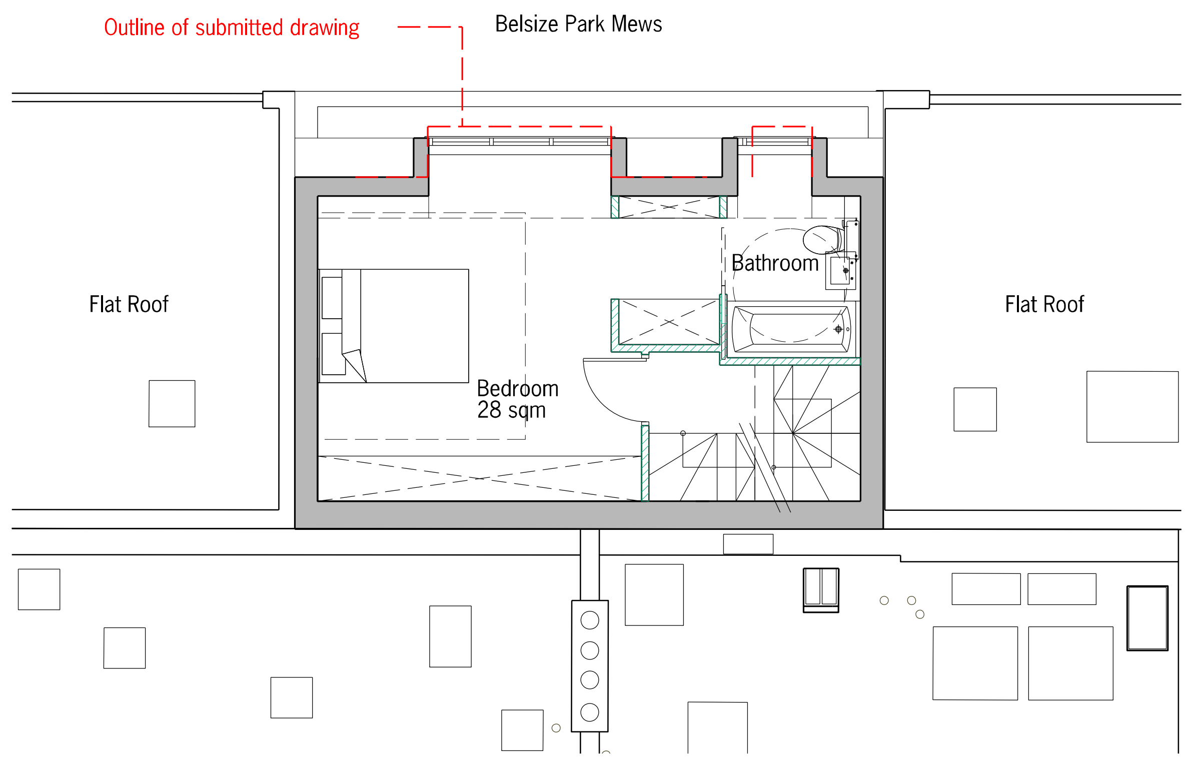

04 Proposed Second Floor Plan
1:100@A3

0 1 2 3 4 5m

Rev	Date	Description	Chk
P01	23.01.23	For Information	NP
P02	09.08.23	Planning Submission	NP

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Drawing Title:			Project Name:		Client	
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2211	**00-201**	**P01**	**1:100@A3**	**PLANNING**	**11.01.23**	**TN**

01 Proposed Front Elevation
1:100@A3

02 Proposed Section
1:100@A3

- (01) Slate tiles
- (02) Black RAL 9006 Aluminum Frame - Double Glazed Windows with Copper reveal detail
- (03) Aluminum Perforated Screening - Copper finish
- (04) Black Slip Brick (Vandersanden - Morvan) Motar - Joint free.
- (05) Skylight
- (06) Breaker tank / pump (Plant)

0 1 2 3 4 5m

Rev	Date	Description	Chk
P01	14.02.23	For Information	NP
P02	14.08.23	For Information	NP

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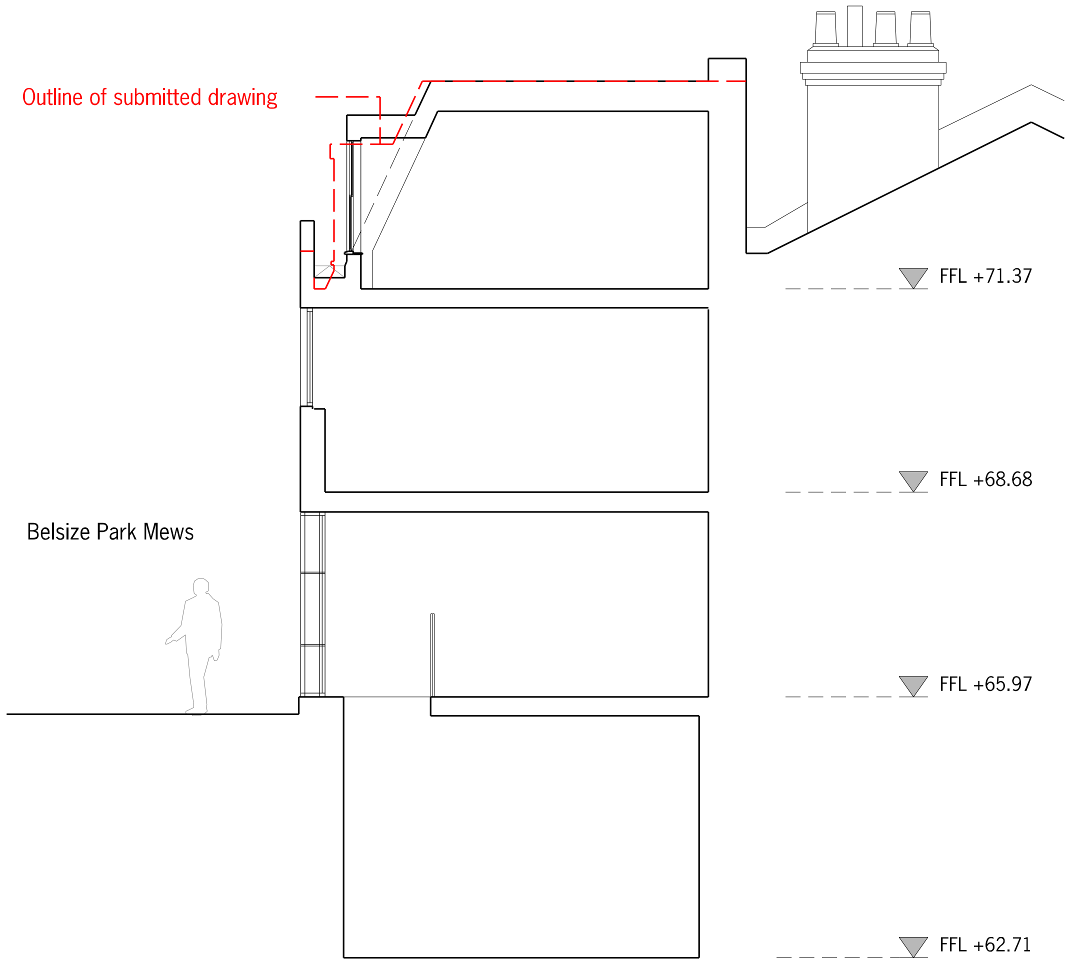

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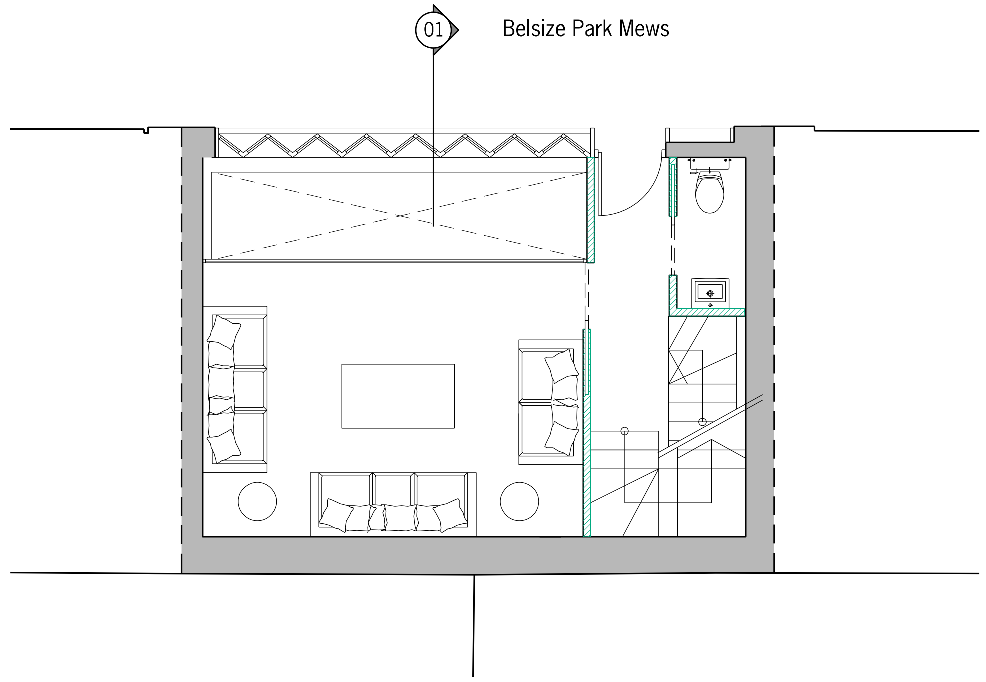

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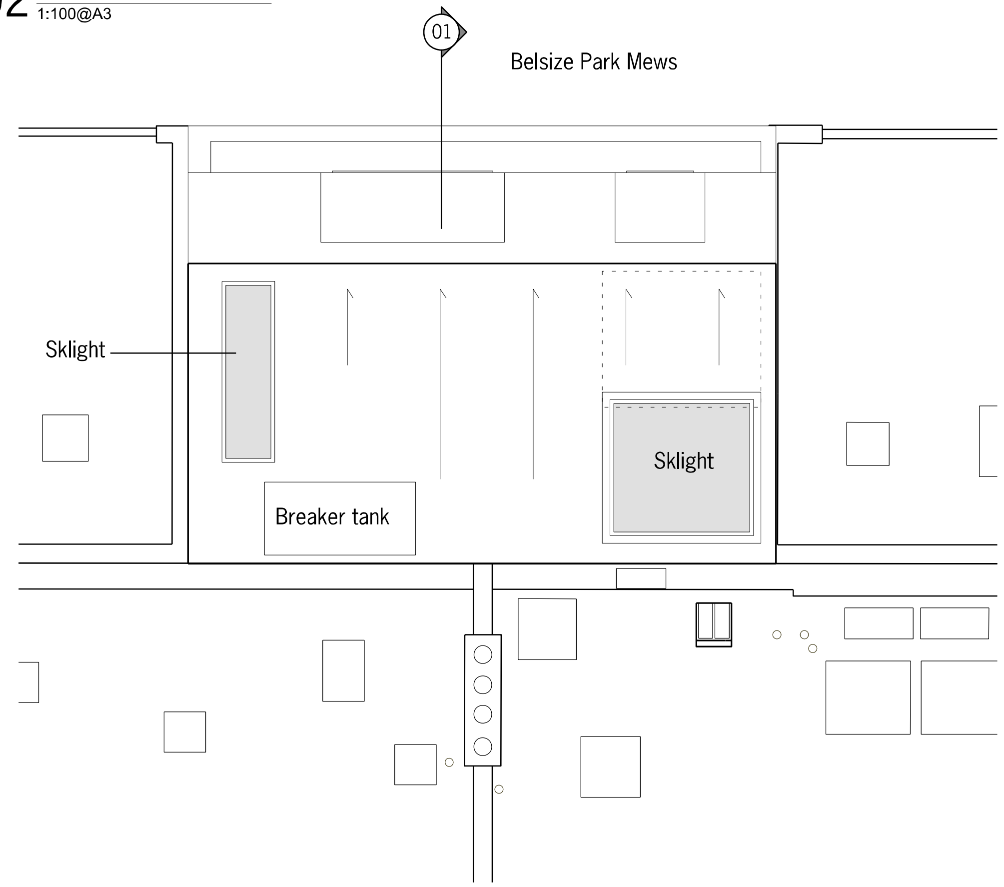

03 Roof Plan
1:100@A3

0 1 2 3 4 5m

Rev	Date	Description	Chk
P01	06.03.23	For Information	NP
P02	09.08.23	For Information	NP

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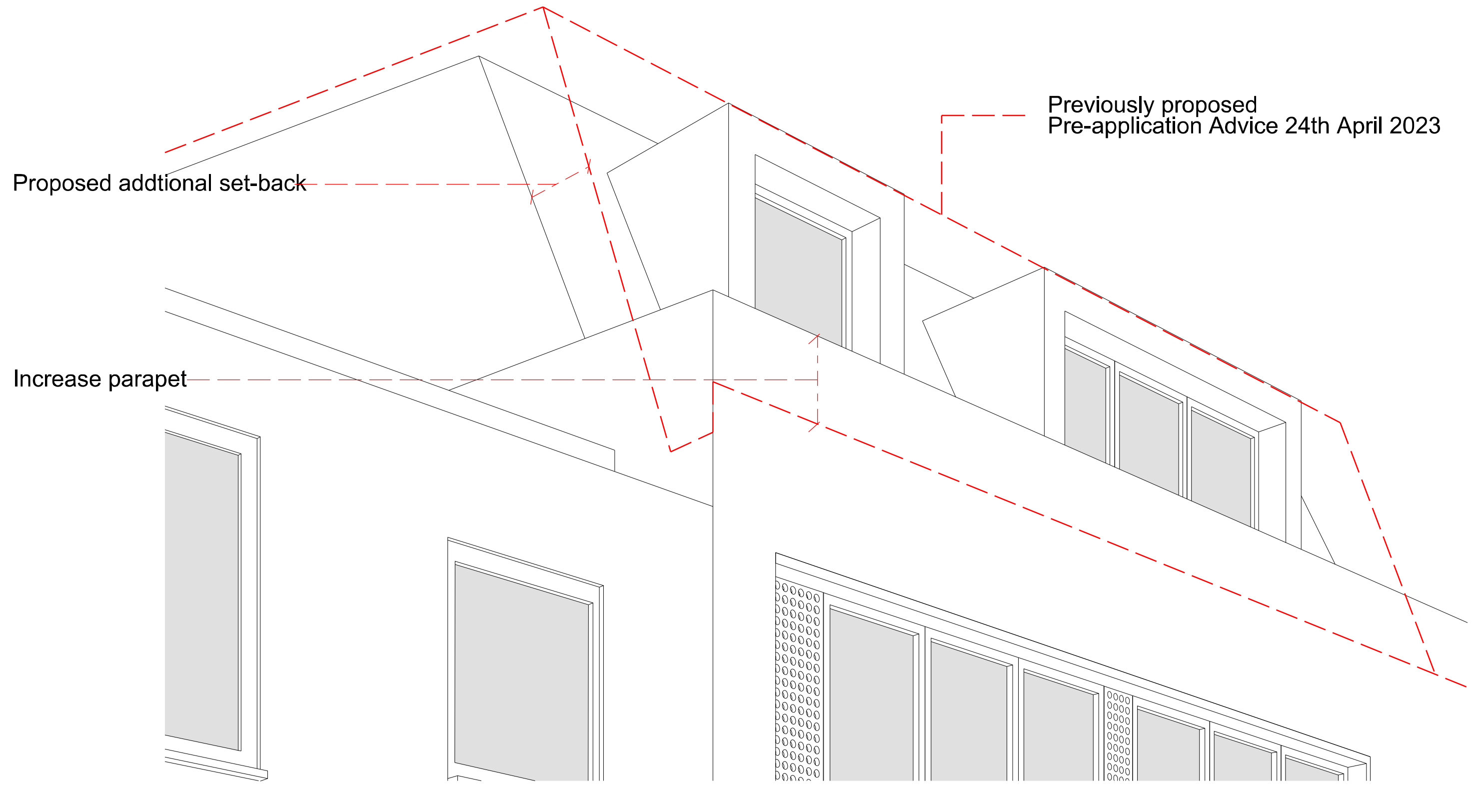
01 Pre-application Advice 24th April 2023

02 Pre-application Advice 11th July 2023

03 PLANNING SUBMISSION



04 PLANNING SUBMISSION

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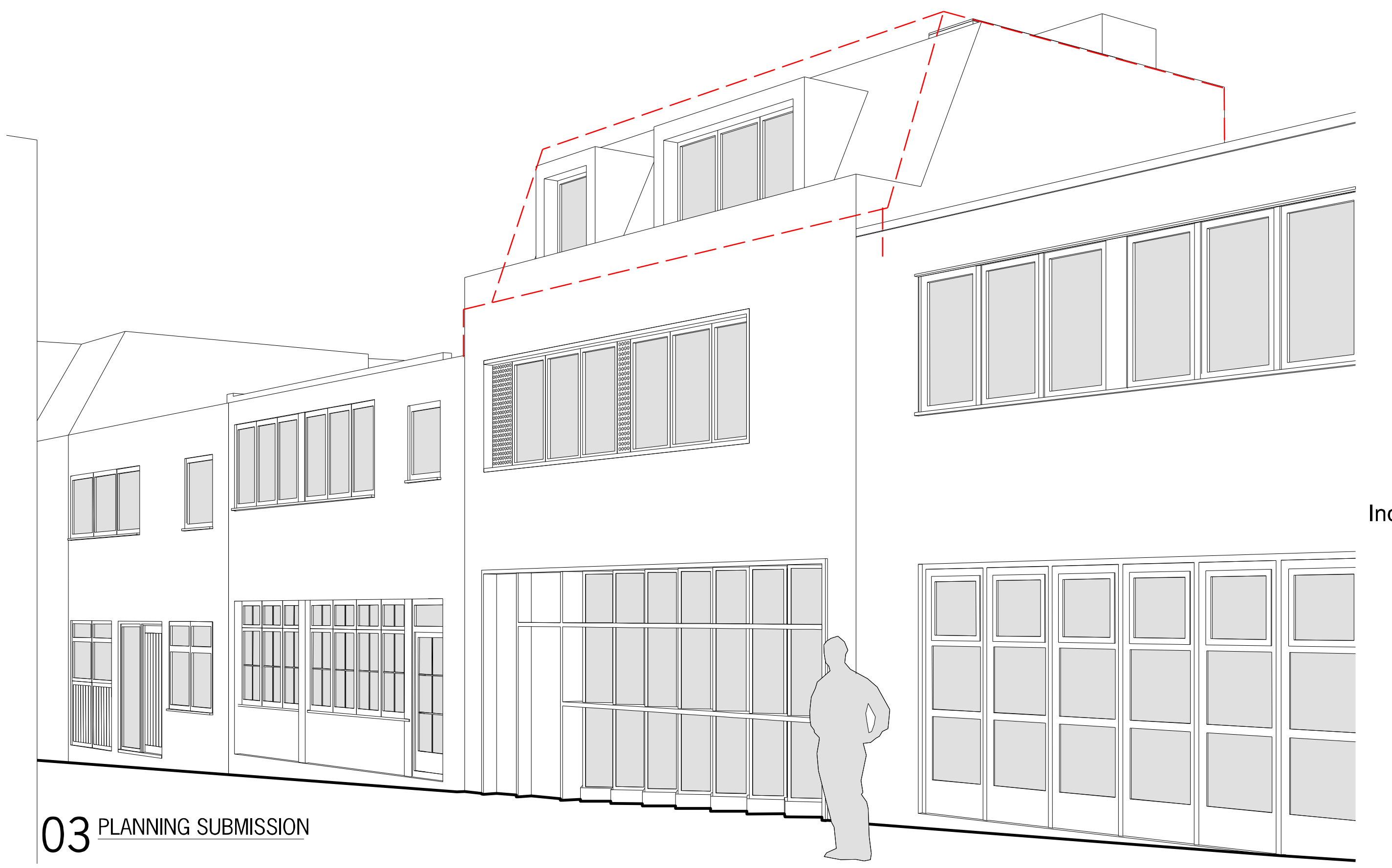
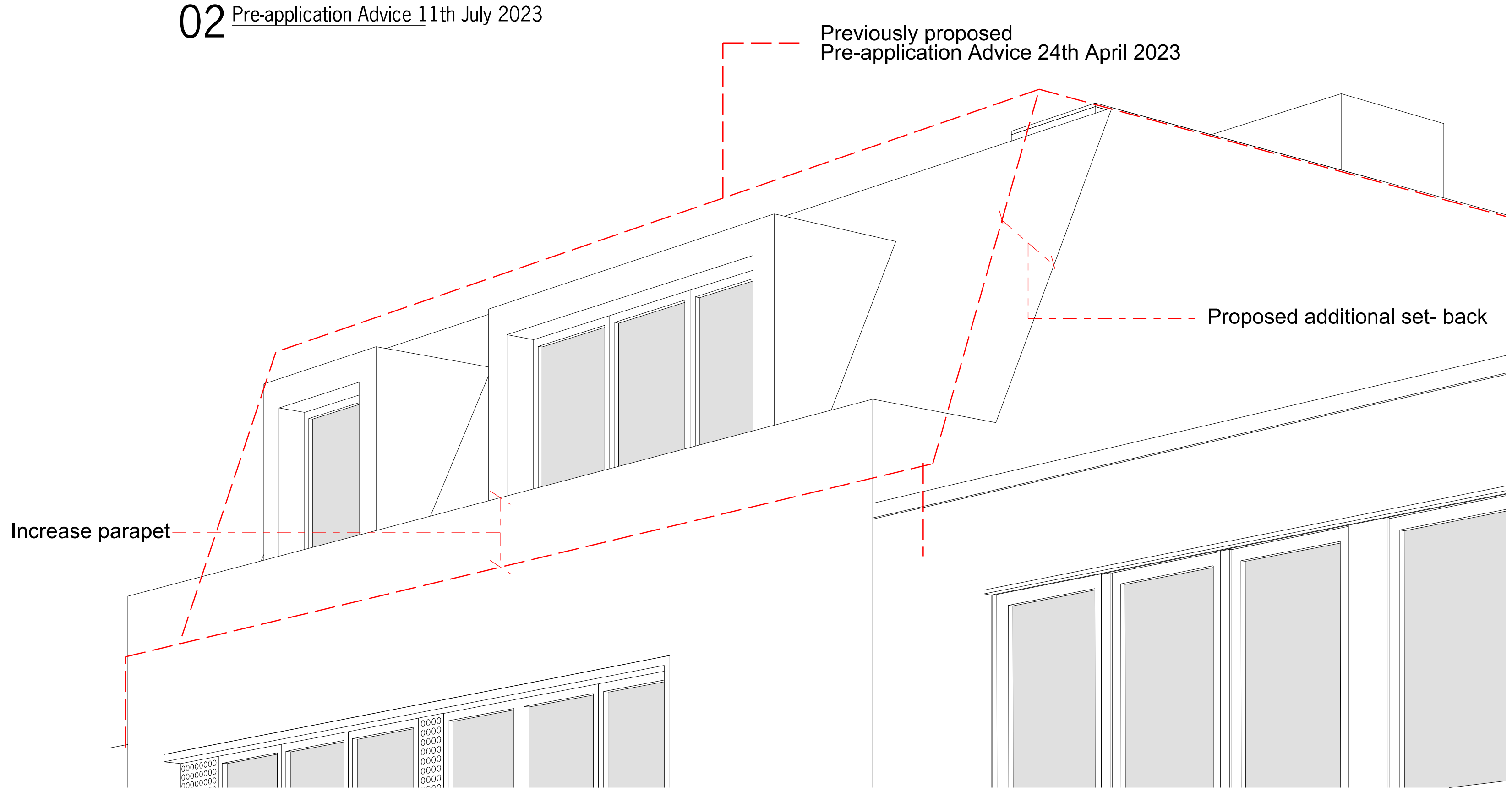
02 Pre-application Advice 11th July 2023



03 PLANNING SUBMISSION



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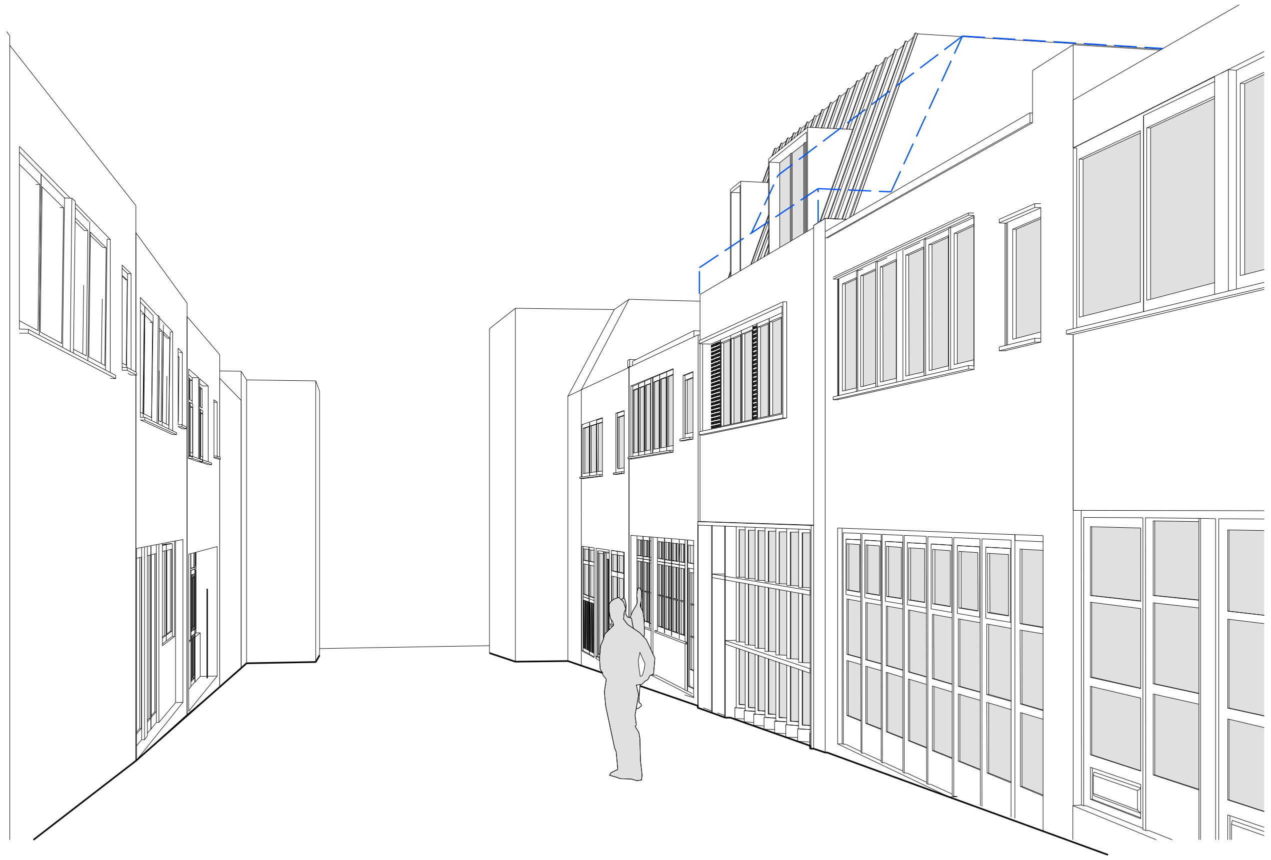
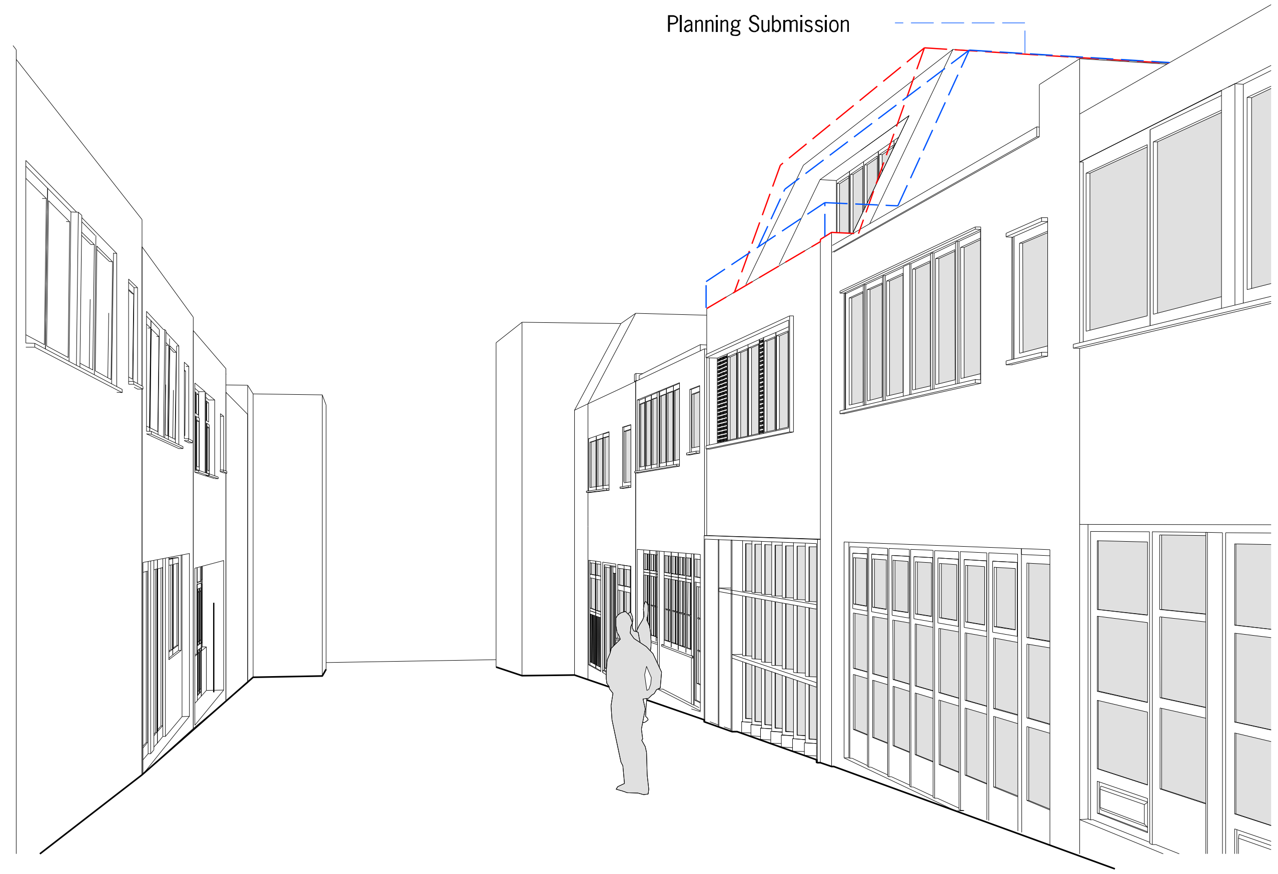
Rev	Date	Description	Chk
P01	11.08.23	PLANNING SUBMISSION	NP

PAPA ARCHITECTS
222 Archway Road, Highgate, London N6 5AX
w: papaarchitects.co.uk t:+44 20 8348 8411

Drawing Title:			Project Name:		Client	
Line Drawing View 2			15 Belsize Park Mews NW3 5BL			
Project No:	Drawing No:	Rev:	Scale:	Status	Date:	Drawn:
2211	00 231	P01	Not to scale	PLANNING	23.06.23	TN

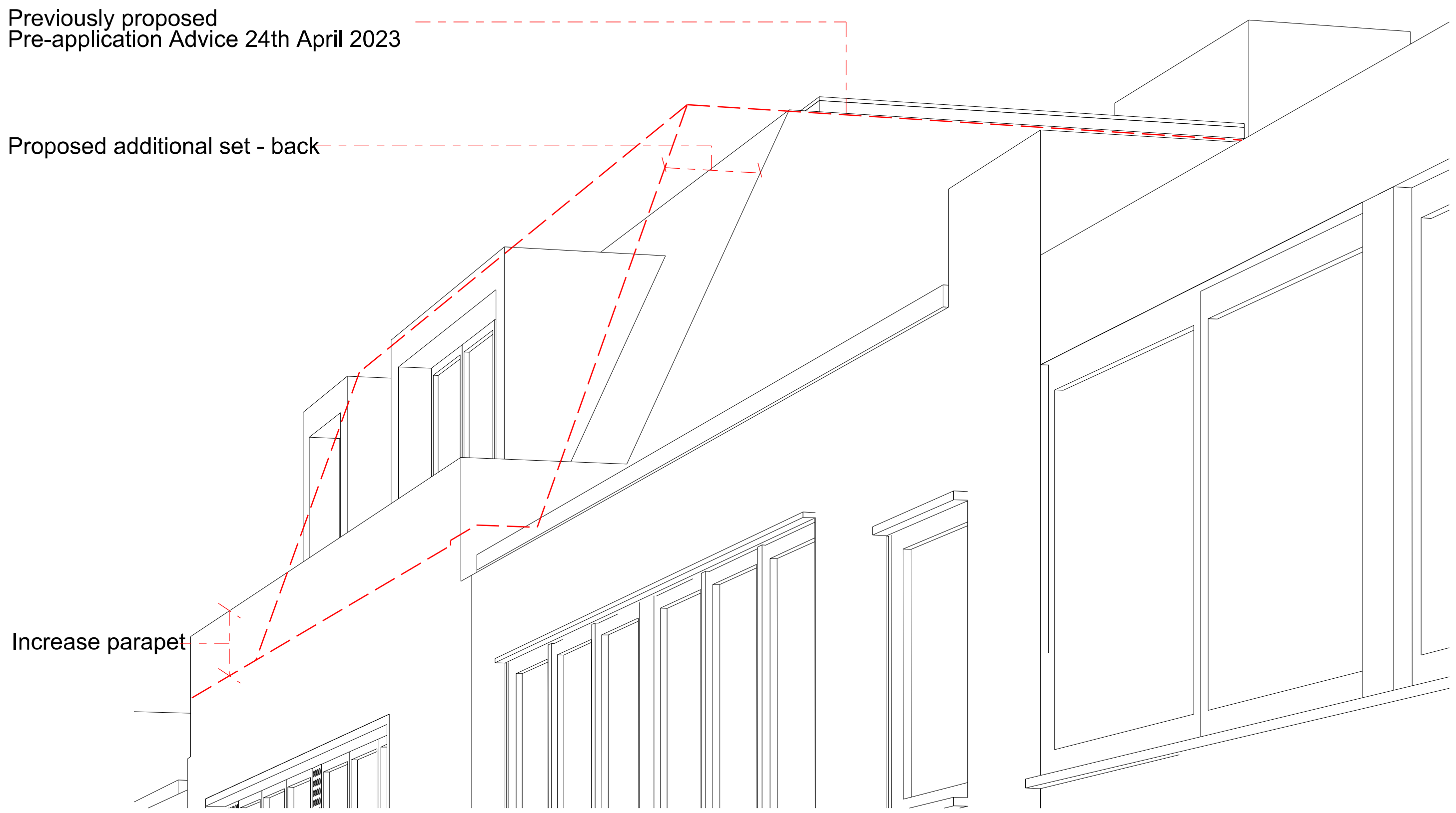


01 Pre-application Advice 24th April 2023



02 Pre-application Advice 11th July 2023

03 PLANNING SUBMISSION



04 PLANNING SUBMISSION

0 m

Rev	Date	Description	Chk
P01	14.08.23	PLANNING SUBMISSION	NP

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Drawing Title:			Project Name:		Client	
Line Drawing View 3			15 Belsize Park Mews NW3 5BL			
Project No:	Drawing No:	Rev:	Scale:	Status	Date:	Drawn:
2211	00 232	P01	N.T.S@A3	PLANNING	23.06.23	TN

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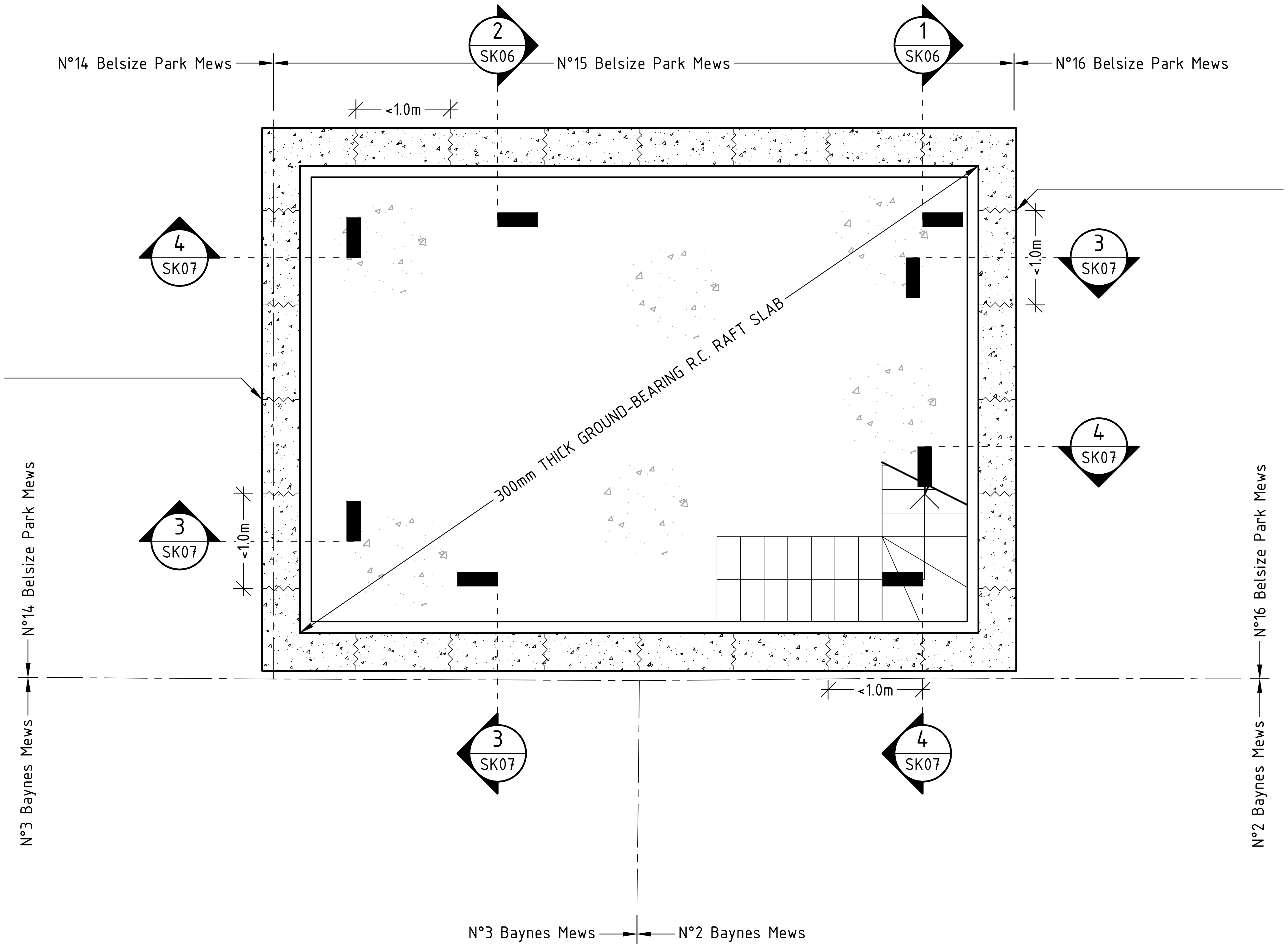
Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

UNDERPIN/RETAINING WALLS TO BE CAST IN BAYS NOT EXCEEDING 1.0m IN LENGTH. SEQUENCE OF UNDERPINNING TO BE AGREED.

400mm WIDE (MINIMUM) R.C. RETAINING/UNDERPINNING WALLS TO HAVE 175mm MINIMUM LINER WALL UPSTAND TO INSIDE FACE OF EXISTING MASONRY WALLS. REAR FACE OF WALL CAST TO MATCH NEIGHBOUR'S FACE OF EXISTING WALL.



Client:	Electron Holdings Management Ltd.	Title:	Proposed Basement Floor Layout	Drawing N°: SK01	Rev: 00
Project:	15 Belsize Park Mews, London, NW3 5BL	Project N°:	23066	Date: Aug 2023	Drawn: JL
				Scale @A3: 1:50	Engineer: CC

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Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

STEEL COLUMN SCHEDULE

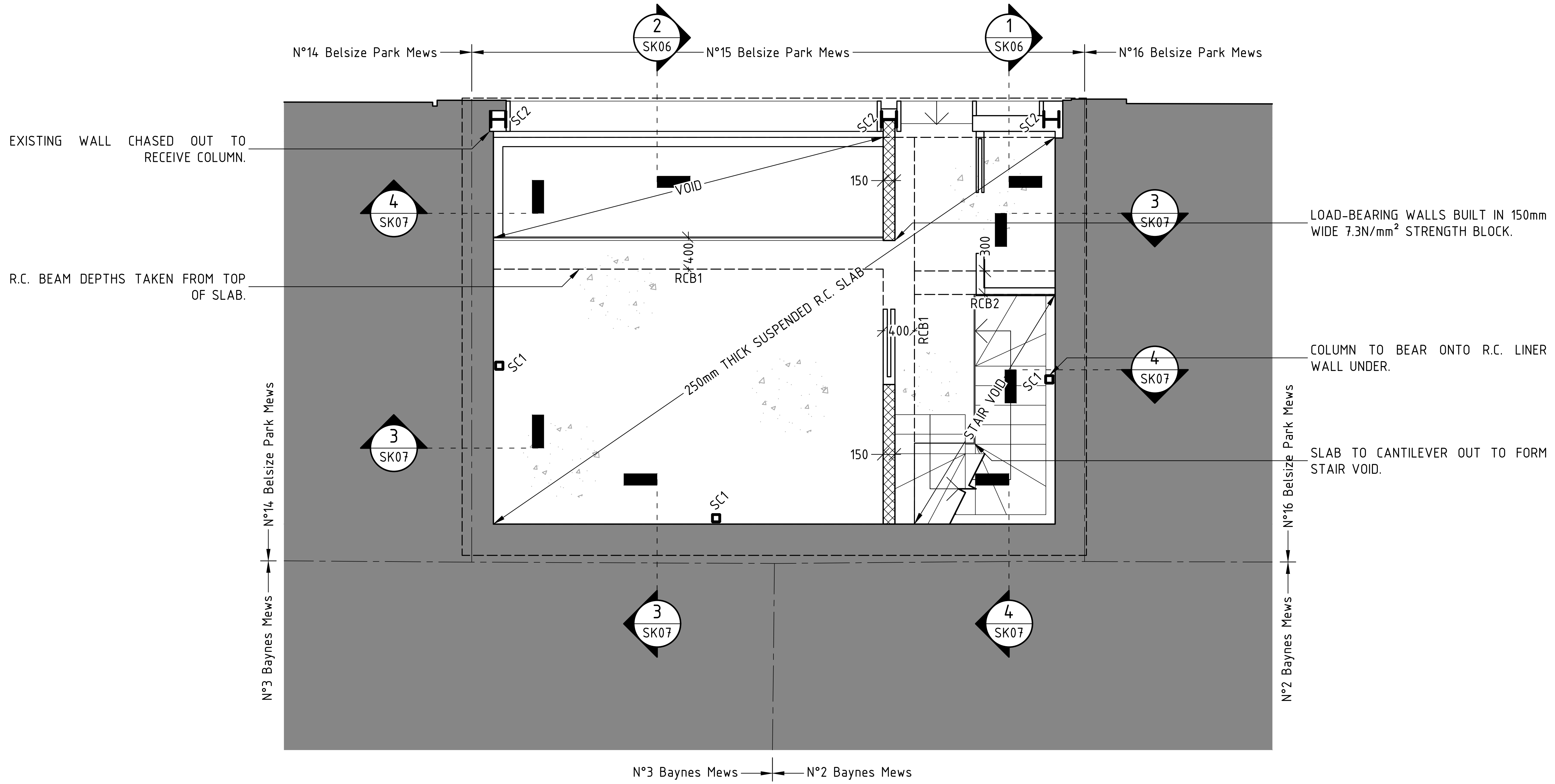
MARK	DESIGNATION
SC1	SHS 100
SC2	UC 203

GROUND FLOOR BEAM SCHEDULE

MARK	DESIGNATION
GB1	400mm WIDE ×600mm DEEP REINFORCED CONCRETE
GB2	400mm WIDE ×600mm DEEP REINFORCED CONCRETE

GROUND FLOOR BEAM SCHEDULE

MARK	DESIGNATION
GB3	300mm WIDE ×300mm DEEP REINFORCED CONCRETE



Client: Electron Holdings Management Ltd.
Project: 15 Belsize Park Mews, London, NW3 5BL
Title: Proposed Ground Floor Layout
Project N°: 23066
Drawing N°: SK02
Rev: 00
Date: Aug 2023
Drawn: JL
Scale @A3: 1:50
Engineer: CC

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Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

STEEL COLUMN SCHEDULE

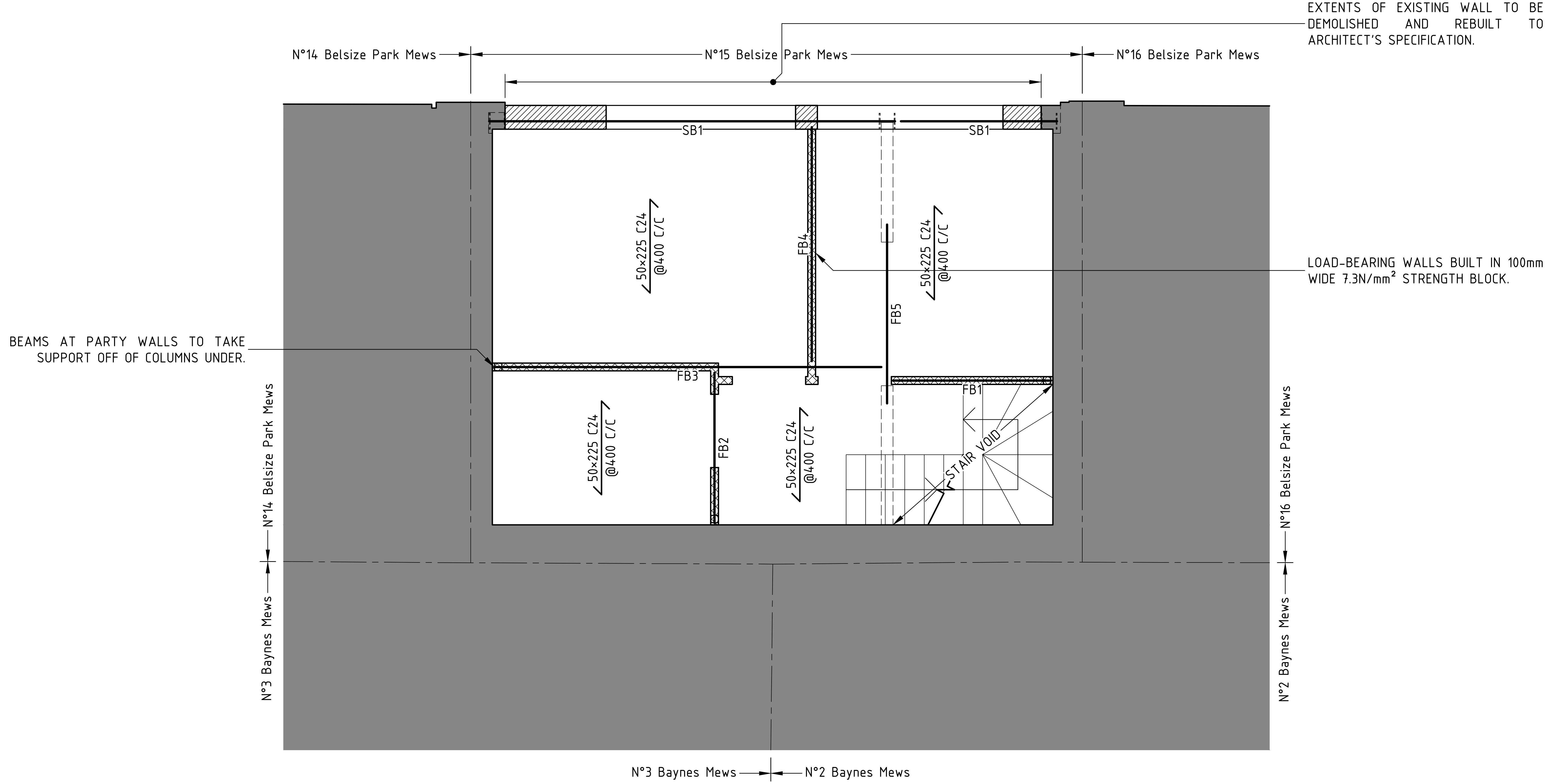
MARK	DESIGNATION
SC1	SHS 100
SC2	UC 203

FIRST FLOOR BEAM SCHEDULE

MARK	DESIGNATION
FB1	UB 203
FB2	UB 203
FB3	UC 203

FIRST FLOOR BEAM SCHEDULE

MARK	DESIGNATION
FB4	UC 203
FB5	UB 203



Client: Electron Holdings Management Ltd.
Project: 15 Belsize Park Mews, London, NW3 5BL
Title: Proposed First Floor Layout
Project N°: 23066
Drawing N°: SK03
Rev: 00
Date: Aug 2023
Drawn: JL
Scale @A3: 1:50
Engineer: CC

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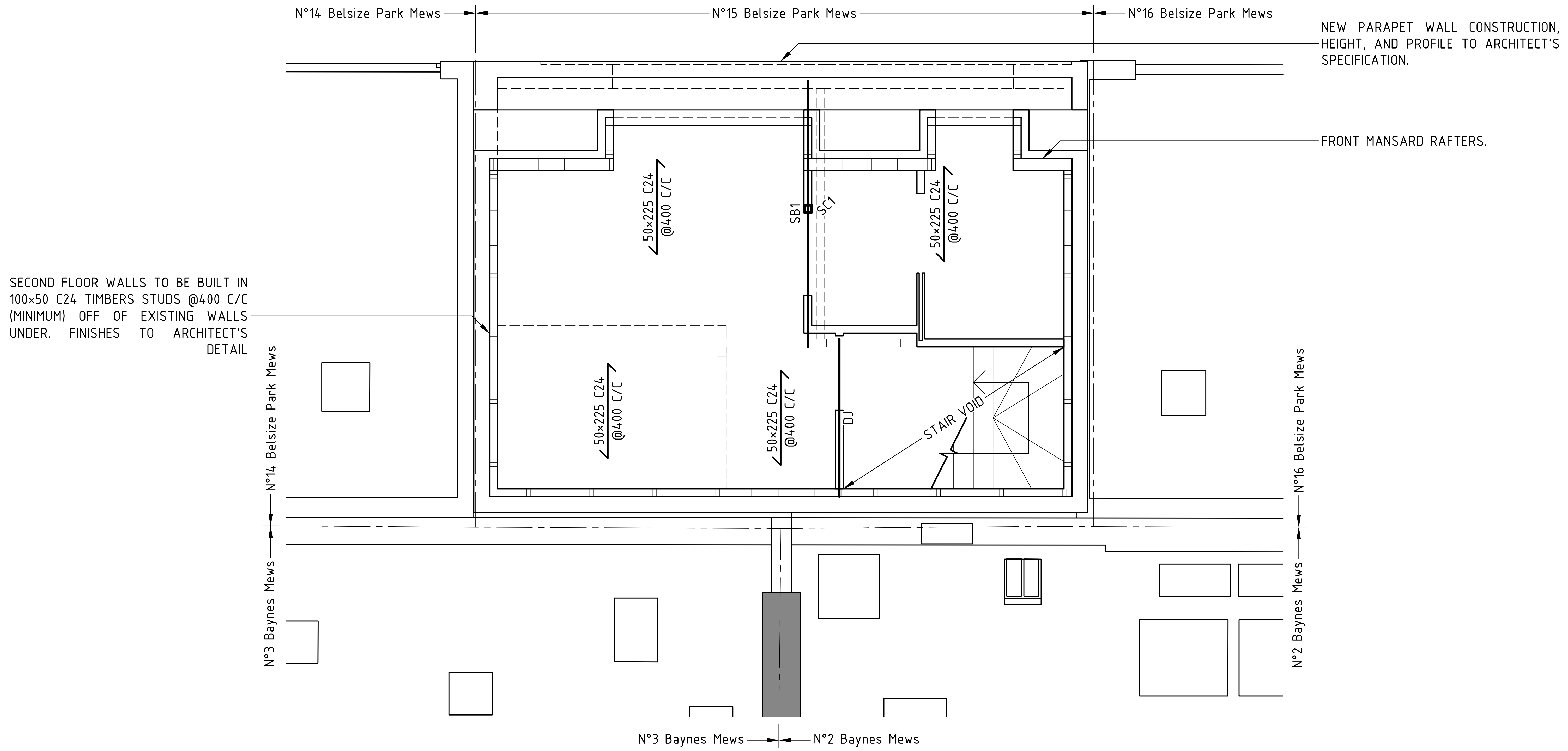
STEEL COLUMN SCHEDULE	
MARK	DESIGNATION
SC1	SHS 100
SC2	UC 203

SECOND FLOOR BEAM SCHEDULE	
MARK	DESIGNATION
SB1	UC 152

Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17



Client: Electron Holdings Management Ltd.

Project: 15 Belsize Park Mews, London, NW3 5BL

Title: Proposed Second Floor Layout

Project N°: 23066

Drawing N°: SK04

Rev: 00

Date: Aug 2023

Drawn: JL

Scale @A3: 1:50

Engineer: CC

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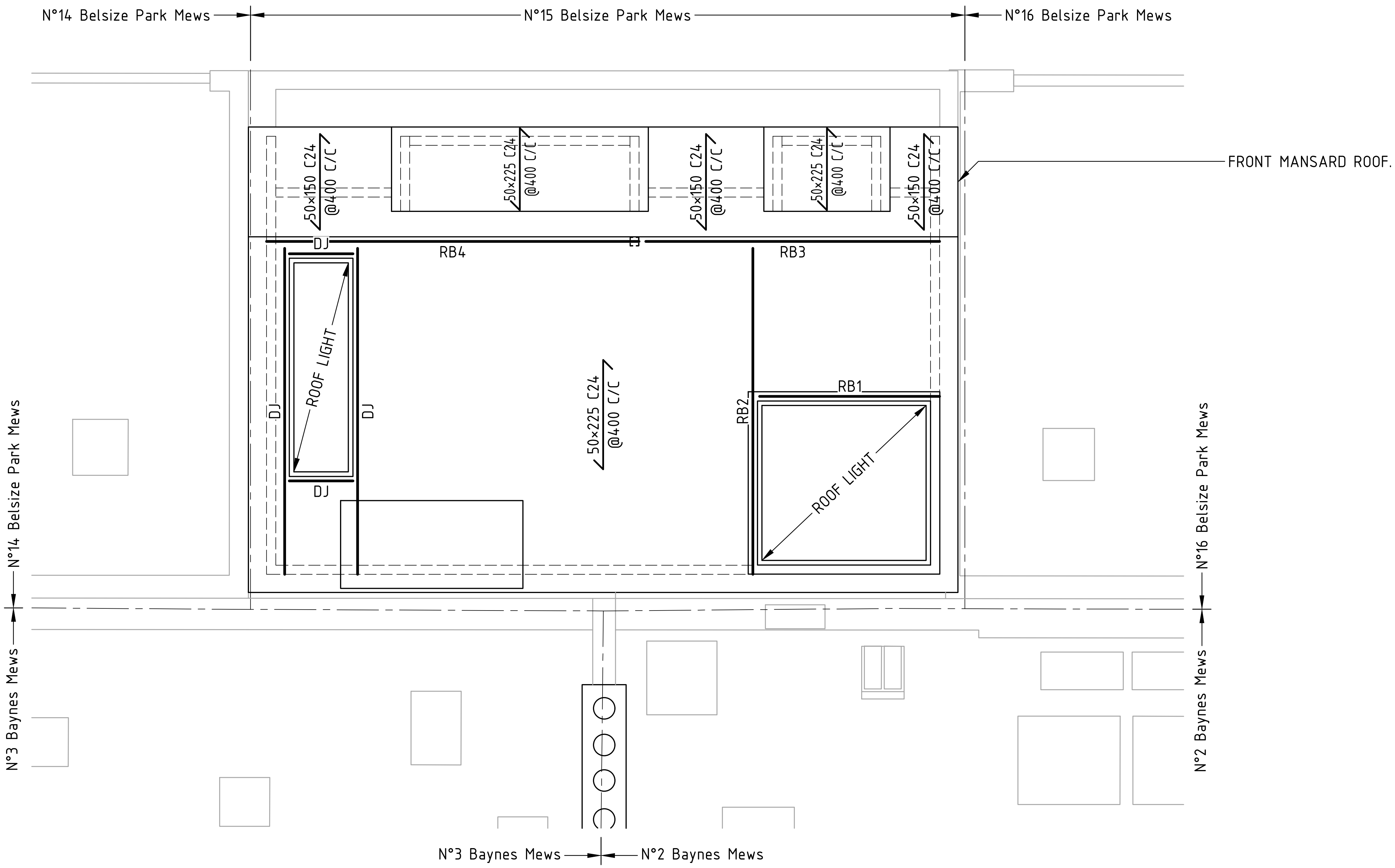
Drawing Status	INFORMATION			
REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

ROOF BEAM SCHEDULE

MARK	DESIGNATION
RB1	UC 152
RB2	UC 152
RB3	UC 152
RB4	UC 152



Client: Electron Holdings Management Ltd.

Project: 15 Belsize Park Mews, London, NW3 5BL

Title: Proposed Roof Layout

Project N°: 23066

Drawing N°: SK05

Rev: 00

Date: Aug 2023

Drawn: JL

Scale @A3: 1:50

Engineer: CC

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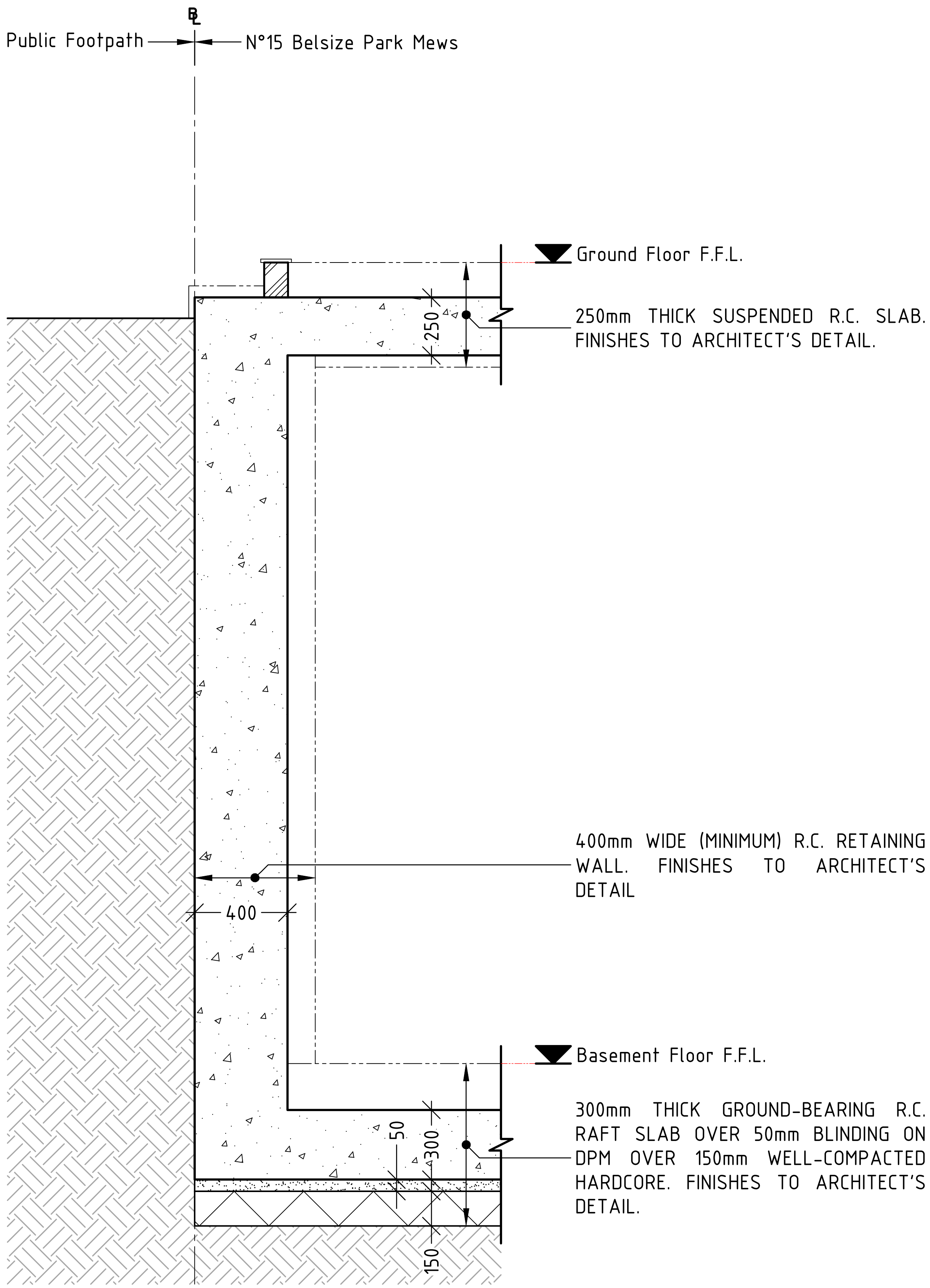
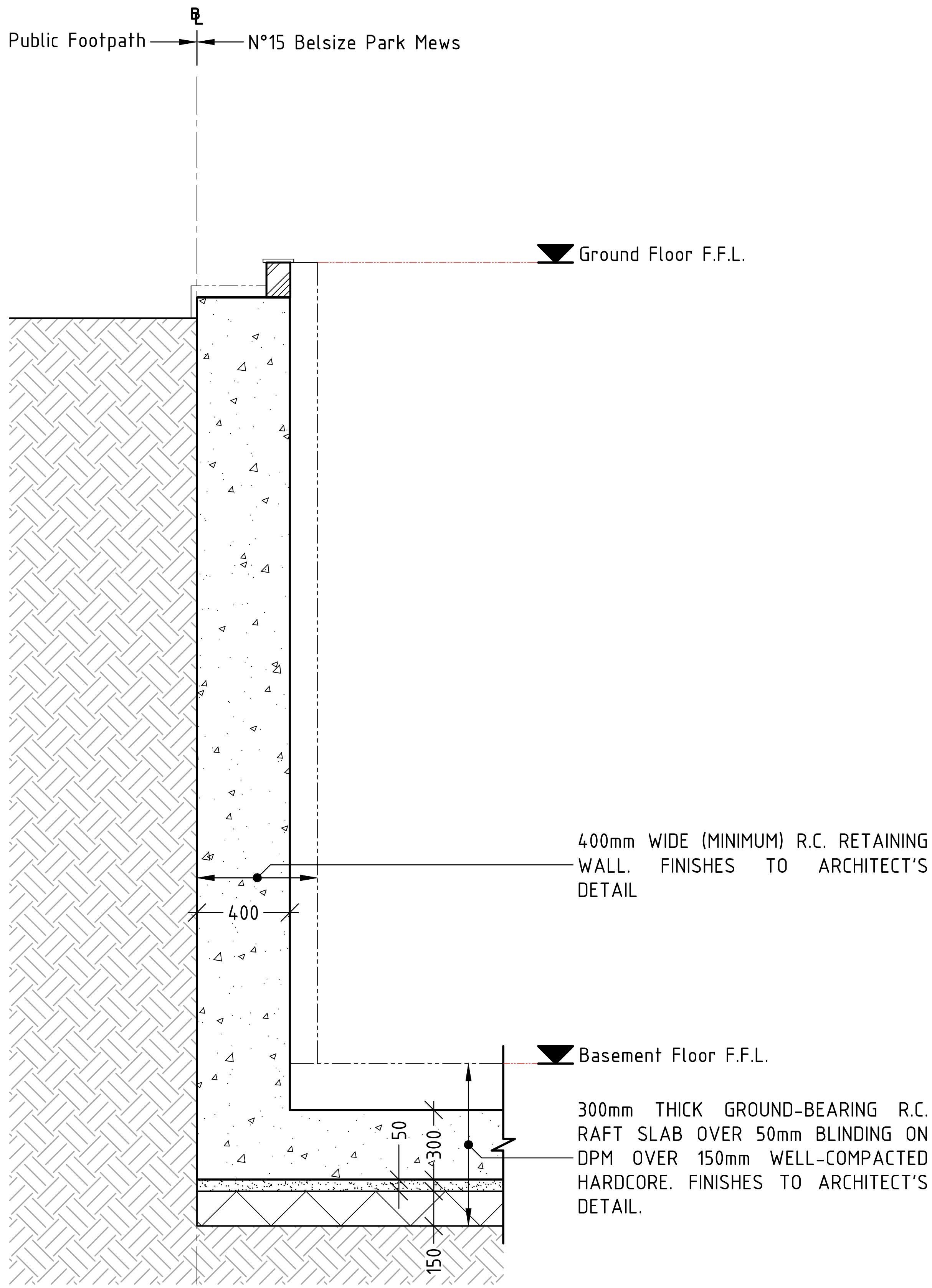
Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

SECTION 1-1
1:25 @ A3



SECTION 2-2
1:25 @ A3



Client: Electron Holdings Management Ltd.

Project: 15 Belsize Park Mews, London, NW3 5BL

Title: Proposed Sections 1 & 2

Project N°: 23066

Drawing N°: SK06
Rev: 00
Date: Aug 2023
Drawn: JL
Scale @A3: 1:25
Engineer: CC

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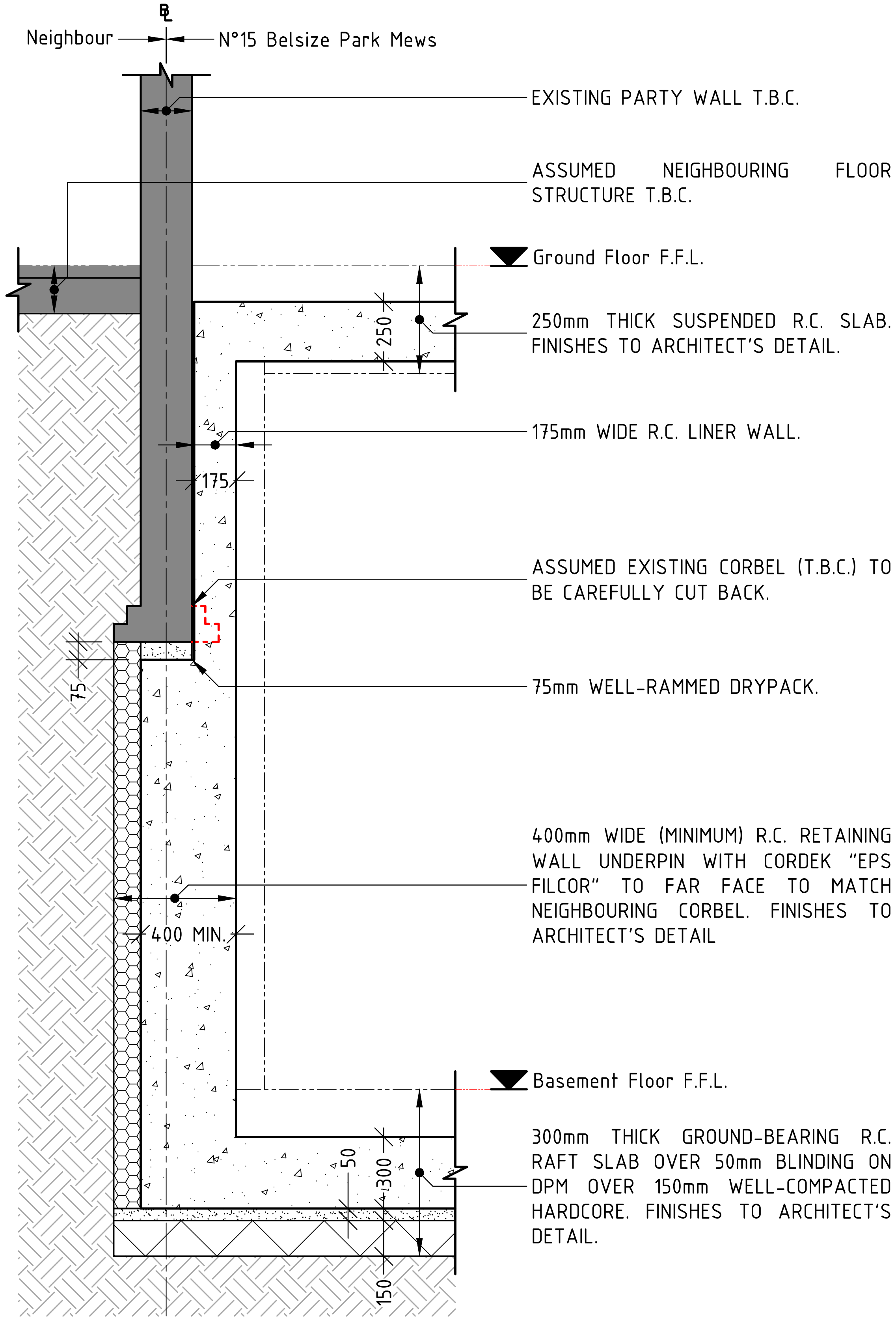
Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

SECTION 3-3
1:25 @ A3



SECTION 4-4
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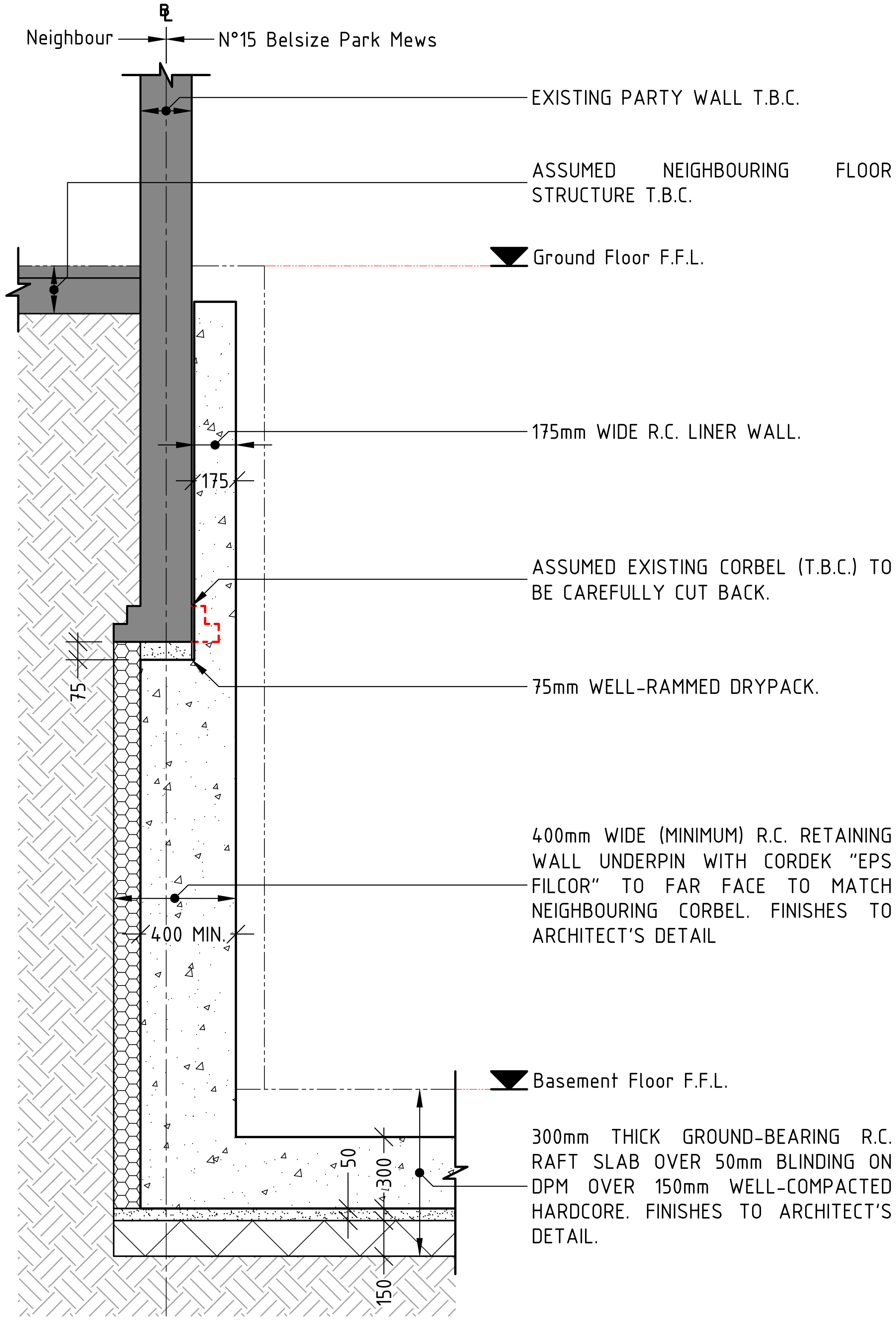

Client: Electron Holdings Management Ltd.
Project: 15 Belsize Park Mews, London, NW3 5BL
Title: Proposed Sections 3 & 4
Project N°: 23066
Drawing N°: SK07
Rev: 00
Date: Aug 2023
Drawn: JL
Scale @A3: 1:25
Engineer: CC

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Appendices 5 – Proposed Drainage

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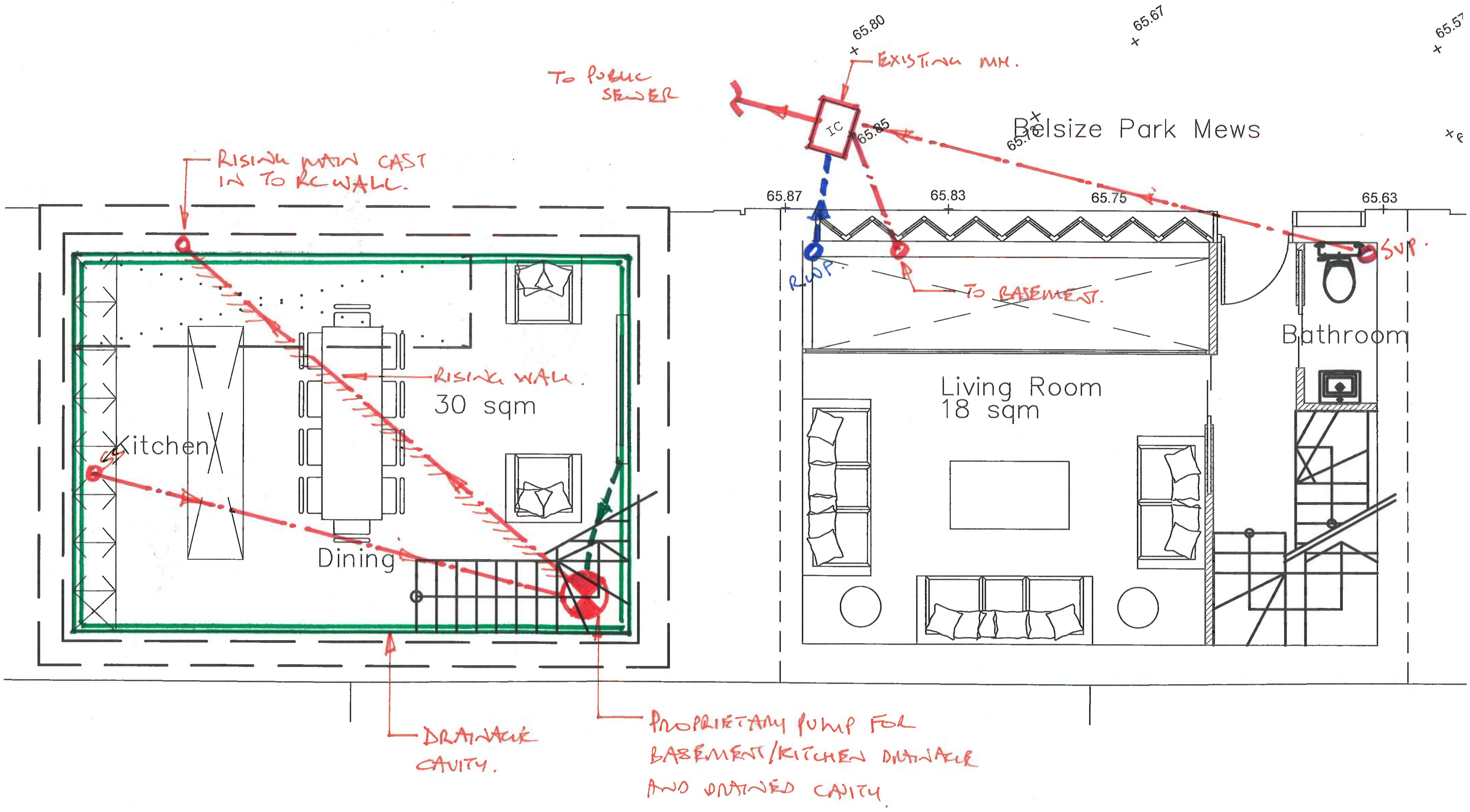
Drawing Status INFORMATION



Client: Electron Holdings Management Limited	Title: Proposed Site Drainage	Drawing N°: DM002	Rev: 00
Project: 15 Belsize Park Mews London, NW3 5BL	Project N°: 23066	Date: Aug 2023	Drawn: CAC
		Scale @A3: 1:50	Engineer: CAC

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Appendices 6 – Construction Sequence

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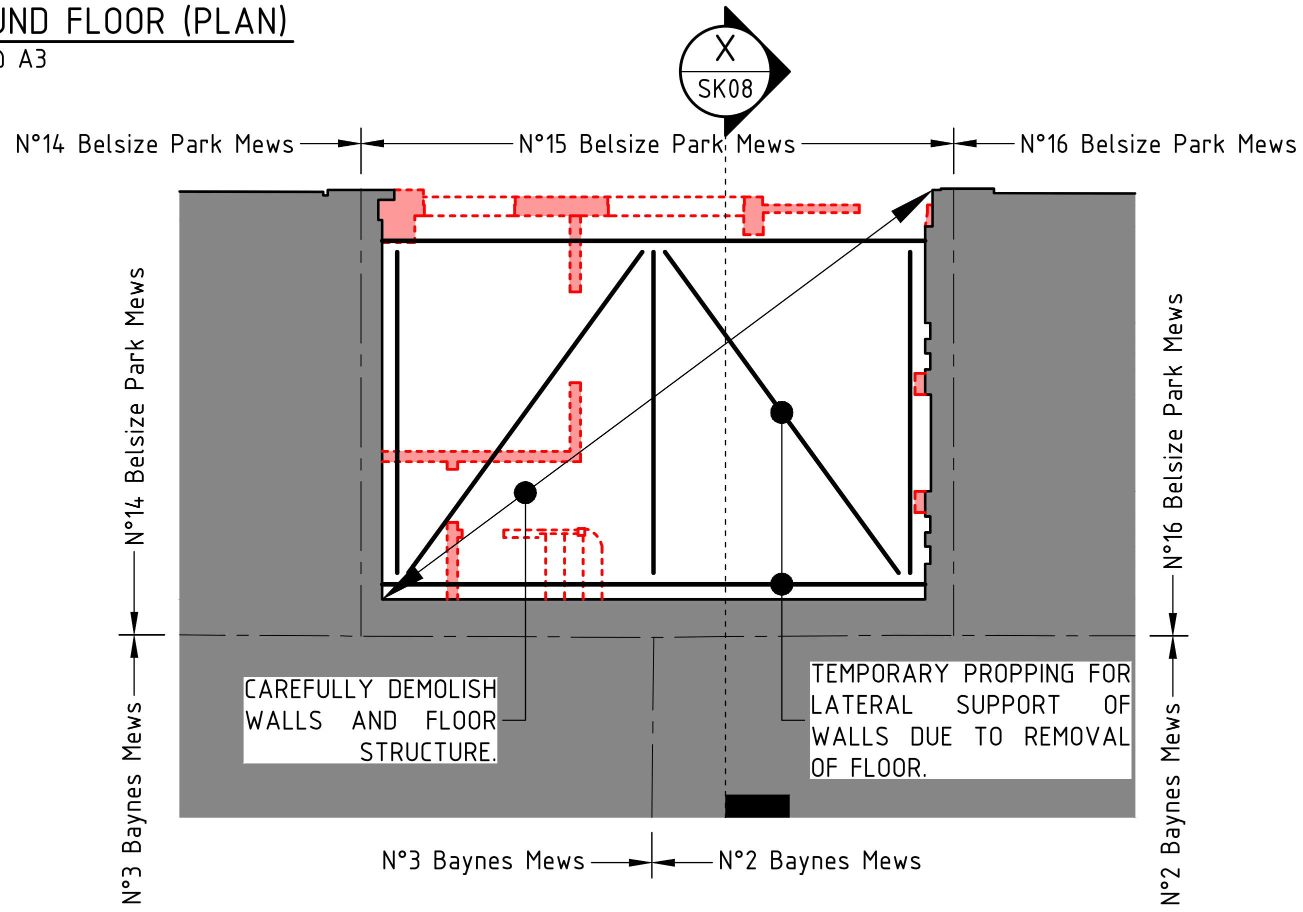
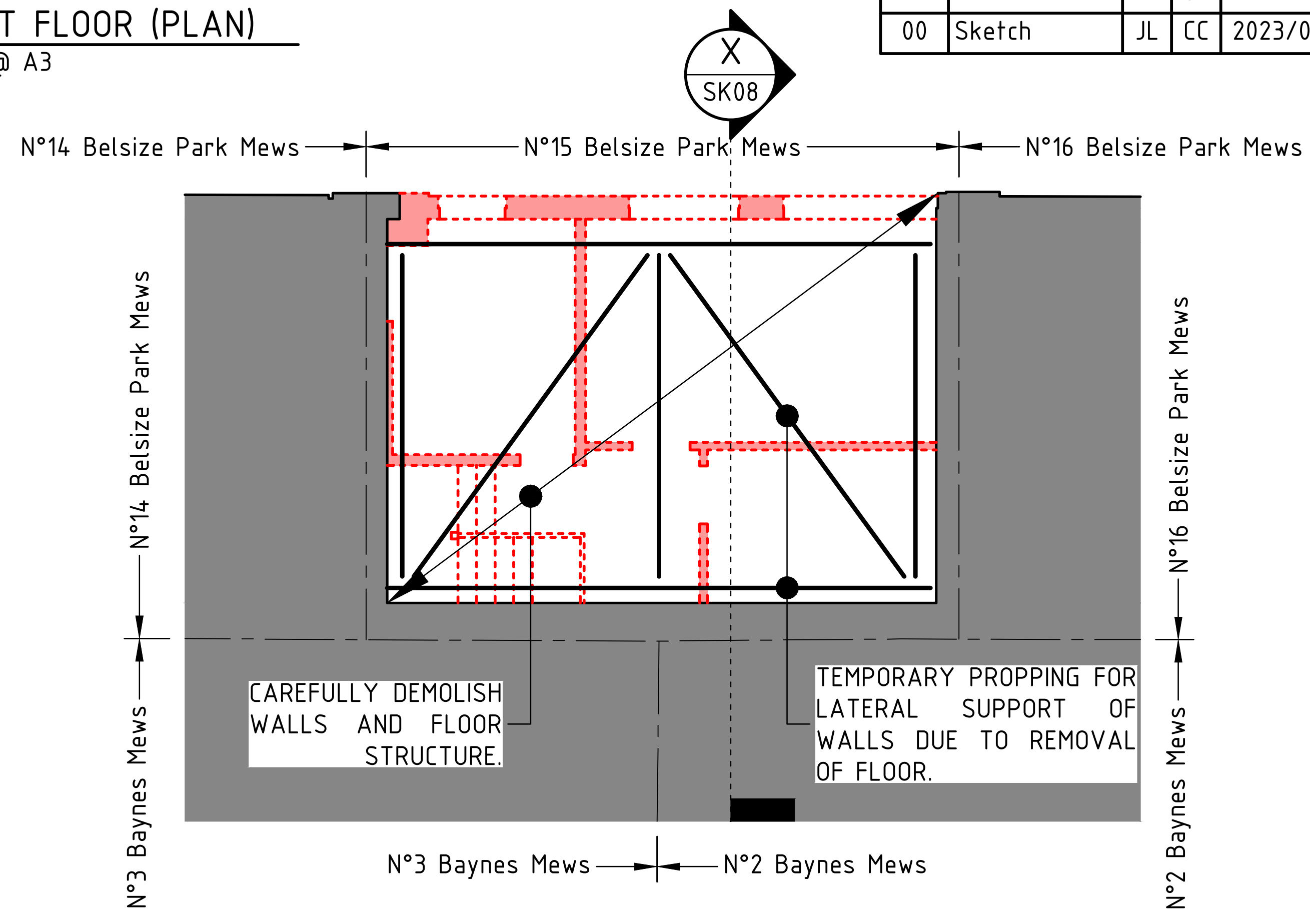
Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

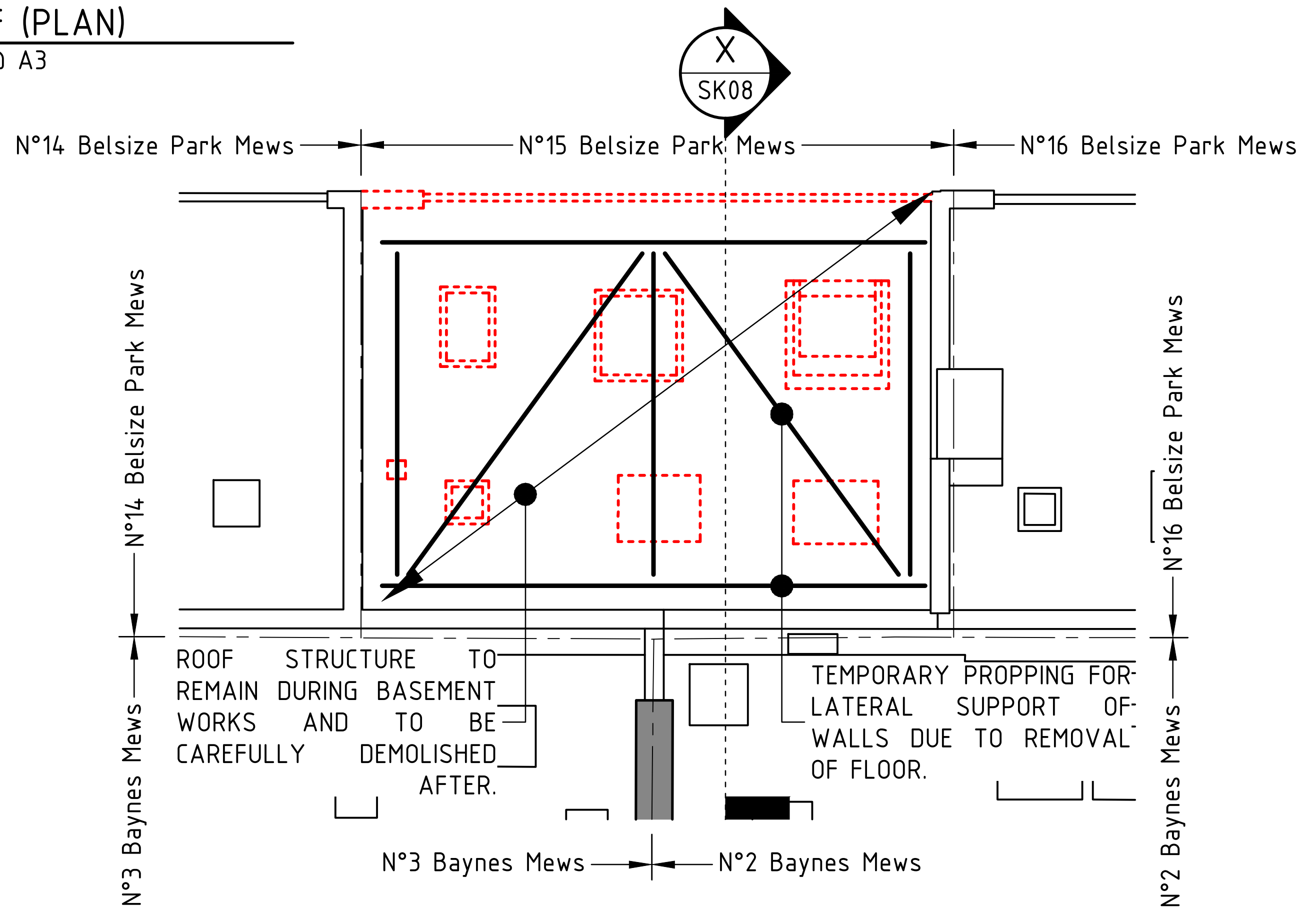
GROUND FLOOR (PLAN)
1:100 @ A3



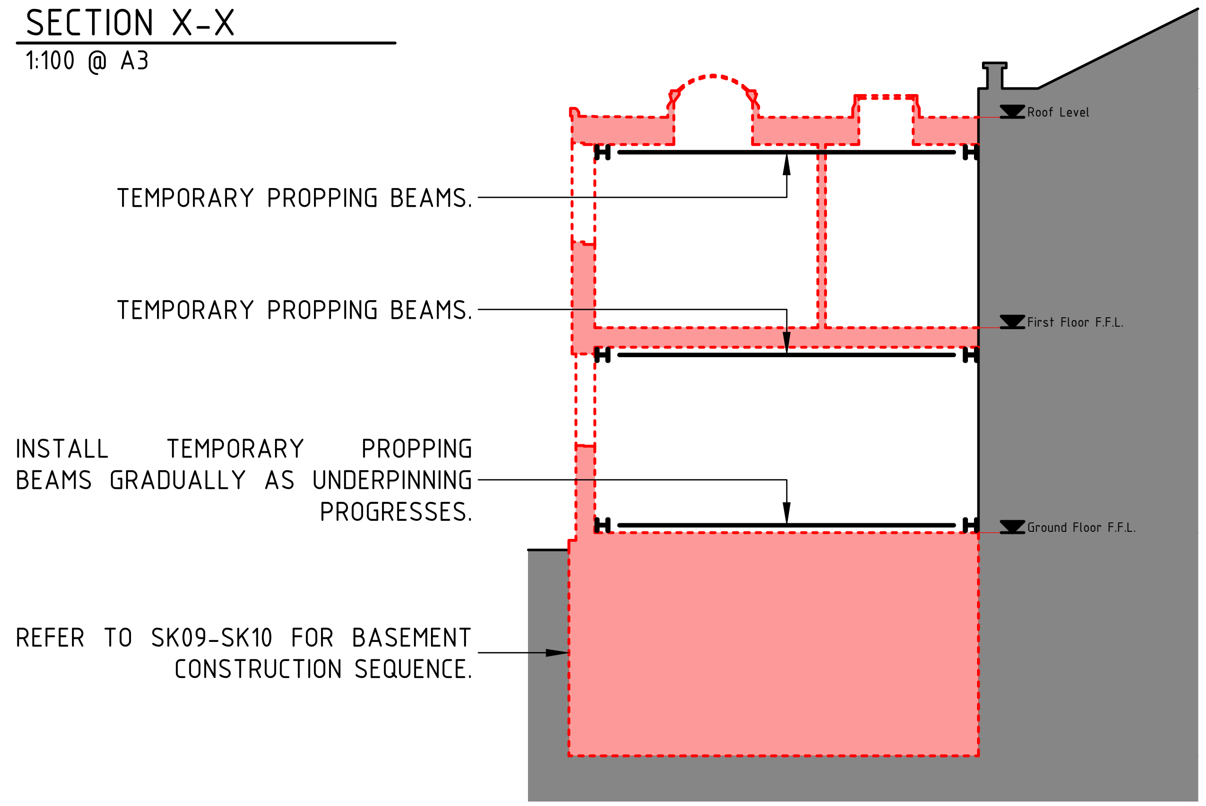
FIRST FLOOR (PLAN)
1:100 @ A3



ROOF (PLAN)
1:100 @ A3



SECTION X-X
1:100 @ A3



Client:	Electron Holdings Management Ltd.	Title:	Temporary Works Sequencing Sheet 1
Project:	15 Belsize Park Mews, London, NW3 5BL	Project N°:	23066

Drawing N°: SK08	Rev: 00
Date: Aug 2023	Drawn: JL
Scale @A3: 1:100	Engineer: CC

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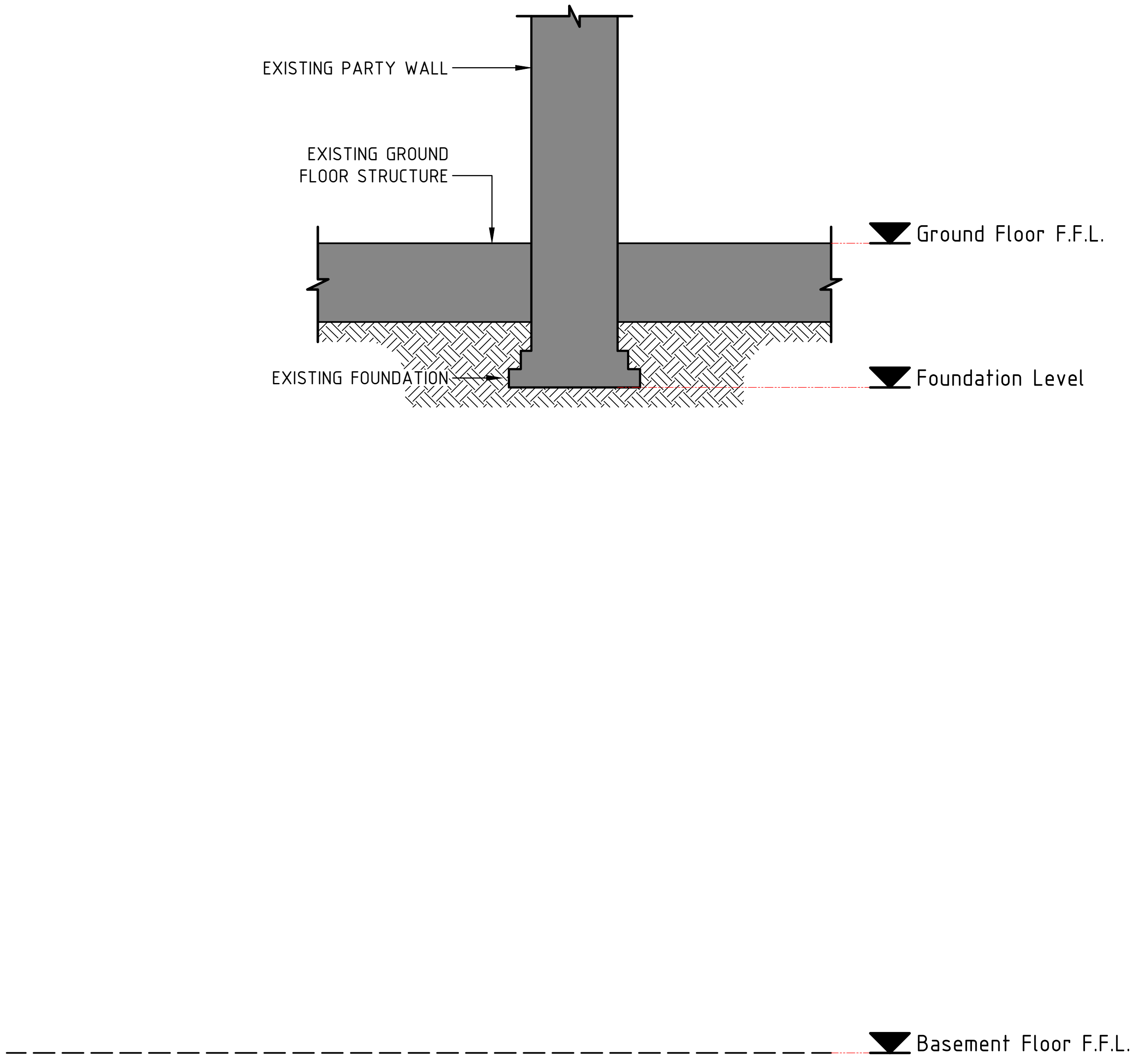
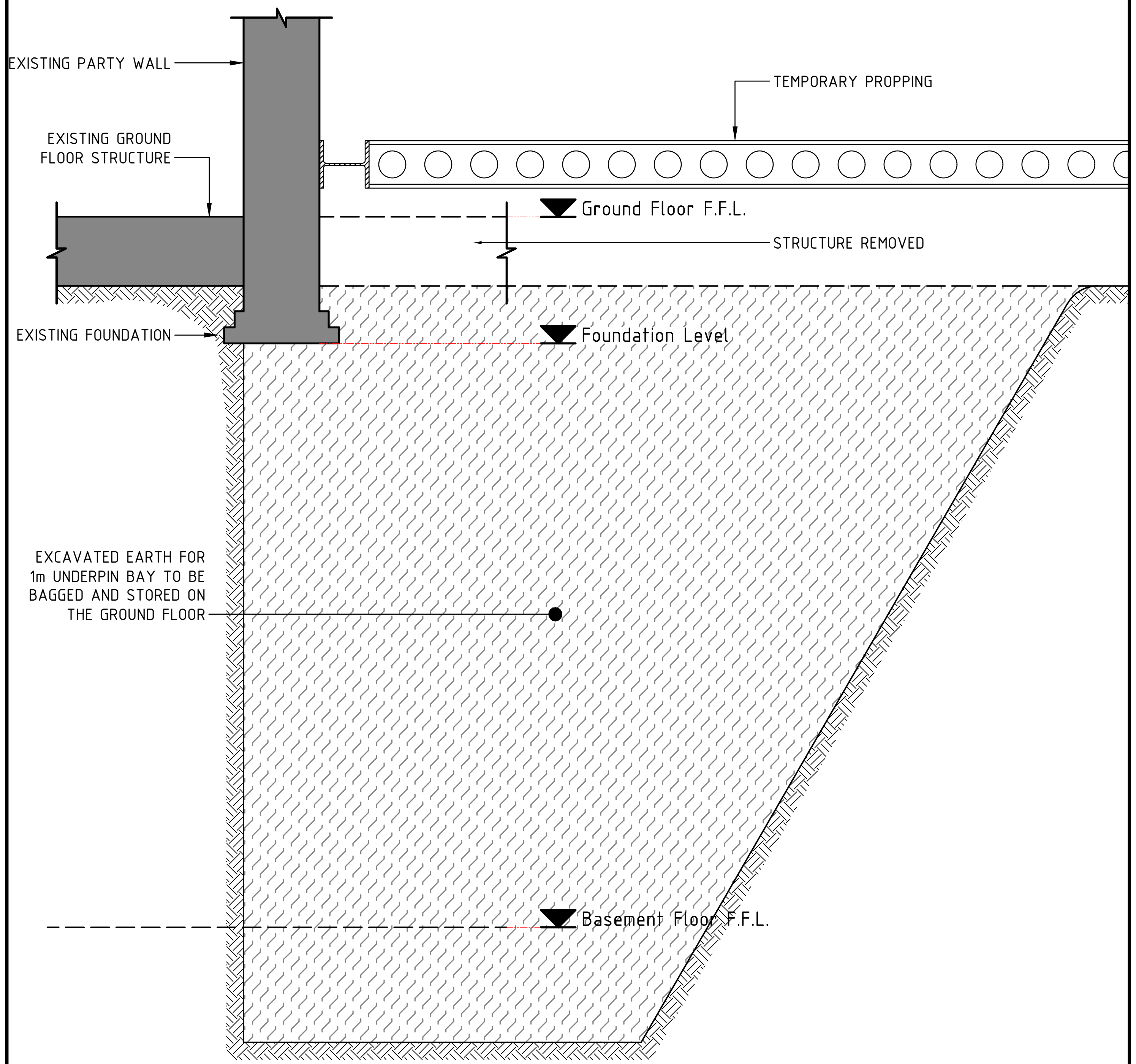
Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

SECTION THROUGH PARTY WALL
EXISTING



SECTION THROUGH PARTY WALL
STAGE 1



STAGE 1
1. DEMOLITION OF THE GROUND FLOOR SLAB AND INSTALL TEMPORARY PROPPING.
2. EXCAVATE 1m WIDTH EARTH FOR UNDERPIN BAY (IN NUMBERED SEQUENCE).
3. EARTH TO BE BAGGED AND MOVED/STORED ON GROUND FLOOR READY FOR COLLECTION.

Client: Electron Holdings Management Ltd.
Project: 15 Belsize Park Mews, London, NW3 5BL
Title: Temporary Works Sequencing Sheet 2
Project N°: 23066
Drawing N°: SK09
Date: Aug 2023
Scale @A3: 1:25
Rev: 00
Drawn: JL
Engineer: CC

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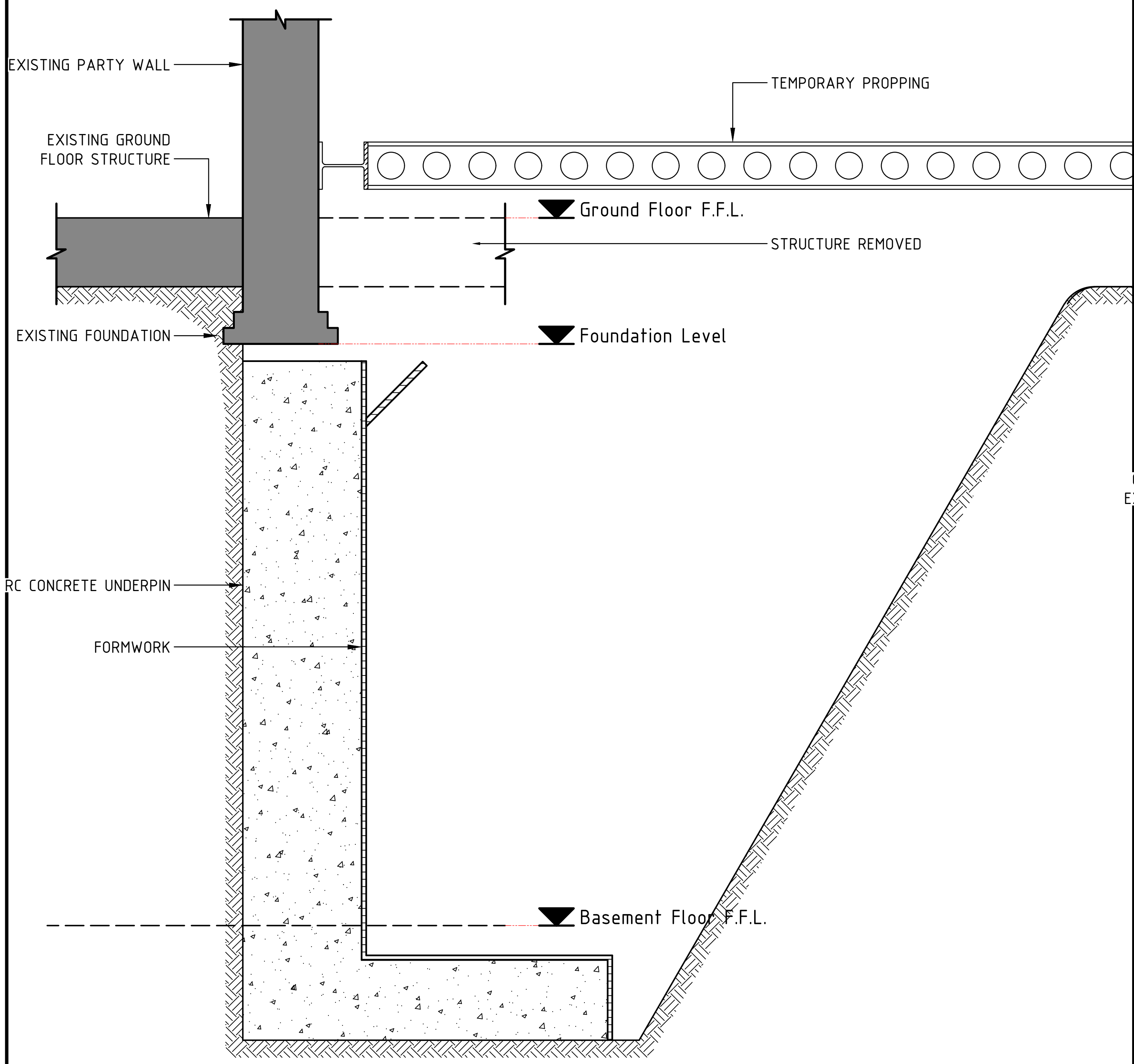
Drawing Status **INFORMATION**

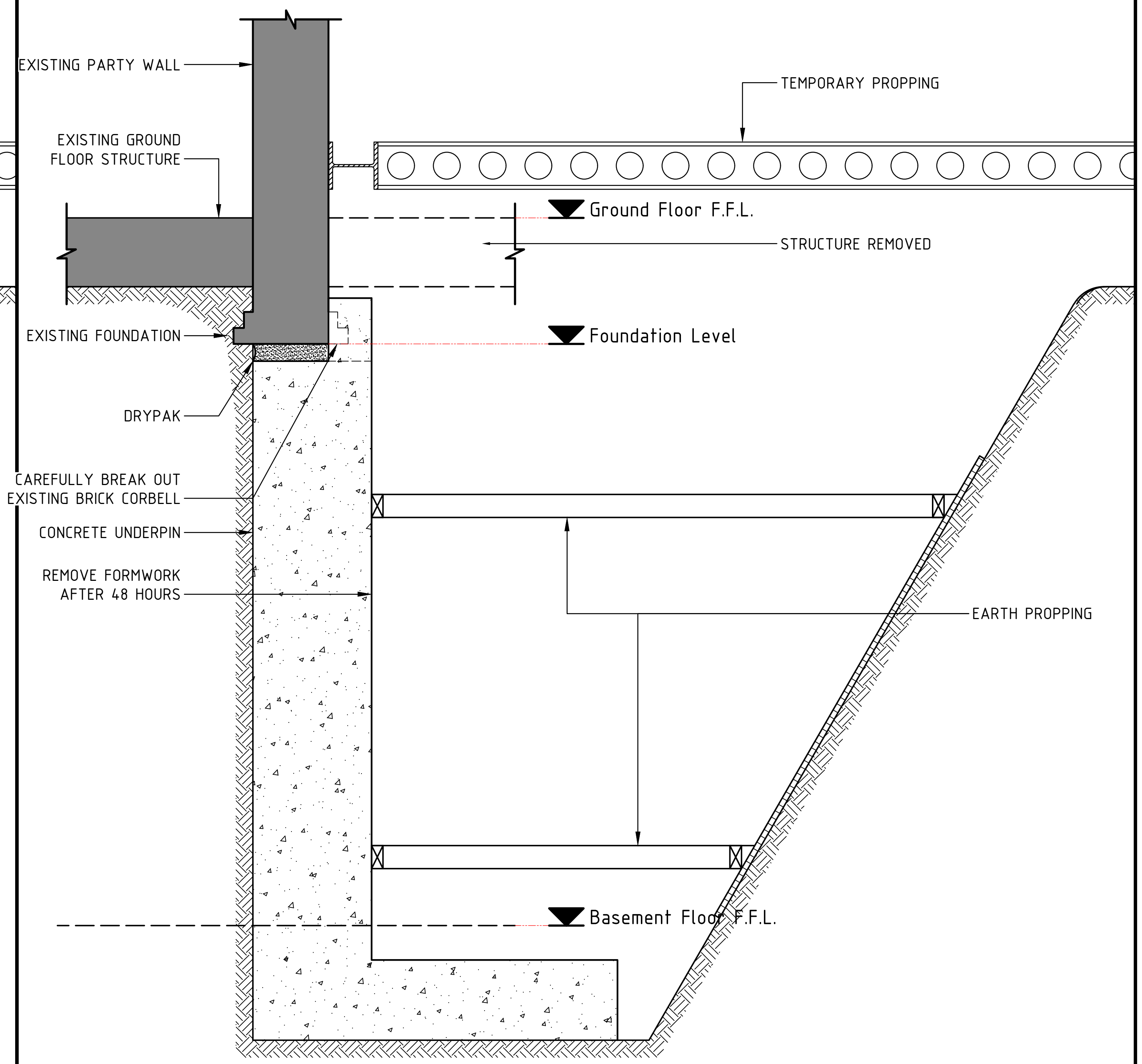
REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2023/08/17

SECTION THROUGH PARTY WALL
STAGE 2



STAGE 2
1. INSTALL FORMWORK.
2. POUR CONCRETE TO 75mm BELOW EXISTING FOUNDATION LEVEL. LEAVE CONCRETE FOR 24 HOURS TO SET.

SECTION THROUGH PARTY WALL
STAGE 3



STAGE 3
1. 24 HOURS AFTER POURING CONCRETE IN TO UNDERPIN BAY DRYPACK BETWEEN UNDERSIDE OF EXISTING FOUNDATION AND TOP OF UNDERPIN. DRYPACK TO BE WELL RAMMED.
2. 24 HOURS AFTER DRYPACKING REMOVE FORMWORK AND INSTALL EARTH PROPPING.
3. CAREFULLY REMOVE EXISTING BRICK CORBELL AND CAST CONCRETE KEY.
4. COMMENCE WITH NEXT UNDERPIN BAY IN THE NUMBERED SEQUENCE.
5. ONCE ALL BAYS COMPLETE, CAST BASEMENT SLAB.

Client:	Electron Holdings Management Ltd.	Title:	Temporary Works Sequencing Sheet 3	Drawing N°: SK10	Rev: 00
Project:	15 Belsize Park Mews, London, NW3 5BL	Project N°:	23066	Date: Aug 2023	Drawn: JL
				Scale @A3: 1:25	Engineer: CC

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Appendices 7 – Stage 1 & 2 BIA_Report

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STAGE 1 & 2
BASEMENT IMPACT ASSESSMENT
(SCREENING & SCOPING)
REPORT

15 Belsize Park Mews
Camden
NW3 5BL

JOMAS ASSOCIATES LTD
Unit 24 Sarum Complex, Salisbury Road, Uxbridge Ub8 2RZ
www.jomasassociates.com 0333-305-9054 info@jomasassociates.com

Report Title: **Stage 1 & 2 Basement Impact Assessment (Screening & Scoping) report for 15 Belsize Park Mews Camden NW3 5BL**

Report Status: **Final v1.0**

Job No: **P5188J2818/SC**

Date: **22 June 2023**

Quality Control - Revisions

Version	Date	Issued By

Prepared by: JOMAS ASSOCIATES LTD **For: ELECTRONIC HOLDINGS MANAGEMENT LTD**

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Senior Principal - Geotechnics

Approved by

James Field BSc (Hons), CGeol, FGS, RoGEP - Professional

Associate Director

....

Authorised by

Roni Savage BEng (Hons), MSc, SiLC, CGeol CEng, FICE, HonRIBA, MCIWM, FGS

Managing Director

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CONTENTS

Page

EXECUTIVE SUMMARY

Electronic Holdings Management Ltd ("The Client") has commissioned Jomas Associates Ltd ('Jomas'), to prepare a Basement Impact Assessment for a site referred to as 15 Belsize Park Mews, Camden, NW3 5BL. The aim of this report is to assess whether the ground conditions within the local area represent an impediment to the proposed development.

It should be noted that the table below is an executive summary of the findings of this report and is for briefing purposes only. Reference should be made to the main report for detailed information and analysis.

Desk Study	
Current Site Description	The site consists of a two-storey residential property bounded to either side and the rear by other mews residences. There are no external areas of site as the property faces directly onto the cobbled street of Belsize Park Mews.
Proposed Site Description	Construction of a basement and addition of a mansard roof to the existing two-storey mews house. The proposed basement will be formed within the existing footprint of the building, which itself covers the entire site footprint.
Site History	On the earliest available maps (1871-74), the site is shown as vacant and appears to be situated within farmland associated with Belsize Farm. An underground railway and associated ventilation shaft are shown ~100m north of site. Two ponds were shown within 250m and a culverted stream is shown 300m west of site. By the maps dated 1894/96, the site has been developed into residential mews property resembling the present-day layout. The surrounding area has undergone large-scale residential development with the previously identified ponds, and culverted stream no longer shown. No significant observational changes then occur to the site until the most recent map dated 2023.
Site Setting	The British Geological Survey indicates that the site is directly underlain by solid deposits of the London Clay Formation. The underlying London Clay Formation is identified as an unproductive stratum. There are no water networks or surface water features reported within 250m of the site. The site is located within an EA Flood Zone 1. The site is not within an area with a RoFRaS rating. The site is not within an area benefiting from flood defences. Groundsure states that the site is at negligible risk of both surface water and groundwater flooding.
Potential Geological Hazards	The Groundsure data identified a moderate risk of shrink swell clays beneath the site due to the underlying London Clay Formation. The presence of London Clay Formation may be a source of elevated sulphate associated with disseminated pyrite noted by BGS to be within this deposit. If such levels are noted, then sulphate resistant concrete may be required. It is recommended that a geotechnical ground investigation is undertaken to inform foundation design.

Screening and Scoping (Basement Impact Assessment)	
Subterranean (Groundwater) Flow	A ground investigation is recommended to confirm the ground conditions and groundwater levels (if any) beneath the site.
Land Stability	The site, as with the surrounding area, is generally flat. The Groundsure report has noted that there is a "very low" risk of land instability issues for the site. Atterberg Limits of the underlying London Clay Formation should be determined by the ground investigation to assess shrink/swell potential of the soils. Existing foundations should be established. It is noted that the London Borough of Camden's guidance documents requires a Ground Movement Assessment to be undertaken as part of the Basement Impact Assessment. Such an assessment uses a ground model based on a zone of influence equivalent of four times the proposed depth of excavation. Consequently, such a study is strongly recommended.
Surface Flow and Flooding	The proposed development will comprise a basement within the existing footprint of the building, which itself covers the entire site footprint. Therefore, the proposed development will not cause a significant change in surface water run-off. If SUDS can be incorporated into the design, this will further decrease the potential risk of surface water flooding, though the practicality of SUDS may be limited based on the anticipated ground conditions and spatial constraints. A drainage strategy/SUDS report should be produced for the site.

Preliminary Basement Impact Assessment	
Preliminary Impact Assessment	The overall assessment of the site is that the creation of a basement for the existing development will not adversely impact the site or its immediate environs, providing measures are taken to protect surrounding land and properties during construction. The proposed basement excavation will be within 5m of a public highway. It is also laterally within 5m of neighbouring properties. Unavoidable lateral ground movements associated with the basement excavations must be controlled during temporary and permanent works so as not to impact adversely on the stability of the surrounding ground and any associated services. During the construction phase careful and regular monitoring will need to be undertaken to ensure that the property above, is not adversely affected. This may mean that the property needs to be suitably propped and supported. From the studies that have been undertaken so far, and subject to the findings of an intrusive investigation, it is concluded that the construction of the basement will not present a problem for groundwater. The proposed development is not expected to cause significant problems to the subterranean drainage. However, should be confirmed by a ground investigation and a subsequently updated Basement Impact Assessment.

Recommended Further Work	
Works	An intrusive ground investigation is recommended to confirm the ground conditions and groundwater levels (if any) beneath the site, as well as to inform foundation design. Due to the restricted nature of the site this could comprise hand-excavated trial pits. A Ground Movement Assessment is recommended. A drainage strategy/SUDS report is recommended. It should be noted that the following items are required as part of Camden Planning Guidance Basements (January 2021): • Plans and sections to show foundation details of adjacent structures. • Programme for enabling works, construction and restoration. • Construction Sequence Methodology. • Proposals for monitoring during construction. • Evidence of consultation with neighbours. • Ground Movement Assessment (GMA). • Drainage assessment.

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 Electronic Holdings Management Ltd ("The Client") has commissioned Jomas Associates Ltd ('Jomas'), to prepare a Stage 1 & 2 Basement Impact Assessment (Screening & Scoping) Report at a site at 15 Belsize Park Mews, Camden, NW3 5BL.

1.1.2 Jomas' work has been undertaken in accordance with email proposal dated 11th May 2023.

1.2 Proposed Development

1.2.1 The proposed development for this site is understood to comprise the construction of a basement and addition of a mansard roof to the existing two-storey mews house.

1.2.2 A plan of the proposed development is included in Appendix 1.

1.2.3 For the purpose of geotechnical assessment, it is considered that the project could be classified as a Geotechnical Category (GC) 2 site in accordance with BS EN 1997 Part 1.

1.3 Objectives

1.3.1 The objectives of Jomas' investigation was as follows:

- To present a description of the present site status, based upon the published geology, hydrogeology and hydrology of the site and surrounding area;
- To review readily available historical information (i.e., Ordnance Survey maps and database search information) for the site and surrounding areas;
- To assess the potential impacts that the proposal may have on ground stability, the hydrogeology and hydrology on the site and its environs.

1.4 Scope of Works

1.4.1 The following tasks were undertaken to achieve the objectives listed above:

- A walkover survey of the site;
- A desk study, which included the review of a database search report (GeoInsight Report, attached in Appendix 2) and historical Ordnance Survey maps (attached in Appendix 3);
- A Basement Impact Assessment (BIA);
- The compilation of this report, which collects and discusses the above data, and presents an assessment of the site conditions, conclusions and recommendations.

1.5 Scope of Basement Impact Assessment

1.5.1 As the site lies within the purview of the London Borough of Camden, their document "Camden Planning Guidance Basements" (CPGB) (January 2021) has been used to form the methodology utilised in undertaking this BIA.

1.5.2 Jomas' BIA covers most items required under CPGB, with the exception of;

- Plans and sections to show foundation details of adjacent structures.
- Programme for enabling works, construction and restoration.
- Evidence of consultation with neighbours.
- Ground Movement Assessment (GMA), to include assessment of significant adverse impacts and specific mitigation measures required, as well as confirmatory and reasoned statement identifying likely damage to nearby properties according to the Burland Scale.
- Construction Sequence Methodology.
- Proposals for monitoring during construction.
- Drainage assessment.

1.5.3 This Jomas BIA also takes into account the Campbell Reith pro forma BIA produced on behalf of and published by the London Borough of Camden as guidance for applicants to ensure that all of the required information is provided.

1.5.4 A number of the requirements set out in the London Borough of Camden document CPGB will need to be addressed in a construction management plan, this stage is not within the scope of work that Jomas Associates have been commissioned.

1.6 Supplied Documentation

1.6.1 Jomas Associates have not been supplied with any previously produced reports at the time of writing this report.

1.7 Limitations

1.7.1 Jomas Associates Ltd has prepared this report for the sole use of Electronic Holdings Management Ltd in accordance with the generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of Jomas. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.

1.7.2 The records search was limited to information available from public sources; this information is changing continually and frequently incomplete. Unless Jomas has actual knowledge to the contrary, information obtained from public sources or provided to Jomas by site personnel and other information sources, have been assumed to be correct. Jomas does not assume any liability for the misinterpretation of information or for items not visible, accessible or present on the subject property at the time of this study.

1.7.3 Whilst every effort has been made to ensure the accuracy of the data supplied, and any analysis derived from it, there may be conditions at the site that have not been disclosed by the investigation, and could not therefore be taken into account. As with any site, there may be differences in soil conditions between exploratory hole positions. Furthermore, it should be noted that groundwater conditions may vary due to seasonal and other effects and may at times be significantly different from those measured by the investigation. No liability can be accepted for any such variations in these conditions.

1.7.4 ***This report is not an engineering design and the figures and calculations contained in the report should be used by the Structural Engineer, taking note that variations may apply, depending on variations in design loading, in techniques used, and in site conditions. Our recommendations should therefore not supersede the Engineer's design.***

2 SITE SETTING & HISTORICAL INFORMATION

2.1 Site Information

2.1.1 The site location plan is appended to this report in Appendix 1.

Table 2.1: Site Information

Name of Site	-
Address of Site	15 Belsize Park Mews, Camden, London, NW3 5BL
Approx. National Grid Ref.	527737, 179077
Site Area (Approx)	<0.005 hectares
Site Occupation	Residential
Local Authority	London Borough of Camden
Proposed Site Use	Residential with a basement located within the footprint of the building.

2.2 Walkover Survey

2.2.1 The site was visited by a Jomas Engineer on 12th June 2023. The following information was noted while on site.

Table 2.2: Site Description

Area	Item	Details
On-site:	**Current Uses:**	The site consists of a two-storey residential property bounded to either side and the rear by other mews residences. There are no external areas of site as the property faces directly onto the cobbled street of Belsize Park Mews.
	Evidence of historic uses:	No evidence of historic uses observed on site.
	Surfaces:	The building footprint covers the entire site.
	Vegetation:	None observed.
	Topography / Slope Stability:	The site and surrounding area was observed to be relatively flat and level.
	Drainage:	The site appears to be connected to normal drainage facilities with several drain covers present in Belsize Park Mews.
	Services:	The site appears to be connected to the usual domestic services which are in use.
	Controlled waters:	No controlled waters were observed on site.

Area	Item	Details
	Tanks:	No tanks were observed on site.
Neighbouring land:	**North:**	Residential.
	East:	Residential.
	South:	Residential and retail.
	West:	Residential and retail.

2.2.2 Photos taken during the site walkover are provided in Appendix 1.

2.3 Historical Mapping Information

2.3.1 The historical development of the site and its surrounding areas was evaluated following the review of a number of Ordnance Survey historic maps, procured from GroundSure, and these are provided in Appendix 3 of this report.

2.3.2 A summary produced from the review of the historical map is given in Table 2.3 below. Distances are taken from the site boundary.

Table 2.3: Historical Development

Dates and Scale of Map	Relevant Historical Information	
	On Site	**Off Site**
1871/74 1:1,056 1:2,500 1:10,560	Site is devoid of features and appears to be situated within farmland associated with Belsize Farm.	Ventilating shaft and underground railway tunnel located 110m north-west. Railway tunnel traversing in approx. east-west direction. Ponds 50m south and 125m north-east. Culverted stream 300m west. Well located 100m north-east. Belsize Farm buildings located 75-100m south-west. Surrounding land is predominantly fields/farmland to north and west, and residential to south and east.
1894/96 1:1,056 1:2,500 1:10,560	Site has been developed into residential mews property resembling the present-day layout.	Large-scale residential development of surrounding area. Previously identified ponds, farm, stream and well are no longer shown.
1915/19/20 1:1,056 1:2,500 1:10,560	No significant changes.	No significant changes.
1935/38 1:2,500 1:10,560	No significant changes.	No significant changes.

Dates and Scale of Map	Relevant Historical Information	
	On Site	Off Site
1951/53/55/58 1:1,250 1:2,500 1:10,560	No significant changes.	Sparse WWII bomb damage visible north of site on small-scale map dated 1951.
1968/69/70/74 1:1,250 1:2,500 1:10,000 1:10,560	No significant changes.	No significant changes.
1989/91/94 1:1,250 1:10,000	No significant changes.	No significant changes.
2001/03/10/23 1:1,250 1:10,000	No significant changes.	Minor residential re-developments.

2.3.4 Aerial photographs supplied as part of the GroundSure Enviro+GeoInsight report range from 1999 to 2021. These show the site in a residential setting with no significant changes occurring to the surrounding area over this time period.

2.4 Planning Information

2.4.1 A review of the local authority's planning portal was undertaken on 14th June 2023 but no pertinent information (e.g. former basement developments, ground investigation reports etc.) could be found in the vicinity of the site.

2.5 Radon

2.5.1 The site is reported not to lie within a Radon affected area, as less than 1% of properties are above the action level.

2.5.2 Consequently, no radon protective measures are necessary in the construction of new dwellings or extensions as described in publication BR211 (BRE, 2015).

2.5.3 However, a growing number of London Boroughs are adopting Public Health England guidance as outline in their 'UK National Radon Action Plan' (PHE, 2018), which states that Radon measurements should be made in regularly occupied basements of properties irrespective of their geographical location. Therefore, such an assessment, or radon protection measures may be required by the London Borough of Camden.

3 GEOLOGICAL SETTING & HAZARD REVIEW

3.1.1 The following section summarises the principal geological resources of the site and its surroundings. The data discussed herein is generally based on the information given within the Groundsure Report (in Appendix 2).

3.2 Solid and Drift Geology

3.2.1 Information provided by the British Geological Survey (BGS) indicates that the site is directly underlain by solid deposits of the London Clay Formation. An extract of the BGS description is provided below:

> *"…bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite."*

3.3 British Geological Survey (BGS) Borehole Data

3.3.1 No BGS borehole records were available within 250m of the site.

3.4 Geological Hazards

3.4.1 The following are brief findings extracted from the GroundSure GeoInsight Report, that relate to factors that may have a potential impact upon the engineering of the proposed development.

Table 3.1: Geological Hazards

Potential Hazard	Site check Hazard Rating	Details	Further Action Required?
Shrink swell clays	Moderate	Ground conditions predominantly high plasticity	Yes
Running sands	Very low	Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly	No
Compressible deposits	Negligible	Compressible strata are not thought to occur.	No
Collapsible Deposits	Very low	Deposits with potential to collapse when loaded and saturated are unlikely to be present	No
Landslides	Very low	Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered	No
Ground dissolution soluble rocks	Negligible	Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present	No
Coal mining	None	The study site is not located within the specified search distance of an identified coal mining area.	No

Potential Hazard	Site check Hazard Rating	Details	Further Action Required?
Non-coal mining	None	The study site is not located within the specified search distance of an identified non-coal mining area.	No

3.4.2 In addition, the GeoInsight report notes the following:

- 2No. historical surface ground working features are reported within 250m of the site. Both entries dated 1874 and refer to a pond 132m north-east and an unspecified pit 226m north-east of the site.
- 15No. historical underground working features are reported within 250m of the site. The nearest reported are a tunnel and unspecified shaft located 104m north and 106m north-west of the site respectively.
- No other features relating to mining, ground workings or natural cavities were reported within 250m of the site.

3.4.3 Foundations should not be formed within Made Ground or organic rich materials due to the unacceptable risk of total and differential settlement.

3.4.4 Foundations must be designed so as not to load nor undermine adjacent boundary walls and buildings.

3.4.5 The BGS notes disseminated pyrite within the London Clay Formation and as such may be a source of elevated sulphate. If such levels are noted then sulphate resistant concrete may be required.

3.4.6 The potential for shrink swell clays beneath the proposed footprint may mean that heave precautions would be required.

3.4.7 It is recommended that a geotechnical ground investigation is undertaken to inform design.

4 HYDROGEOLOGY, HYDROLOGY AND FLOOD RISK REVIEW

4.1 Hydrogeology & Hydrology

4.1.1 General information about the hydrogeology of the site was obtained from the MAGIC website.

Groundwater Vulnerability

4.1.2 Since 1 April 2010, the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. This comprises;

- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
- **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- **Principal Aquifer** – this is a formation with a high primary permeability, supplying large quantities of water for public supply abstraction.
- **Unproductive Strata** - These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hydrogeology

4.1.3 The baseline hydrogeology of the site is based on available hydrogeological mapping, including the BGS online mapping, and generic information obtained from the Groundsure Report.

4.1.4 The available data indicates that the geology of the area consists of the London Clay Formation. Groundwater is not expected to be present within this unproductive stratum.

Hydrology

4.1.5 The hydrology of the site and the area covers water abstractions, rivers, streams, other water bodies and flooding.

4.1.6 The Environment Agency defines a floodplain as the area that would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.

4.1.7 There are two different kinds of area shown on the Flood Map for Planning. They can be described as follows:

Areas that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- from the sea by a flood that has a 0.5 per cent (1 in 200) or greater chance of happening each year;
- or from a river by a flood that has a 1 per cent (1 in 100) or greater chance of happening each year.

(For planning and development purposes, this is the same as Flood Zone 3, in England only.)

- The additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1 per cent (1 in 1000) chance of occurring each year.

(For planning and development purposes, this is the same as Flood Zone 2, in England only.)

4.1.8 These two areas show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

4.1.9 Outside of these areas flooding from rivers and the sea is very unlikely. There is less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year. The majority of England and Wales falls within this area. (For planning and development purposes, this is the same as Flood Zone 1, in England only.)

4.1.10 Some areas benefit from flood defences and these are detailed on Environment Agency mapping.

4.1.11 Flood defences do not completely remove the chance of flooding, however, and can be overtopped or fail in extreme weather conditions.

4.1.12 No surface water features or water networks have been identified within 250m of the site.

Table 4.1: Summary of Hydrogeological & Hydrology

Feature		On Site	Off Site
Aquifer	**Superficial:**	-	None reported within 500m of site.
	Solid:	Unproductive	Secondary A aquifer reported 145m north-west of site. (Claygate Member)

Feature		On Site	Off Site
Surface Water Features		None reported	No water networks or surface water features reported within 250m of site.
Discharge Consents		None reported	None reported within 500m of site.
Flood Risk	**EA Flood Zone 2**	No	Not reported within 50m of site.
	EA Flood Zone 3	No	Not reported within 50m of site.
	RoFRaS	None	Not reported within 50m of site.
	Historical Flood Events	None reported within 250m of site	
	Flood Defences	There are no areas benefiting from flood defences reported within 250m of the study site	
	Surface Water Flooding	Negligible	Highest risk within 50m is '1 in 30 year, >1.0m'
	Groundwater Flooding	Negligible	Highest risk within 50m is 'negligible'

4.1.13 According to "The Lost Rivers of London" (Barton 1992), the site is about equidistant between the two tributaries of the lost river Tyburn.

4.1.14 The Camden Strategic Flood Risk Assessment (SFRA) (URS, 2014) states that the River Tyburn has been incorporated into the Thames Water sewer network as the King's Scholar's Main Sewer. Further evidence of this was identified on the historic OS maps dated 1871/74 (See Table 2.3); a culverted stream was located 300m west of site. Figure 2 of the Camden SFRA does not show this feature but does show another culverted watercourse 400m east of site.

4.2 Flood Risk Review

4.2.1 In accordance with the NPPF Guidance, below is a review of flood risks posed to and from the development and recommendations for appropriate design mitigation where necessary. Specific areas considered are based on the requirements laid out in the "Camden Guidance for Subterranean Development" as this document is generally considered to be the most comprehensive Local Authority Guidance in the London area.

Table 4.2: Flood Risk Review

Flood Sources	Site Status	Comment on flood risk posed to / from the development
Fluvial / Tidal	Site is not within 50m of an Environment Agency Zone 2 or zone 3 floodplain. Risk of flooding from rivers and the sea (RoFRaS) rating none/negligible.	Low risk.
Groundwater	The BGS considers that the site is at negligible risk from groundwater flooding	Basement will be fully waterproofed as appropriate to industry standard.

		If SUDS can be incorporated into the design, this will further decrease the potential risk of groundwater flooding. Low risk.
Artificial Sources	No surface water features within 250m of site.	Low risk.
Surface Water / Sewer Flooding	No surface water features within 250m of site. Condition, depth and location of surrounding infrastructure uncertain.	Basement will be fully waterproofed as appropriate to industry standard. If SUDS can be incorporated into the design, this will further decrease the potential risk of surface water flooding. Low risk.
Climate Change	Included in the flood modelling extents. Site not within climate change flood extent area	Development will not significantly increase the peak flow and volume of discharge from the site. Low risk posed to and from the development.

4.2.2 Information about the risk to the study site from flooding has been obtained from the following documents produced for London Borough of Camden: London Borough of Camden Strategic Flood Risk Assessment (SFRA) (URS, July 2014); Preliminary Flood Risk Assessment for London Borough of Camden (Halcrow, 2011); and Surface Water Management Plan for London Borough of Camden (Halcrow, 2011). Potential impacts to the site are discussed below.

Flooding from Fluvial/Tidal Sources

4.2.3 The site is located within EA Flood Zone 1 and no water networks or surface water features have been identified within 250m of the site.

4.2.4 The SFRA states that all main rivers historically located within the borough are now culverted and incorporated into the TWUL (Thames Water) sewer network and therefore there is no fluvial flood risk within the borough.

Groundwater Flooding

4.2.5 Figure 4e of the SFRA shows the site is not within an area designated as having an increased susceptibility to elevated groundwater. The nearest EA groundwater flood incident is shown 675m north-west of site and the nearest LBC groundwater flood incident is shown approximately 625m south-west of site, with 8No. properties affected.

4.2.6 The site (and most of the Borough) is underlain by unproductive strata of London Clay Formation. Groundsure reports the site to be at negligible risk of groundwater flooding.

Surface Water Flooding

4.2.7 Figure 3v of the SFRA indicates that risk of flooding from surface water at the site is very low (<1 in 1000 year). The figure also shows that Belsize Lane (~30m south-east of site) was affected by surface water flooding in 1975 and 2002. No historic surface water flooding records are shown within 500m of site.

4.2.8 Figure 3x shows the flood hazard at site to be <0.75m (low).

4.2.9 In addition to this, the site lies within an EA Flood Zone 1. Based on EA mapping, the site and highways surrounding the site are not within an area identified as a high risk for surface water flooding potential; the site itself not likely to be inundated.

Sewer/Artificial Flooding

4.2.10 Figures 5a and 5b of the SFRA show the number of sewer flooding events for 4-digit postcode prefixes across the borough. For the postcode "NW3 5--" where the site is situated, no properties have been impacted by internal sewer flooding whilst only 1No. property has been affected by exterior sewer flooding.

4.2.11 The London Borough of Camden SWMP states the postcodes at the highest risk of sewer flooding based on historic events; the list does not include "NW3 5--".

4.2.12 The site is located 1km from the nearest reservoir – Hampstead No.1 Pond. In addition, this pond has the highest standard of protection of all the reservoirs in the borough (1 in 10,000-year rainfall event where overtopping occurs).

Critical Drainage Areas (CDAs)

4.2.13 A CDA is defined in the LBC SWMP as "*A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more LFRZ during severe weather thereby affecting people, property or local infrastructure*".

4.2.14 A Local Flood Risk Zone (LFRZ) is defined in the LBC SWMP as "*A discrete area of flooding that does not exceed the national criteria for a Flood Risk Area but affects houses, businesses and/or local infrastructure. The boundary is defined as the actual spatial extent of predicted flooding in a single location"*.

4.2.15 According to Figure 6 (Rev 2) of the SFRA, the site is situated within CDA Group3_005 and is therefore within a catchment area which contributes to a flooding hotspot.

4.2.16 The nearest LFRZ within the CDA is South East Regent's Park, located 2.9km south-east of site.

Sustainable Drainage Systems (SuDS)

4.2.17 The proposed basement is defined by the approximate footprint of the existing building which itself covers the entire site footprint.

4.2.18 In accordance with the NPPF, PPG and LLFA policy requirements, sustainable drainage systems (SUDS) should be incorporated wherever possible to reduce positive surface water run-off and flood risk to other areas.

4.2.19 However, given the expected underlying ground and hydrogeological conditions it is considered that infiltration drainage would likely be impracticable.

4.2.20 It is also likely that the feasibility of SUDS would be limited by the small size of the site and proximity to buildings and boundary walls.

Conclusion

4.2.21 Based on the available data, the site is considered to be at low risk from identified potential sources of flooding. The basement can be constructed and operated safely in flood risk terms without increasing flood risk elsewhere and is therefore considered NPPF compliant.

4.2.22 Excerpts of figures from the Camden SFRA are included in Appendix 4.

4.3 Sequential and Exception Tests

4.3.1 The Sequential Test aims to ensure that development does not take place in areas at high risk of flooding when appropriate areas of lower risk are reasonably available.

Sequential Test: within FZ1 and no additional dwelling hence pass by default.

4.3.2 Paragraph 19 of PPS25 recognizes the fact that wider sustainable development criteria may require the development of some land that cannot be delivered through the sequential test. In these circumstances, the Exception Test can be applied to some developments depending on their vulnerability classification (Table D.2 of PPS25). The Exception Test provides a method of managing flood risk while still allowing necessary development to occur.

Exception Test: FZ1 hence pass by default and low risk posed to and from other sources.

4.4 Flood Resilience

4.4.1 In accordance with general basement flood policy and basement design, the proposed development will utilize the flood resilient techniques recommended in the NPPF Technical Guidance where appropriate and also the recommendations that have previously been issued by various councils.

4.4.2 These include:

- Basement to be fully waterproofed (tanked) and waterproofing to be tied in to the ground floor slab as appropriate: to reduce the turnaround time for returning the property to full operation after a flood event.
- Plasterboards will be installed in horizontal sheets rather than conventional vertical installation methods to minimise the amount of plasterboard that could be damaged in a flood event.
- Wall sockets will be raised to as high as is feasible and practicable in order to minimise damage if flood waters inundate the property.
- Any wood fixings on basement / ground floor will be robust and/or protected by suitable coatings in order to minimise damage during a flood event.
- The basement waterproofing where feasible will be extended to an appropriate level above existing ground levels.
- The concrete sub floor as standard will likely be laid to fall to drains or gullies which will remove any build-up of ground water to a sump pump where it will be pumped into the mains sewer. This pump will be fitted with a non-return valve to prevent water backing up into the property should the mains sewer become full.
- Insulation to the external walls will be specified as rigid board which has impermeable foil facings that are resistant to the passage of water vapour and double the thermal resistance of the cavity.

5 SCREENING AND SCOPING ASSESSMENT

5.1 Screening Assessment

5.1.1 Screening is the process of determining whether or not there are areas of concern which require a BIA for a particular project. This was undertaken in previous sections by the site characterisation. Scoping is the process of producing a statement which defines further matters of concern identified in the screening stage. This defining is in terms of ground processes in order that a site specific BIA can be designed and executed by deciding what aspects identified in the screening stage require further investigation by desk research or intrusive drilling and monitoring or other work.

5.1.2 The scoping stage highlights areas of concern where further investigation, intrusive soil and water testing and groundwater monitoring may be required.

5.1.3 This Jomas BIA also takes into account the Campbell Reith pro forma BIA produced on behalf of and published by the London Borough of Camden as guidance for applicants to ensure that all of the required information is provided. Within the pro forma a series of tables have been used to identify what issues are relevant to the site.

5.1.4 Each question posed in the tables is completed by answering "Yes", "No" or "Unknown". Any question answered with "Yes" or "Unknown" is then subsequently carried forward to the scoping phase of the assessment.

5.1.5 The results of the screening process for the site are provided in Table 5.1 below. Where further discussion is required the items have been carried forward to scoping.

5.1.6 The numbering within the questions refers the reader to the appropriate question / section in the London Borough of Camden BIA pro forma.

5.1.7 A ground investigation is undertaken where necessary to establish base conditions and the impact assessment determines the impact of the proposed basement on the baseline conditions, taking into account any mitigating measures proposed.

Table 5.1: Screening Assessment

Query	Y / N	Comment
Subterranean (Groundwater) Flow (see London Borough of Camden BIA Pro Forma Section 4.1.1)		
1a) Is the site located directly above an aquifer?	No	The site is directly underlain by the London Clay Formation, which is classified as an unproductive stratum.
1b) Will the proposed basement extend below the surface of the water table?	No	Due to the presence of unproductive, practically impermeable London Clay Formation reported to underlie the site, it is unlikely that groundwater will be encountered.
2) Is the site within 100m of a watercourse, well (disused or used) or a potential spring line?	No	No water networks or surface water features within 250m of site. The 1871 OS Map identified a well 100m north-east of the site, although this is not shown on subsequent editions.
3) Is the site within the catchment of any surface water features?	No	No water networks or surface water features within 250m of site.
4) Will the proposed basement development result in a change in the proportion of hard surfaced/paved areas?	No	The proposed development will comprise a basement within the existing footprint of the building, which itself covers the entire site footprint.
5) As part of the site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	The proposed development will comprise a basement within the existing footprint of the building, which itself covers the entire site footprint.
6) Is the lowest point of the proposed excavation (allowing of any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond (not just the pond chains on Hampstead Heath or spring line?	No	No water networks or surface water features within 250m of site.
Slope Stability ((see London Borough of Camden BIA Pro Forma Section 4.2)		
1) Does the existing site include slopes, natural or manmade, greater than 7 degrees? (approximately 1 in 8)	No	The site is flat and level with the surrounding land.
2) Will the proposed re-profiling of landscaping change slopes at the property to more than 7 degrees? (approximately 1 in 8)	No	Re-profiling of change of slopes is not anticipated as part of the proposed development.
3) Does the developments' neighbouring land include railway cuttings and the like, with a slope greater than 7 degrees? (approximately 1 in 8)	No	Land uses within the surrounding area are primarily residential.

Query	Y / N	Comment
4) Is the site within a wider hillside setting in which the general slope is greater than 7 degrees? (approximately 1 in 8)	No	Surrounding area is relatively level.
5) Is the London Clay the shallowest strata at the site?	Yes	The site is directly underlain by solid deposits of the London Clay Formation.
6) Will any trees be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	No trees were noted on site during the walkover.
7) Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	Unknown	No obvious evidence of the effects of shrink-swell subsidence was noted on site. However, the site is directly underlain by the London Clay Formation and is reported to be in area at moderate risk from shrink swell clays.
8) Is the site within 100m of a watercourse or a spring line?	No	No water networks or surface water features within 250m of site.
9) Is the site within an area of previously worked ground?	No	Site has only had the current development in place.
10) Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No	The site is directly underlain by unproductive strata of the London Clay Formation.
11) Is the site within 50m of the Hampstead Heath ponds (or other waterbody)?	No	No water networks or surface water features within 250m of site.
12) Is the site within 5m of a highway or pedestrian 'right of way'?	Yes	The site faces onto a Belsize Park Mews to the north-east.
13) Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Unknown	Neighbouring foundations are unknown.
14) Is the site over (or within the exclusion of) any tunnels e.g. railway lines?	No	The nearest underground railway is reported 104m north of site, identified as Belsize Fast Tunnel.
Surface Flow and Flooding (see London Borough of Camden BIA Pro Forma Section 4.3)		
1) Is the site within the catchment of the pond chains on Hampstead Heath?	No	The site is located 1km from the Hampstead Heath Ponds.
2) As part of the site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially different from the existing route?	No	The proposed development will comprise a basement within the existing footprint of the building and therefore surface water flow is unlikely to be affected.

Query	Y / N	Comment
3) Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	The proposed development will comprise a basement within the existing footprint of the building, which itself covers the entire site footprint.
4) Will the proposed basement result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	No	No water networks or surface water features within 250m of site. No increase in impermeable areas.
5) Will the proposed basement result in changes to the quality of surface waters being received by adjacent properties or downstream watercourses?	No	-
6) Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?	No	No water networks or surface water features within 250m of site. Site is located within an EA Flood Zone 1.

5.2 Scoping

5.2.1 Scoping is the activity of defining in further detail the matters to be investigated as part of the BIA process. Scoping comprises of the definition of the required investigation needed in order to determine in detail the nature and significance of the potential impacts identified during screening.

5.2.2 The potential impacts for each of the matters highlighted in Table 5.1 above are discussed in further detail below together with the requirements for further investigations. Detailed assessment of the potential impacts and recommendations are provided where possible.

Subterranean (Groundwater) Flow

5.2.3 A ground investigation is recommended to confirm the ground conditions and groundwater levels (if any) beneath the site.

Land Stability

5.2.4 The site, as with the surrounding area, is generally flat. The Groundsure report has noted that there is a “very low” risk of land instability issues for the site.

5.2.5 Atterberg Limits of the underlying London Clay Formation should be determined by the ground investigation to assess shrink/swell potential of the soils.

5.2.6 Existing foundations should be established.

5.2.7 It is noted that the London Borough of Camden's guidance documents requires a Ground Movement Assessment to be undertaken as part of the Basement Impact Assessment. Such an assessment uses a ground model based on a zone of influence equivalent of four times the proposed depth of excavation. Consequently, such a study is strongly recommended.

Surface Flow and Flooding

5.2.8 The proposed development will comprise a basement within the existing footprint of the building, which itself covers the entire site footprint. Therefore, the proposed development will not cause a significant change in surface water run-off.

5.2.9 If SUDS can be incorporated into the design, this will further decrease the potential risk of surface water flooding. .

5.2.10 A drainage strategy/SUDS report should be produced for the site.

6 PRELIMINARY BASEMENT IMPACT ASSESSMENT

6.1 Proposed Changes to Areas of External Hardstanding

6.1.1 Existing areas of hardstanding include the existing building on site which covers the entire site. The proposed development will comprise a basement within the existing footprint of the building.

6.1.2 As a result, there is will not be a change in the proportion of hardstanding areas and it is not considered necessary to undertake further assessment in this regard.

6.2 Past Flooding

6.2.1 The National Planning Policy Framework sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow.

6.2.2 When assessing the site-specific flood risk and the potential for historic flooding to reoccur the above guidance recommends that, historic flooding records and any other relevant and available information including flood datasets (e.g. flood levels, depths and/or velocities) and any other relevant data, which can be acquired are assessed.

6.2.3 The nearest EA groundwater flood incident is shown 675m north-west of site and the nearest LBC groundwater flood incident is shown approximately 625m south-west of site, with 8No. properties affected.

6.2.4 Belsize Lane (~30m east of site) was affected by surface water flooding in 1975 and 2002. No LB Camden historic surface water flooding records are shown within 500m of site.

6.2.5 For the postcode "NW3 5--" where the site is situated, no properties have been impacted by internal sewer flooding whilst only 1No. property has been affected by exterior sewer flooding

6.2.6 There are no historical flood events reported by Groundsure within 250m of the site.

6.2.7 The site is therefore considered to be at low risk of flooding based on historic flooding.

6.3 Geological Impact

6.3.1 With reference to British Geological Survey (BGS) mapping, the geology of the site is anticipated to comprise the London Clay Formation. Given that the site has been developed previously, a thickness of Made Ground could also be present overlying the natural soils.

6.3.2 The London Clay Formation poses a moderate risk of shrink-swell conditions due to volume change, and a ground investigation should be carried out to determine what considerations should be taken into account for basement design in this regard.

6.3.3 Due to the practically impermeable nature of the London Clay Formation, a shallow groundwater table is not anticipated. There is, however, the potential for perched groundwater to be encountered at the interface between the Made Ground and London Clay Formation, though significant volumes of groundwater are not anticipated.

6.4 Hydrology and Hydrogeology Impact

6.4.1 Based on the information available at the time of writing, the risk of flooding from groundwater is considered to be low. The proposed basement is unlikely to have a detectable impact on the local groundwater regime.

6.4.2 Appropriate water proofing measures should be included within the whole of the proposed basement wall/floor design as a precaution.

6.4.3 The proposed development will lie outside of flood risk zones and is therefore assessed as being at a low probability of fluvial flooding.

6.4.4 There are no water networks or surface water features on or within 250m of the site. It is therefore not anticipated that the site will have an impact upon the hydrology of the area.

6.4.5 The London Borough of Camden SWMP indicates that overall groundwater flooding across the Borough is considered to be a relatively low risk.

6.4.6 The site is situated within Critical Drainage Area Group 3_005 and is therefore within a catchment area which contributes to a flooding hotspot, the nearest being South East Regent's Park, located 2.9km south-east of site.

6.4.7 The information available suggests that the site lies in an area that is at low risk of surface water flooding.

6.4.8 The proposed basement construction is considered unlikely to create a reduction of impermeable area in the post development scenario.

6.4.9 No risk of flooding to the site from artificial sources has been identified.

6.5 Impacts of Basement on Adjacent Properties and Pavement

6.5.1 The proposed basement excavation will be within 5m of a public pavement. It is also within 5m of neighbouring properties.

6.5.2 Unavoidable lateral ground movements associated with the basement excavations must be controlled during temporary and permanent works so as not to impact adversely on the stability of the surrounding ground, any associated services and structures.

6.5.3 It is recommended that the site is supported by suitably designed temporary support with a basement box construction. This will ensure that the adjacent land is adequately supported in the temporary and permanent construction.

6.5.4 Careful and regular monitoring of the structure will need to be undertaken during the construction phase to ensure that vertical movements do not adversely affect the above and neighbouring properties. If necessary, the works may have to be carried out in stages with the above structure suitably propped and supported.

6.5.5 It will be necessary to ensure that the basements are designed in accordance with the NHBC Standards and take due cognisance of the potential impacts highlighted above. This may be achieved by ensuring best practice engineering and design of the proposed scheme by competent persons and in full accordance with the Construction (Design and Management) Regulations. This will include:

- Establishment of the likely ground movements arising from the temporary and permanent works and the mitigation of excessive movements;
- Assessment of the impact on any adjacent structures (including adjacent properties and the adjacent pavement with potential services);
- Determination of the most appropriate methods of construction of the proposed basements;
- Undertake pre-condition surveys of adjacent structures;
- Monitor any movements and pre-existing cracks during construction;
- Establishment of contingencies to deal with adverse performance;
- Ensuring quality of workmanship by competent persons.

6.5.6 Full details of the suitable engineering design of the scheme in addition to an appropriate construction method statement should be submitted by the Developer to the London Borough of Camden.

6.6 Cumulative Impacts

6.6.1 The site is reported to be directly underlain by practically impermeable London Clay Formation. Such materials would prevent both the movement of groundwater and the ingress of surface water into the ground.

6.6.2 The proposed development is therefore unlikely to have an accumulative impact on the local hydrogeology.

6.7 Ground Movement

6.7.1 CIRIA C580 Table 2.5 uses information on the damage to walls of buildings based on Burland et al (1977), Boscardin and Cording (1989) and Burland (2001) to categorise damage into 5 categories. A summary of Table 2.5 from CIRIA C580 is provided below.

6.7.2 It would be generally good practise to ensure that the design and construction should aim to limit damage to all buildings to a maximum of Category 2 (Slight) as set out in CIRIA Report 580.

Table 6.1: Summary of CIRIA C580 Table 2.5 (after Burland et al (1977), Boscardin and Cording (1989) and Burland (2001))

Category of damage		Description of Typical Damage	Approximate crack width (mm)	Limiting tensile strain (%)
0	Negligible	Hairline cracks of less than about 0.1mm are classes as negligible.	< 0.1	0.0-0.05
1	Very Slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.	<1	0.05-0.075
2	Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weather tightness. Doors and windows may stick slightly	<5	0.075-0.15
3	Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weather-tightness often impaired.	5-15 or a number of cracks >3	0.15 – 0.3
4	Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floors sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15-25 but also depends on number of cracks	>0.3
5	Very Severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	Usually >25 but depends on number of cracks	

6.7.3 The first three categories (namely Negligible, Very Slight and Slight categories) are generally regarded as acceptable for buildings where no structural damage is permissible.

6.7.4 Assuming cantilever retaining walls are formed in short sections, it is considered that in the short term maintaining the category of damage to Category 1 could be relatively easily achieved. It would be recommended that a full inspection of the neighbouring properties should be undertaken prior to starting work and a watching brief of the structure, the excavations and the adjacent properties is maintained during the works.

6.7.5 In the long term a suitably designed and constructed retaining wall should provide sufficient support to ensure that post construction movement is minimal and the damage classification post construction of any cracks caused in the short term should not get worse. It is considered unlikely that new cracks would occur post construction.

6.7.6 This advice does not comprise a Ground Movement Assessment and a formal assessment is recommended.

6.8 Size of Basement

6.8.1 The London Borough of Camden document "Camden Planning Guidance Basements" (January 2021) outlines how Local Plan Policy A5 on basements limits the size of basement developments.

Table 6.2: Screening Assessment

Criterion from LBC Policy A5	Jomas Comments on the Proposed Development in relation to LBC Policy A5
f. not comprise of more than one storey;	The proposed basement is only a single storey.
g. not be built under an existing basement;	The proposed basement will be formed under the existing ground floor.
h. not exceed 50% of each garden within the property;	The site does not have a garden.
i. be less than 1.5 times the footprint of the host building in area;	The proposed basement will be formed within the existing building footprint and will therefore not exceed this.
j. extend into the garden no further than 50% of the depth of the host building measured from the principal rear elevation;	The site does not have a garden.
k. not extend into or underneath the garden further than 50% of the depth of the garden;	The site does not have a garden.

Criterion from LBC Policy A5	Jomas Comments on the Proposed Development in relation to LBC Policy A5
l. be set back from neighbouring property boundaries where it extends beyond the footprint of the host building;	The proposed basement will not extended beyond the existing building footprint.
m. avoid the loss of garden space or trees of townscape or amenity value	The site does not have a garden or trees etc.

6.9 Summary

6.9.1 The overall assessment of the site is that the creation of a basement for the existing development should not adversely impact the site or its immediate environs, providing measures are taken to protect surrounding land and properties during construction.

6.9.2 A Ground Investigation is recommended to confirm the assumptions in this report, as well as to inform the recommended Ground Movement Assessment. Due to the very restricted nature of the site, a ground investigation could comprise hand-excavated trial pits (as opposed to full-scale percussive drilling).

7 REFERENCES

Barton (1992) "*The Lost Rivers of London*"

British Standards Institution (2015) BS 5930:2015 *Code of practice for ground investigations*. Milton Keynes: BSI

Campbell Reith (March 2018) *"Pro Forma Basement Impact Assessment*", London Borough of Camden

CIRIA C580, Embedded retaining walls – guidance for economic design

Groundsure Enviro+GeoInsight Report Ref JOMAS-1SP-TK7-K3L-5HY, June 2023

Halcrow (2011) "*Preliminary Flood Risk Assessment, London Borough of Camden*"

Halcrow (2011) "*Surface Water Management Plan, London Borough of Camden*"

London Borough of Camden (January 2021) *"Camden Planning Guidance Basements"*

Ministry of Housing, Communities & Local Government: *National Planning Policy Framework*. February 2019

URS (July 2014) *"London Borough of Camden Strategic Flood Risk Assessment*

APPENDICES

APPENDIX 1 – FIGURES

APPENDIX 2 – GROUNDSURE REPORTS

APPENDIX 3 – OS HISTORICAL MAPS

APPENDIX 4 – SELECTED MAPS FROM LONDON BOROUGH OF CAMDEN SFRA

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Appendices 8 – Outline Retaining Wall Calculations

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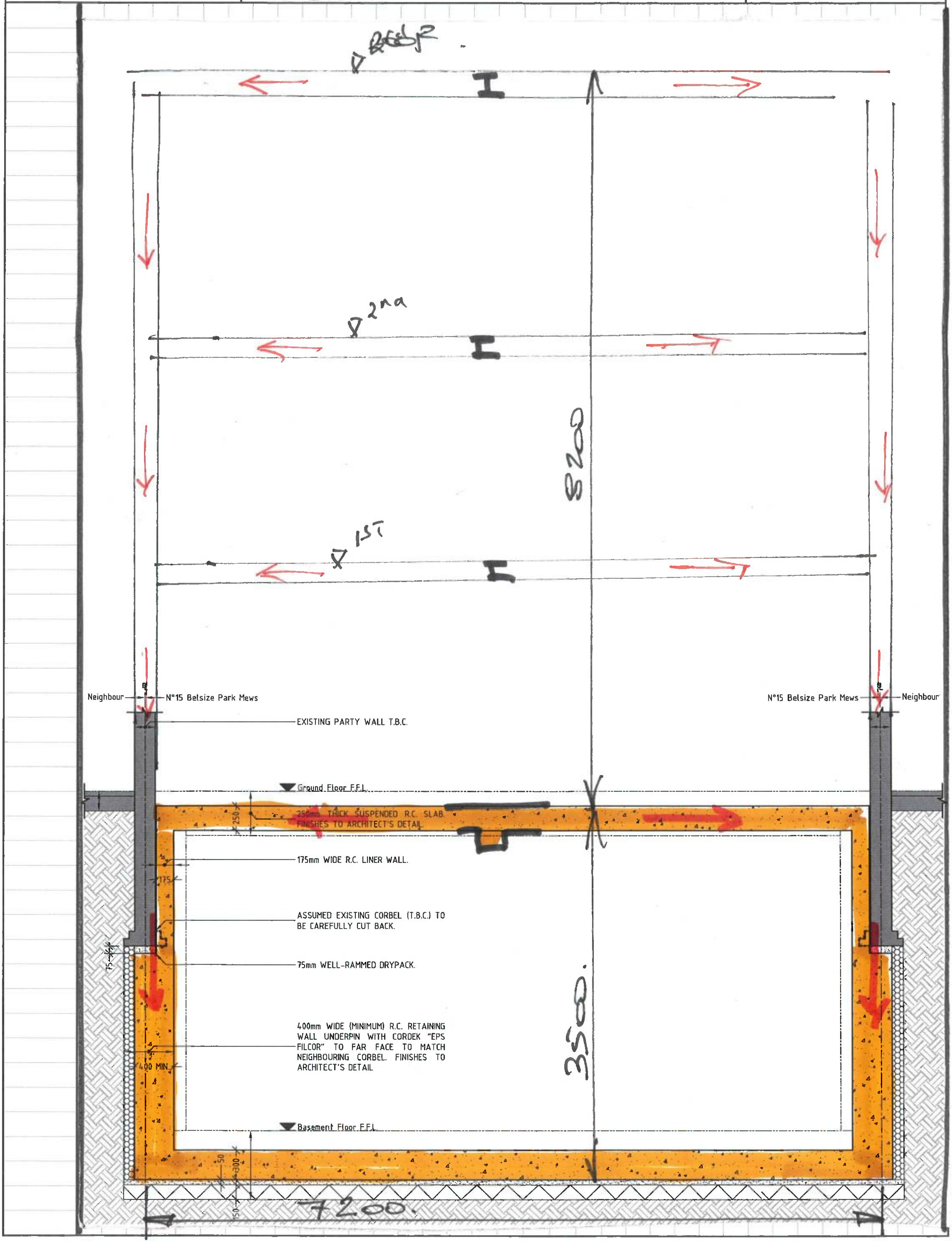
Project: 15 BELSIZE VIEW	Job no. 23066
	drg/page no.
Title: OUTLINE RETAINING WALL DESIGN.	Scale:
	Date: 04/01/24
	Drawn: CAE
	Checked:



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Drawn: GAE

Checked:

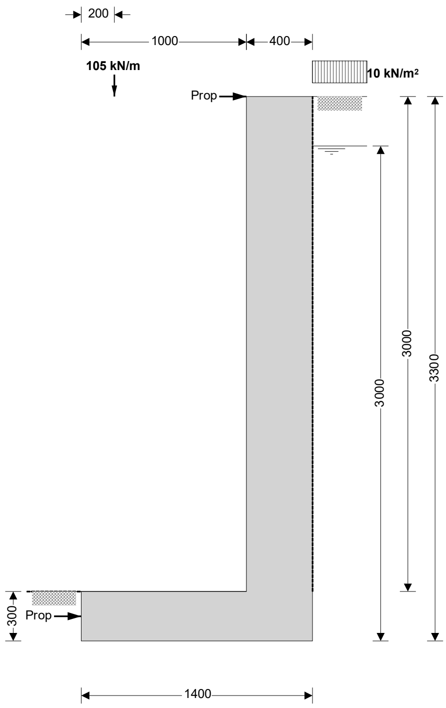
LOAD ASSESMENT ON PARTY WALL FOUNDATIONS

			DL	LL
ROOF (TIMBER).	0.30kN/m² * 7.4m/4	=	1.48	
	0.60kN/m² * " "	=		1.11
2nd (TIMBER)	0.30kN/m² * 7.4m/4	=	1.48	
	1.50kN/m² * " "	=		2.78
1ST (TIMBER)	0.30kN/m² * 7.4m/4	=	1.48	
	1.50kN/m² * " "	=		2.78
GROUND (250 RC)	8.0kN/m² * 7.4m/4	=	14.8	
	1.50kN/m² * " "	=		2.78.
PARTY WALL (GROUND & ABOVE)	5.0kN/m² * 8.2m	=	41	
UNDERPIN (400 RC)	10kN/m² * 3.5m	=	35	
			95.2	9.45.

SEE AHEAD FOR RETAINING WALL CALCS.

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.08



Wall details

Retaining wall type	**Cantilever propped at both**
Height of retaining wall stem	h_{stem} = **3000** mm
Thickness of wall stem	t_{wall} = **400** mm
Length of toe	l_{toe} = **1000** mm
Length of heel	l_{heel} = **0** mm
Overall length of base	$l_{base} = l_{toe} + l_{heel} + t_{wall}$ = **1400** mm
Thickness of base	t_{base} = **300** mm
Depth of downstand	d_{ds} = **0** mm
Position of downstand	l_{ds} = **0** mm
Thickness of downstand	t_{ds} = **300** mm
Height of retaining wall	$h_{wall} = h_{stem} + t_{base} + d_{ds}$ = **3300** mm
Depth of cover in front of wall	d_{cover} = **0** mm
Depth of unplanned excavation	d_{exc} = **0** mm
Height of ground water behind wall	h_{water} = **3000** mm
Height of saturated fill above base	$h_{sat} = \max(h_{water} - t_{base} - d_{ds}, 0\text{ mm})$ = **2700** mm
Density of wall construction	γ_{wall} = **23.6** kN/m^3
Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of rear face of wall	α = **90.0** deg
Angle of soil surface behind wall	β = **0.0** deg
Effective height at virtual back of wall	$h_{eff} = h_{wall} + l_{heel} \times \tan(\beta)$ = **3300** mm

Retained material details

Mobilisation factor	M = **1.5**
Moist density of retained material	γ_m = **21.0** kN/m^3

Saturated density of retained material γ_s = **23.0** kN/m^3

Design shear strength ϕ' = **24.2** deg

Angle of wall friction δ = **18.6** deg

Base material details

Moist density γ_{mb} = **18.0** kN/m^3

Design shear strength ϕ'_b = **24.2** deg

Design base friction δ_b = **18.6** deg

Allowable bearing pressure $P_{bearing}$ = **160** kN/m^2

Using Coulomb theory

Active pressure coefficient for retained material

$$K_a = \sin(\alpha + \phi')^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta) \times [1 + \sqrt{(\sin(\phi' + \delta) \times \sin(\phi' - \beta) / (\sin(\alpha - \delta) \times \sin(\alpha + \beta)))}]^2) = \mathbf{0.369}$$

Passive pressure coefficient for base material

$$K_p = \sin(90 - \phi'_b)^2 / (\sin(90 - \delta_b) \times [1 - \sqrt{(\sin(\phi'_b + \delta_b) \times \sin(\phi'_b) / (\sin(90 + \delta_b)))}]^2) = \mathbf{4.187}$$

At-rest pressure

At-rest pressure for retained material $K_0 = 1 - \sin(\phi') = \mathbf{0.590}$

Loading details

Surcharge load on plan Surcharge = **10.0** kN/m^2

Applied vertical dead load on wall W_{dead} = **95.2** kN/m

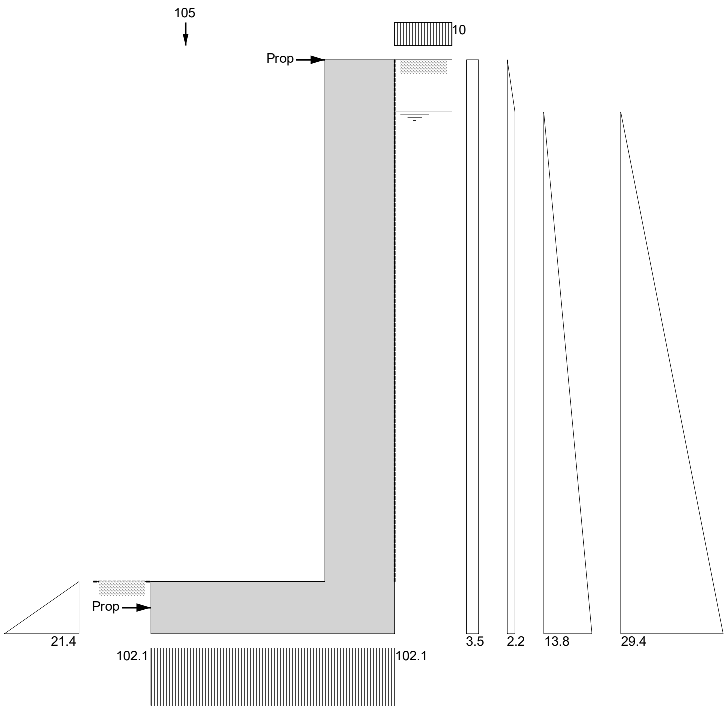
Applied vertical live load on wall W_{live} = **9.5** kN/m

Position of applied vertical load on wall l_{load} = **200** mm

Applied horizontal dead load on wall F_{dead} = **0.0** kN/m

Applied horizontal live load on wall F_{live} = **0.0** kN/m

Height of applied horizontal load on wall h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Vertical forces on wall

Wall stem $w_{wall} = h_{stem} \times t_{wall} \times \gamma_{wall}$ = **28.3** kN/m

Wall base $w_{base} = l_{base} \times t_{base} \times \gamma_{base}$ = **9.9** kN/m

Applied vertical load $W_v = W_{dead} + W_{live}$ = **104.7** kN/m

Total vertical load $W_{total} = w_{wall} + w_{base} + W_v$ = **142.9** kN/m

Horizontal forces on wall

Surcharge $F_{sur} = K_a \times \cos(90 - \alpha + \delta) \times Surcharge \times h_{eff}$ = **11.5** kN/m

Moist backfill above water table $F_{m\_a} = 0.5 \times K_a \times \cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water})^2$ = **0.3** kN/m

Moist backfill below water table $F_{m\_b} = K_a \times \cos(90 - \alpha + \delta) \times \gamma_m \times (h_{eff} - h_{water}) \times h_{water}$ = **6.6** kN/m

Saturated backfill $F_s = 0.5 \times K_a \times \cos(90 - \alpha + \delta) \times (\gamma_s - \gamma_{water}) \times h_{water}^2$ = **20.8** kN/m

Water $F_{water} = 0.5 \times h_{water}^2 \times \gamma_{water}$ = **44.1** kN/m

Total horizontal load $F_{total} = F_{sur} + F_{m\_a} + F_{m\_b} + F_s + F_{water}$ = **83.4** kN/m

Calculate total propping force

Passive resistance of soil in front of wall $F_p = 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb}$ = **3.2** kN/m

Propping force $F_{prop} = \max(F_{total} - F_p - (W_{total} - W_{live}) \times \tan(\delta_b), 0\ kN/m)$

F_{prop} = **35.3** kN/m

Overturning moments

Surcharge $M_{sur} = F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2$ = **19** kNm/m

Moist backfill above water table $M_{m\_a} = F_{m\_a} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3$ = **1** kNm/m

Moist backfill below water table $M_{m\_b} = F_{m\_b} \times (h_{water} - 2 \times d_{ds}) / 2$ = **9.9** kNm/m

Saturated backfill $M_s = F_s \times (h_{water} - 3 \times d_{ds}) / 3$ = **20.8** kNm/m

Water $M_{water} = F_{water} \times (h_{water} - 3 \times d_{ds}) / 3$ = **44.1** kNm/m

Total overturning moment $M_{ot} = M_{sur} + M_{m\_a} + M_{m\_b} + M_s + M_{water}$ = **94.9** kNm/m

Restoring moments

Wall stem $M_{wall} = w_{wall} \times (l_{toe} + t_{wall} / 2)$ = **34** kNm/m

Wall base $M_{base} = w_{base} \times l_{base} / 2$ = **6.9** kNm/m

Design vertical load $M_v = W_v \times l_{load}$ = **20.9** kNm/m

Total restoring moment $M_{rest} = M_{wall} + M_{base} + M_v$ = **61.9** kNm/m

Check bearing pressure

Total vertical reaction $R = W_{total}$ = **142.9** kN/m

Distance to reaction $x_{bar} = l_{base} / 2$ = **700** mm

Eccentricity of reaction $e = abs((l_{base} / 2) - x_{bar})$ = **0** mm

Reaction acts within middle third of base

Bearing pressure at toe $p_{toe} = (R / l_{base}) - (6 \times R \times e / l_{base}^2)$ = **102.1** kN/m^2

Bearing pressure at heel $p_{heel} = (R / l_{base}) + (6 \times R \times e / l_{base}^2)$ = **102.1** kN/m^2

PASS - Maximum bearing pressure is less than allowable bearing pressure

Calculate propping forces to top and base of wall

Propping force to top of wall

$F_{prop\_top} = (M_{ot} - M_{rest} + R \times l_{base} / 2 - F_{prop} \times t_{base} / 2) / (h_{stem} + t_{base} / 2)$ = **40.564** kN/m

Propping force to base of wall $F_{prop\_base} = F_{prop} - F_{prop\_top}$ = **-5.284** kN/m

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.08

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4**

Live load factor γ_{f_l} = **1.6**

Earth and water pressure factor γ_{f_e} = **1.4**

Factored vertical forces on wall

Wall stem $w_{wall\_f} = \gamma_{f\_d} \times h_{stem} \times t_{wall} \times \gamma_{wall}$ = **39.6** kN/m

Wall base $w_{base\_f} = \gamma_{f\_d} \times l_{base} \times t_{base} \times \gamma_{base}$ = **13.9** kN/m

Applied vertical load $W_{v\_f} = \gamma_{f\_d} \times W_{dead} + \gamma_{f\_l} \times W_{live}$ = **148.4** kN/m

Total vertical load $W_{total\_f} = w_{wall\_f} + w_{base\_f} + W_{v\_f}$ = **201.9** kN/m

Factored horizontal at-rest forces on wall

Surcharge $F_{sur\_f} = \gamma_{f\_l} \times K_0 \times Surcharge \times h_{eff}$ = **31.2** kN/m

Moist backfill above water table $F_{m\_a\_f} = \gamma_{f\_e} \times 0.5 \times K_0 \times \gamma_m \times (h_{eff} - h_{water})^2$ = **0.8** kN/m

Moist backfill below water table $F_{m\_b\_f} = \gamma_{f\_e} \times K_0 \times \gamma_m \times (h_{eff} - h_{water}) \times h_{water}$ = **15.6** kN/m

Saturated backfill $F_{s\_f} = \gamma_{f\_e} \times 0.5 \times K_0 \times (\gamma_s - \gamma_{water}) \times h_{water}^2$ = **49** kN/m

Water $F_{water\_f} = \gamma_{f\_e} \times 0.5 \times h_{water}^2 \times \gamma_{water}$ = **61.8** kN/m

Total horizontal load $F_{total\_f} = F_{sur\_f} + F_{m\_a\_f} + F_{m\_b\_f} + F_{s\_f} + F_{water\_f}$ = **158.4** kN/m

Calculate total propping force

Passive resistance of soil in front of wall $F_{p\_f} = \gamma_{f\_e} \times 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb}$ = **4.5** kN/m

Propping force $F_{prop\_f} = \max(F_{total\_f} - F_{p\_f} - (W_{total\_f} - \gamma_{f\_l} \times W_{live}) \times \tan(\delta_b), 0 \text{ kN/m})$

F_{prop_f} = **91.0** kN/m

Factored overturning moments

Surcharge $M_{sur\_f} = F_{sur\_f} \times (h_{eff} - 2 \times d_{ds}) / 2$ = **51.4** kNm/m

Moist backfill above water table $M_{m\_a\_f} = F_{m\_a\_f} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3$ = **2.4** kNm/m

Moist backfill below water table $M_{m\_b\_f} = F_{m\_b\_f} \times (h_{water} - 2 \times d_{ds}) / 2$ = **23.4** kNm/m

Saturated backfill $M_{s\_f} = F_{s\_f} \times (h_{water} - 3 \times d_{ds}) / 3$ = **49** kNm/m

Water $M_{water\_f} = F_{water\_f} \times (h_{water} - 3 \times d_{ds}) / 3$ = **61.8** kNm/m

Total overturning moment $M_{ot\_f} = M_{sur\_f} + M_{m\_a\_f} + M_{m\_b\_f} + M_{s\_f} + M_{water\_f}$ = **188.1** kNm/m

Restoring moments

Wall stem $M_{wall\_f} = w_{wall\_f} \times (l_{toe} + t_{wall} / 2)$ = **47.6** kNm/m

Wall base $M_{base\_f} = w_{base\_f} \times l_{base} / 2$ = **9.7** kNm/m

Design vertical load $M_{v\_f} = W_{v\_f} \times l_{load}$ = **29.7** kNm/m

Total restoring moment $M_{rest\_f} = M_{wall\_f} + M_{base\_f} + M_{v\_f}$ = **87** kNm/m

Factored bearing pressure

Total vertical reaction $R_f = W_{total\_f}$ = **201.9** kN/m

Distance to reaction $x_{bar\_f} = l_{base} / 2$ = **700** mm

Eccentricity of reaction $e_f = abs((l_{base} / 2) - x_{bar\_f})$ = **0** mm

Reaction acts within middle third of base

Bearing pressure at toe $p_{toe\_f} = (R_f / l_{base}) - (6 \times R_f \times e_f / l_{base}^2)$ = **144.2** kN/m^2

Bearing pressure at heel $p_{heel\_f} = (R_f / l_{base}) + (6 \times R_f \times e_f / l_{base}^2)$ = **144.2** kN/m^2

Rate of change of base reaction $rate = (p_{toe\_f} - p_{heel\_f}) / l_{base}$ = **0.00** kN/m^2/m

Bearing pressure at stem / toe $p_{stem\_toe\_f} = \max(p_{toe\_f} - (rate \times l_{toe}), 0 \text{ kN/m}^2)$ = **144.2** kN/m^2

Bearing pressure at mid stem $p_{stem\_mid\_f} = \max(p_{toe\_f} - (rate \times (l_{toe} + t_{wall} / 2)), 0\ kN/m^2) =$ **144.2** kN/m^2

Bearing pressure at stem / heel $p_{stem\_heel\_f} = \max(p_{toe\_f} - (rate \times (l_{toe} + t_{wall})), 0\ kN/m^2) =$ **144.2** kN/m^2

Calculate propping forces to top and base of wall

Propping force to top of wall

$F_{prop\_top\_f} = (M_{ot\_f} - M_{rest\_f} + R_f \times l_{base} / 2 - F_{prop\_f} \times t_{base} / 2) / (h_{stem} + t_{base} / 2) =$ **72.637** kN/m

Propping force to base of wall $F_{prop\_base\_f} = F_{prop\_f} - F_{prop\_top\_f} =$ **18.383** kN/m

Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Characteristic strength of concrete $f_{cu} =$ **35** N/mm^2

Characteristic strength of reinforcement $f_y =$ **500** N/mm^2

Base details

Minimum area of reinforcement k = **0.13** %

Cover to reinforcement in toe $c_{toe} =$ **40** mm

Calculate shear for toe design

Shear from bearing pressure $V_{toe\_bear} = (p_{toe\_f} + p_{stem\_toe\_f}) \times l_{toe} / 2 =$ **144.2** kN/m

Shear from weight of base $V_{toe\_wt\_base} = \gamma_{f\_d} \times \gamma_{base} \times l_{toe} \times t_{base} =$ **9.9** kN/m

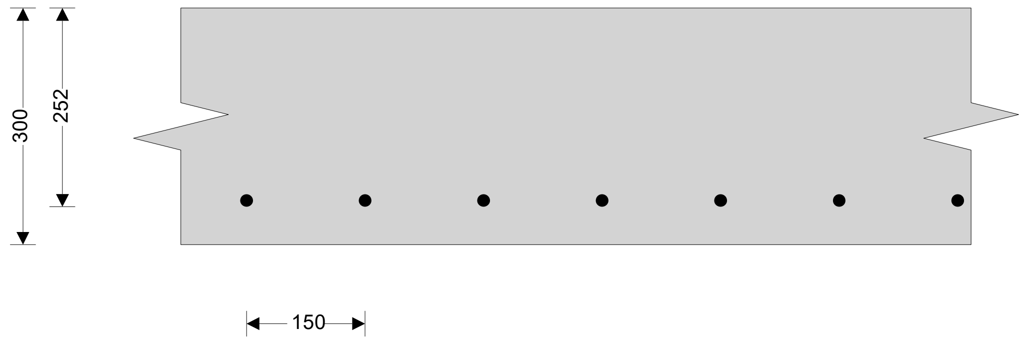
Total shear for toe design $V_{toe} = V_{toe\_bear} - V_{toe\_wt\_base} =$ **134.3** kN/m

Calculate moment for toe design

Moment from bearing pressure $M_{toe\_bear} = (2 \times p_{toe\_f} + p_{stem\_mid\_f}) \times (l_{toe} + t_{wall} / 2)^2 / 6 =$ **103.8** kNm/m

Moment from weight of base $M_{toe\_wt\_base} = (\gamma_{f\_d} \times \gamma_{base} \times t_{base} \times (l_{toe} + t_{wall} / 2)^2 / 2) =$ **7.1** kNm/m

Total moment for toe design $M_{toe} = M_{toe\_bear} - M_{toe\_wt\_base} =$ **96.7** kNm/m



Check toe in bending

Width of toe b = **1000** mm/m

Depth of reinforcement $d_{toe} = t_{base} - c_{toe} - (\phi_{toe} / 2) =$ **252.0** mm

Constant $K_{toe} = M_{toe} / (b \times d_{toe}^2 \times f_{cu}) =$ **0.044**

Compression reinforcement is not required

Lever arm $z_{toe} = \min(0.5 + \sqrt{(0.25 - (\min(K_{toe}, 0.225) / 0.9))}, 0.95) \times d_{toe}$

$z_{toe} =$ **239** mm

Area of tension reinforcement required $A_{s\_toe\_des} = M_{toe} / (0.87 \times f_y \times z_{toe}) =$ **930** mm^2/m

Minimum area of tension reinforcement $A_{s\_toe\_min} = k \times b \times t_{base} =$ **390** mm^2/m

Area of tension reinforcement required $A_{s\_toe\_req} = \max(A_{s\_toe\_des}, A_{s\_toe\_min}) =$ **930** mm^2/m

Reinforcement provided **16 mm dia.bars @ 150 mm centres**

Area of reinforcement provided $A_{s\_toe\_prov} =$ **1340** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress $v_{toe} = V_{toe} / (b \times d_{toe})$ = **0.533** N/mm^2

Allowable shear stress $v_{adm} = \min(0.8 \times \sqrt{(f_{cu} / 1\ N/mm^2)}, 5) \times 1\ N/mm^2$ = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

From BS8110:Part 1:1997 – Table 3.8

Design concrete shear stress v_{c_toe} = **0.643** N/mm^2

$v_{toe} < v_{c\_toe}$ - No shear reinforcement required

Design of reinforced concrete retaining wall stem (BS 8002:1994)

Material properties

Characteristic strength of concrete f_{cu} = **35** N/mm^2

Characteristic strength of reinforcement f_y = **500** N/mm^2

Wall details

Minimum area of reinforcement k = **0.13** %

Cover to reinforcement in stem c_{stem} = **40** mm

Cover to reinforcement in wall c_{wall} = **40** mm

Factored horizontal at-rest forces on stem

Surcharge $F_{s\_sur\_f} = \gamma_{f\_l} \times K_0 \times Surcharge \times (h_{eff} - t_{base} - d_{ds})$ = **28.3** kN/m

Moist backfill above water table $F_{s\_m\_a\_f} = 0.5 \times \gamma_{f\_e} \times K_0 \times \gamma_m \times (h_{eff} - t_{base} - d_{ds} - h_{sat})^2$ = **0.8** kN/m

Moist backfill below water table $F_{s\_m\_b\_f} = \gamma_{f\_e} \times K_0 \times \gamma_m \times (h_{eff} - t_{base} - d_{ds} - h_{sat}) \times h_{sat}$ = **14.1** kN/m

Saturated backfill $F_{s\_s\_f} = 0.5 \times \gamma_{f\_e} \times K_0 \times (\gamma_s - \gamma_{water}) \times h_{sat}^2$ = **39.7** kN/m

Water $F_{s\_water\_f} = 0.5 \times \gamma_{f\_e} \times \gamma_{water} \times h_{sat}^2$ = **50.1** kN/m

Calculate shear for stem design

Surcharge $V_{s\_sur\_f} = 5 \times F_{s\_sur\_f} / 8$ = **17.7** kN/m

Moist backfill above water table $V_{s\_m\_a\_f} = F_{s\_m\_a\_f} \times b_l \times ((5 \times L^2) - b_l^2) / (5 \times L^3)$ = **0.1** kN/m

Moist backfill below water table $V_{s\_m\_b\_f} = F_{s\_m\_b\_f} \times (8 - (n^2 \times (4 - n))) / 8$ = **9.6** kN/m

Saturated backfill $V_{s\_s\_f} = F_{s\_s\_f} \times (1 - (a_l^2 \times ((5 \times L) - a_l) / (20 \times L^3)))$ = **33.1** kN/m

Water $V_{s\_water\_f} = F_{s\_water\_f} \times (1 - (a_l^2 \times ((5 \times L) - a_l) / (20 \times L^3)))$ = **41.7** kN/m

Total shear for stem design $V_{stem} = V_{s\_sur\_f} + V_{s\_m\_a\_f} + V_{s\_m\_b\_f} + V_{s\_s\_f} + V_{s\_water\_f}$ = **102.1** kN/m

Calculate moment for stem design

Surcharge $M_{s\_sur} = F_{s\_sur\_f} \times L / 8$ = **11.2** kNm/m

Moist backfill above water table $M_{s\_m\_a} = F_{s\_m\_a\_f} \times b_l \times ((5 \times L^2) - (3 \times b_l^2)) / (15 \times L^2)$ = **0.1** kNm/m

Moist backfill below water table $M_{s\_m\_b} = F_{s\_m\_b\_f} \times a_l \times (2 - n)^2 / 8$ = **6** kNm/m

Saturated backfill $M_{s\_s} = F_{s\_s\_f} \times a_l \times ((3 \times a_l^2)-(15 \times a_l \times L)+(20 \times L^2))/(60 \times L^2)$ = **16.8** kNm/m

Water $M_{s\_water} = F_{s\_water\_f} \times a_l \times ((3 \times a_l^2)-(15 \times a_l \times L)+(20 \times L^2))/(60 \times L^2)$ = **21.1**

kNm/m

Total moment for stem design $M_{stem} = M_{s\_sur} + M_{s\_m\_a} + M_{s\_m\_b} + M_{s\_s} + M_{s\_water}$ = **55.1** kNm/m

Calculate moment for wall design

Surcharge $M_{w\_sur} = 9 \times F_{s\_sur\_f} \times L / 128$ = **6.3** kNm/m

Moist backfill above water table $M_{w\_m\_a} = F_{s\_m\_a\_f} \times 0.577 \times b_l \times [(b_l^3+5 \times a_l \times L^2)/(5 \times L^3)-0.577^2/3]$ = **0.1**

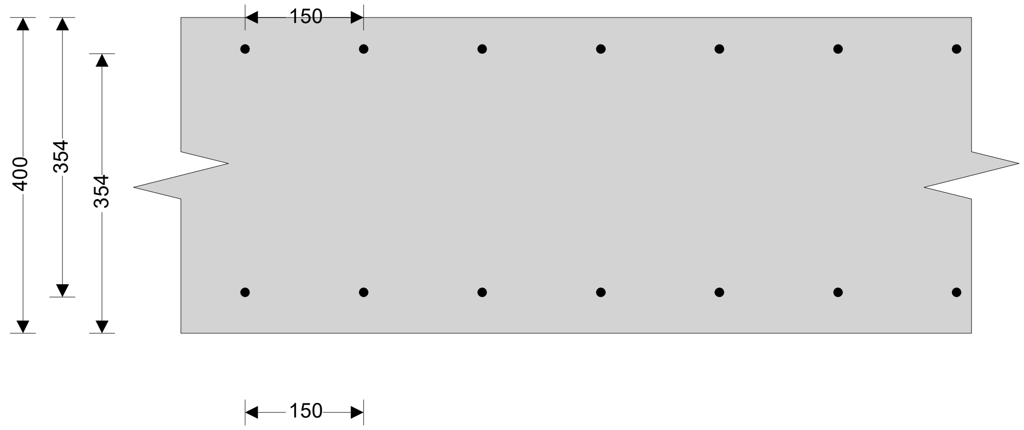
kNm/m

Moist backfill below water table $M_{w\_m\_b} = F_{s\_m\_b\_f} \times a_l \times [((8-n^2 \times (4-n))^2 /16)-4+n \times (4-n)]/8$ = **3.3** kNm/m

Saturated backfill $M_{w\_s} = F_{s\_s\_f} \times [a_l^2 \times x \times ((5 \times L)-a_l)/(20 \times L^3)-(x-b_l)^3 /(3 \times a_l^2)]$ = **7.2** kNm/m

Water $M_{w\_water} = F_{s\_water\_f} \times [a_l^2 \times x \times ((5 \times L)-a_l)/(20 \times L^3)-(x-b_l)^3 /(3 \times a_l^2)]$ = **9** kNm/m

Total moment for wall design $M_{wall} = M_{w\_sur} + M_{w\_m\_a} + M_{w\_m\_b} + M_{w\_s} + M_{w\_water}$ = **25.9** kNm/m



Check wall stem in bending

Width of wall stem — b = **1000** mm/m

Depth of reinforcement — $d_{stem} = t_{wall} - c_{stem} - (\phi_{stem} / 2) =$ **354.0** mm

Constant — $K_{stem} = M_{stem} / (b \times d_{stem}^2 \times f_{cu}) =$ **0.013**

Compression reinforcement is not required

Lever arm — $z_{stem} = \min(0.5 + \sqrt{(0.25 - (\min(K_{stem}, 0.225) / 0.9))}, 0.95) \times d_{stem}$

$z_{stem} =$ **336** mm

Area of tension reinforcement required — $A_{s\_stem\_des} = M_{stem} / (0.87 \times f_y \times z_{stem}) =$ **377** mm²/m

Minimum area of tension reinforcement — $A_{s\_stem\_min} = k \times b \times t_{wall} =$ **520** mm²/m

Area of tension reinforcement required — $A_{s\_stem\_req} = \mathrm{Max}(A_{s\_stem\_des}, A_{s\_stem\_min}) =$ **520** mm²/m

Reinforcement provided — **12 mm dia.bars @ 150 mm centres**

Area of reinforcement provided — $A_{s\_stem\_prov} =$ **754** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress — $v_{stem} = V_{stem} / (b \times d_{stem}) =$ **0.288** N/mm²

Allowable shear stress — $v_{adm} = \min(0.8 \times \sqrt{(f_{cu} / 1 \text{ N/mm}^2)}, 5) \times 1 \text{ N/mm}^2 =$ **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

From BS8110:Part 1:1997 – Table 3.8

Design concrete shear stress — $v_{c\_stem} =$ **0.435** N/mm²

$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Check mid height of wall in bending

Depth of reinforcement — $d_{wall} = t_{wall} - c_{wall} - (\phi_{wall} / 2) =$ **354.0** mm

Constant — $K_{wall} = M_{wall} / (b \times d_{wall}^2 \times f_{cu}) =$ **0.006**

Compression reinforcement is not required

Lever arm — $z_{wall} = \mathrm{Min}(0.5 + \sqrt{(0.25 - (\min(K_{wall}, 0.225) / 0.9))}, 0.95) \times d_{wall}$

$z_{wall} =$ **336** mm

Area of tension reinforcement required — $A_{s\_wall\_des} = M_{wall} / (0.87 \times f_y \times z_{wall}) =$ **177** mm²/m

Minimum area of tension reinforcement — $A_{s\_wall\_min} = k \times b \times t_{wall} =$ **520** mm²/m

Area of tension reinforcement required — $A_{s\_wall\_req} = \mathrm{Max}(A_{s\_wall\_des}, A_{s\_wall\_min}) =$ **520** mm²/m

Reinforcement provided — **12 mm dia.bars @ 150 mm centres**

Area of reinforcement provided — $A_{s\_wall\_prov} =$ **754** mm²/m

PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Basic span/effective depth ratio $ratio_{bas}$ = **20**

Design service stress $f_s = 2 \times f_y \times A_{s\_stem\_req} / (3 \times A_{s\_stem\_prov})$ = **229.9** N/mm^2

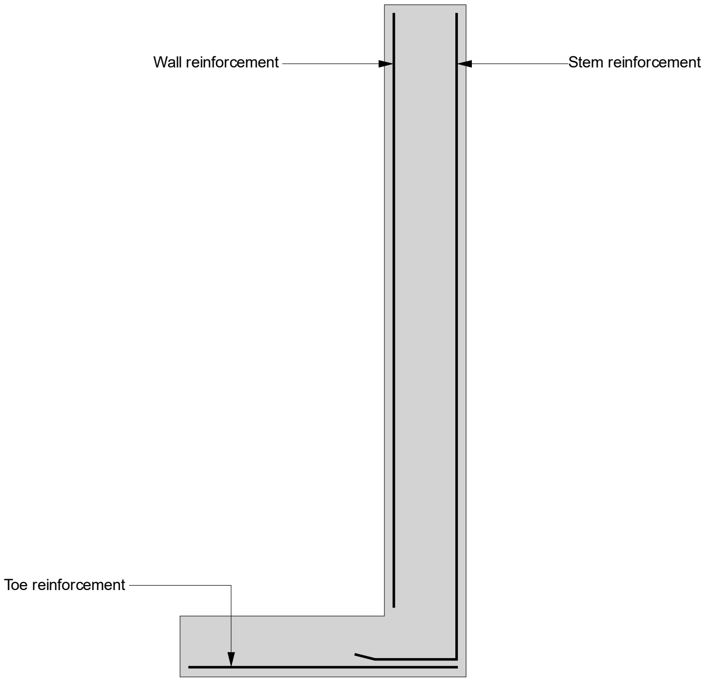
Modification factor $factor_{tens} = \min(0.55 + (477 \text{ N/mm}^2 - f_s)/(120 \times (0.9 \text{ N/mm}^2 + (M_{stem}/(b \times d_{stem}^2)))),2)$ = **2.00**

Maximum span/effective depth ratio $ratio_{max} = ratio_{bas} \times factor_{tens}$ = **40.00**

Actual span/effective depth ratio $ratio_{act} = h_{stem} / d_{stem}$ = **8.47**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 150 mm centres - (1340 mm^2/m)
Wall bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Stem bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)

Appendices 9 – Outline Movement Monitoring Strategy

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Drawing Status **INFORMATION**

REV	DETAIL	Dr	Ch	DATE
00	Sketch	JL	CC	2024/01/31

MONITORING OF STRUCTURE

SURVEY TARGETS ARE TO BE SECURELY FIXED TO THE PARTY WALL AT 1m ABOVE THE EXISTING GROUND FLOOR LEVEL.

INSTALL TARGETS IN AT LEAST THE FOLLOWING LOCATIONS: AT THE JUNCTION OF THE FRONT WALL/PARTY WALLS, THE REAR WALL/PARTY WALLS AND AT APPROXIMATELY 2m CENTRES BETWEEN THE FRONT AND REAR WALLS AS INDICATED ON THE DRAWING.

INSTALL AT LEAST 1 'CONTROL/BENCHMARK' TARGET AS INDICATED ON THE DRAWING ON HIGHWAY.

THE RELATIVE POSITION AND LEVEL OF THE TARGETS SHOULD BE CHECKED WEEKLY DURING EXCAVATION AND CONSTRUCTION OF THE BASEMENT.

THE RESULTS SHOULD BE LOGGED AND PLOTTED TO AN EXAGGERATED VERTICAL SCALE TO HIGHLIGHT EVIDENCE OF ANY MOVEMENT.

THE LOGS SHOULD INCLUDE TRIGGER LEVELS (E.G. A RED LINE AT ±8mm EITHER SIDE OF THE INITIAL PRE BASEMENT WORKS READING).

THE WEEKLY LOGS SHOULD BE ASSESSED AND INTERPRETED BY THE MONITORING SURVEYORS AND ISSUED WEEKLY TO THE PARTY WALL SURVEYORS.

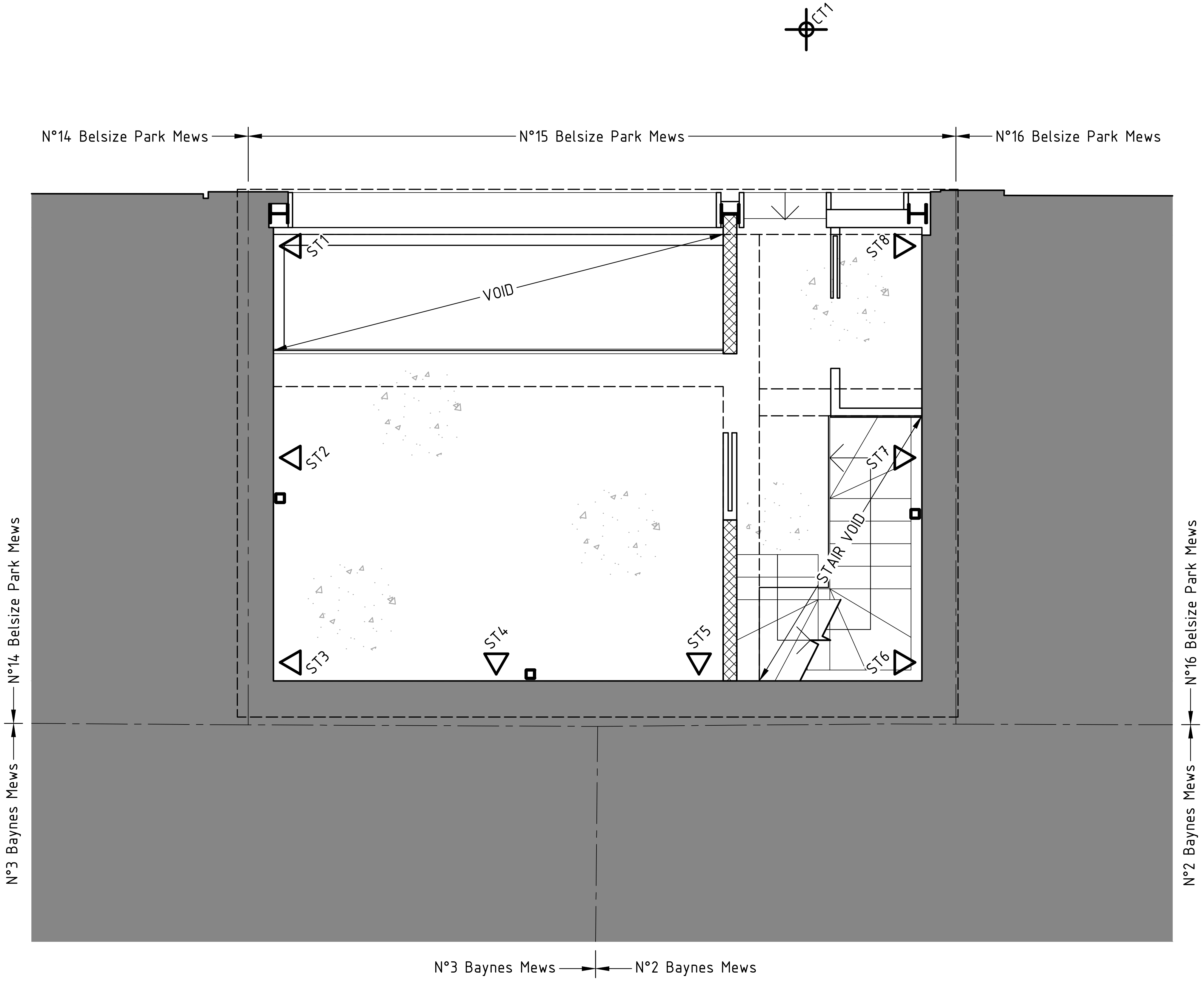
MOVEMENT LIMITS AND ACTIONS ARE AS FOLLOWS;

- GREEN LIMIT: 2.5mm (PLAN AND LEVEL), OR CRACKING IN ADJACENT PROPERTIES OF >1mm. ACTION – MOVEMENT MONITORING TO BE INCREASED TO MINIMUM OF WEEKLY VISITS.
- AMBER LIMIT: 5mm (PLAN AND LEVEL), OR CRACKING IN ADJACENT PROPERTIES OF >2mm. ACTION – GENERAL PHOTOGRAPHS OF SITE TO BE ISSUED TO SURVEYORS AND ENGINEERS FOR IMMEDIATE REVIEW. PROJECT ENGINEERS AND SURVEYORS TO MEET ON SITE WITHIN 10 WORKING DAYS TO REVIEW THE CONSTRUCTION AND AGREE FURTHER ACTION. MOVEMENT MONITORING TO BE INCREASED TO MINIMUM OF WEEKLY VISITS.
- RED LIMIT: 8mm (PLAN AND LEVEL), OR CRACKING IN ADJACENT PROPERTIES OF >5mm. ACTION – ALL WORKS TO STOP. ALL OPEN EXCAVATIONS TO BE BACKFILLED TO WITHIN 1.0m OF ADJOINING OWNERS' PROPERTY GROUND LEVEL AT CLOSEST BOUNDARY. PROJECT ENGINEERS AND SURVEYORS TO BE INFORMED IMMEDIATELY AND TO IDEALLY MEET WITHIN 48 HOURS, BUT NO LATER THAN 6 WORKING DAYS, TO DETERMINE HOW TO COMPLETE THE BASEMENT STRUCTURE.

THERE ARE SPECIALIST SURVEYING COMPANIES WHO PROVIDE MOVEMENT MONITORING SERVICES. WE SUGGEST THE USE 25x25mm YELLOW PRISMATIC TARGETS OR SIMILAR.

ANNOTATION KEY

MARK	DESIGNATION
ST	SURVEY TARGET (25x25 YELLOW PRISMATIC TARGET OR SIMILAR)
CT	CONTROL/BENCHMARK TARGET (GROUND SPIKE WITH FLAT CAP)



Client: Electron Holdings Management Ltd.
Project: 15 Belsize Park Mews, London, NW3 5BL
Title: Structural Monitoring Sheet 1 Notes & Target Positions
Project N°: 23066
Drawing N°: SK11
Rev: 00
Date: Jan 2024
Drawn: JL
Scale @A3: 1:50
Engineer: CC

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