BAKER STRUCTURAL DESIGN CHATTERTON

Construction Method Statement

124 St Pancras Way, NW1 9NB

Ref: J416-S-RP-001
Status: Issued for Information
Rev: 01

Baker Chatterton Structural Design Limited
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Contents

Revision	Status	Written by:	Checked by:	Issue Date
00	Issued for Information	DJC	AB	12.07.2023
01	Issued for Information	DJC	AB	18.07.2023

1.0 Introduction and Brief

Baker Chatterton Structural Design have been appointed by Anya Thomas to carry out the structural design for the proposed refurbishment of 124 St Pancras Way.

This report has been prepared for the client noted above. This report shall not be relied upon by other parties without the express written authority of Baker Chatterton Structural Design. Neither the whole nor any part of this report, nor any reference there to, may be included in any document or statement, nor may it be published in any way without our prior approval in writing as to the form or content in which it will occur.

2.0 Experience and Qualifications of Author

The author of this note, Dylan Julian Chatterton, is a chartered structural engineer (MIStructE) and has worked on refurbishment projects across London and the South of England for over 9 years. In that time, he has a accrued a wide range of experience in the adaption and re-construction of existing buildings, including for new sub-structures, and understands the details and risks involved when working with existing structures, especially basements.

3.0 Existing Property

3.1 Site Description

The existing property is located on St Pancras Way, within the Camden borough. The site bound by Royal College Street and Wilmot Place.

Camden Road over ground station is located approximately 100m away to the South.

College Gardens sits opposite the site, a local green space, lined by large Lime trees.

The building is a mid-terrace property likely constructed in the Victorian era.

The main house towards the front comprises of four floors, including a Lower Ground Floor. Access to the Lower Ground Floor is provided by a lightwell to the front.

The outrigger to the rear comprises three floors, with the levels staggered from the main house, with access provided off the existing stair well.

The outrigger rear elevation is stepped in over the three floors, with the upper two floors appearing to be a more recent addition. Below the ground floor is a raised voided area, currently used as storage.

There is a single storey projection off the Lower Ground Floor to the rear that contains a WC.

The existing garden level sits level with the Ground Floor of the outrigger, with steps down the main Lower Ground Floor. A large tree is positioned within the neighbours property next to the boundary wall.

3.2 Existing Structure

The existing structure comprises of timber joisted floors supported on load bearing timber stud spine wall internally and solid masonry walls externally.

The spine wall becomes masonry at Lower Ground Floor.

The load bearing masonry walls are supported on corbelled masonry footings. The depths vary for the main house and the outrigger an boundary walls.

This has been based on a combination of information gathered from our site walkover undertaken on 05.06.2023, our experience of working with similar properties and local trial pit investigations.

Image 1 – Photo of front elevation

3.3 Appraisal of Existing Structure

The structure appeared to be in reasonable condition.

No obvious defects or cracking were noted within the building. Some minor hairline cracking was noted around lintels and openings to the outrigger. These are not of structural concern.

The existing boundary wall with 122 St Pancras Way has partly collapsed at the rear of the property. This will need to be rebuilt during the works.

Image 2 – Photo of rear elevation

4.0 Proposed Works

4.1 Summary of the Proposed Works

The architectural proposals for the site have been provided by Scenario Architects. The structural alteration to the building includes:

- The full width extension of the existing lower ground floor below the rear garden and outrigger structure. With the construction of a new basement level below. The construction of the basement will require existing perimeter walls and rear elevation to be underpinned and strengthened with a reinforced concrete retaining structure. The basement slab will be formed of a new ground bearing slab.
- A new external lightwell at Lower Ground Floor level formed by new retaining walls
- A new GF outrigger extension and removal of load bearing outrigger walls at GF level.

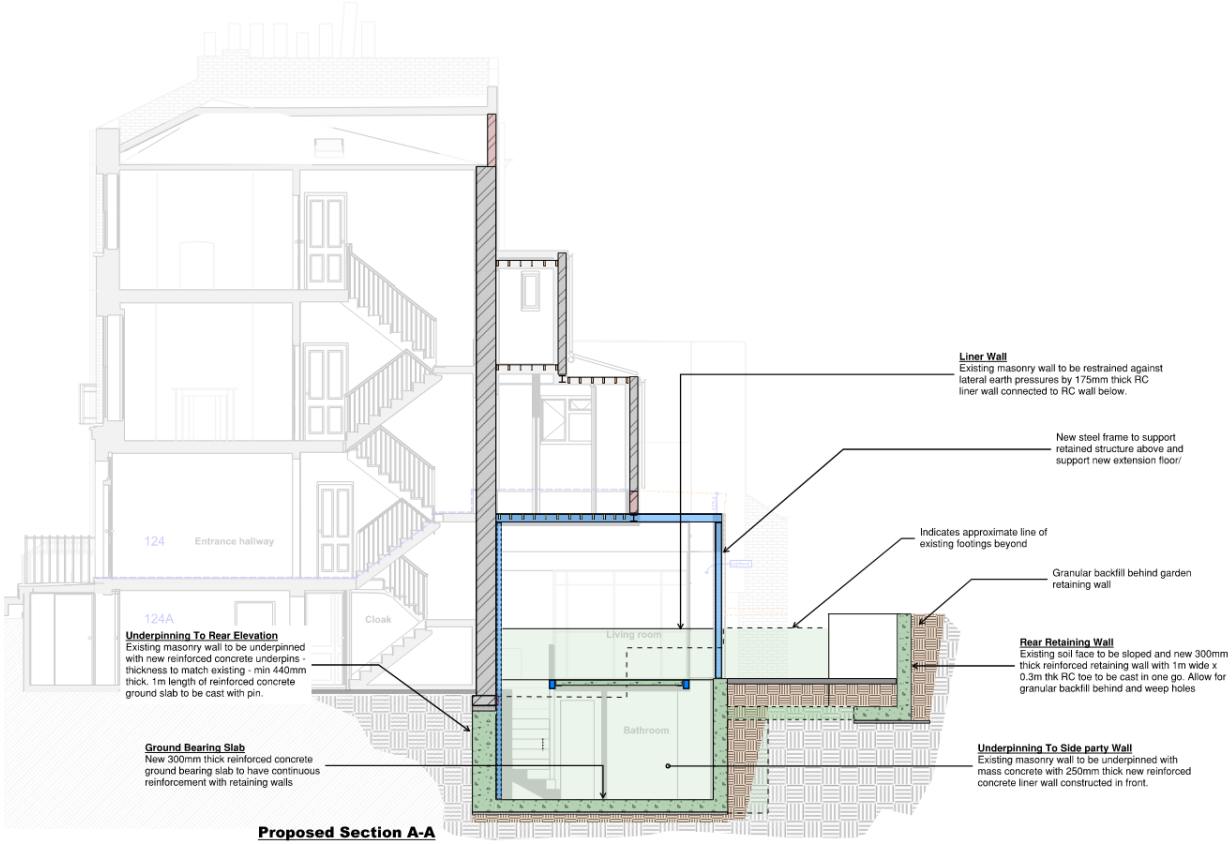


Image 3 – Proposed section through building

4.2 Basement Structure

The proposed basement extension will sit below the existing Lower Ground Floor extension.

The party walls and existing rear elevation will be underpinned in 1m wide strips.

The party walls will be underpinned in mass concrete supported on a mass concrete footing below basement level that will match the width of the existing. A new reinforced concrete retaining wall will be constructed inbound of the underpin to resist the lateral earth pressures.
The underpins below the rear elevation will be formed in reinforced concrete.

The retaining walls will act as propped cantilevers, with fixity at the base provided through the ground bearing slab, with propping at the head provided by the suspended Lower Ground Floor structure.

The reinforced concrete wall will project above the LGF to restrain the portion of masonry wall that sits below the neighbours ground level.

The basement floor will be a reinforced concrete ground bearing slab, constructed within the London Clay strata. The slab will act as a raft foundation spreading the vertical loads acting on it through the retaining wall structure.

The floor slab will be capable of resisting moments and shears enacted at the perimeter by the retaining walls, as well as uplift forces arising from heave and hydrostatic pressures.

Heave forces have been determined from the geotechnical site investigation and included within the Basement Impact Assessment.

Hydrostatic pressures for the design of retaining walls have calculated based on a water table 1m below ground level. While for bouncy, it has been assumed to be acting at the existing Lower Ground Floor level, after which, any water level rises would affect all of the surrounding properties.

4.3 Lower Ground Extension

The Lower Ground Floor will be suspended over the basement and formed using precast concrete beam and block system. The floor will span between the retaining walls and internal steel beam framing.

A structural topping will tie the floor together and allow it to act as a diaphragm, resisting the lateral forces applied by the retaining walls.

The external lightwell will be formed of reinforced concrete cantilever retaining walls, designed to resist overturning.

Water pressures will be limited by providing weep holes at regular centres and granular backfill behind the walls.

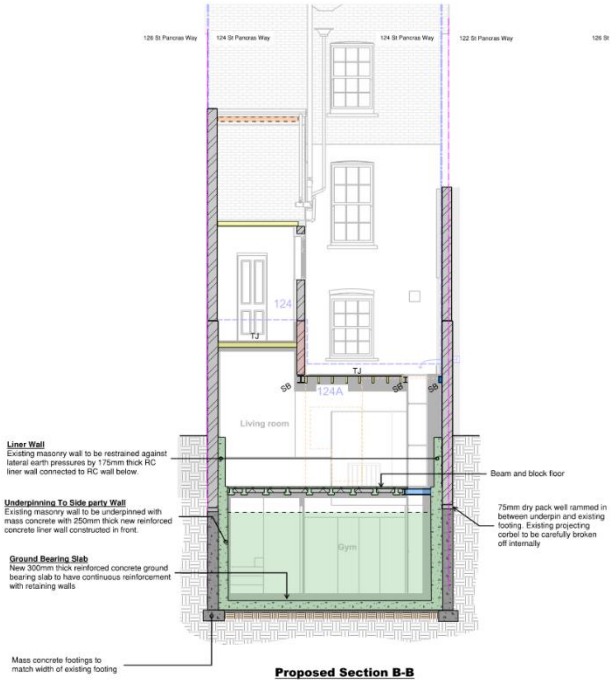


Image 4 – Proposed section through Party Walls

4.5 Ground Floor Outrigger Extension

It is proposed to demolish the existing masonry walls at Ground Floor to the outrigger and the suspended timber ground floor, and extend over the proposed extent of the new Lower Ground Floor.

The extension above LGF will be framed internally in structural steel members and a timber joist infill floor.

The new framing will support the existing solid masonry walls to the outrigger above and transfer the vertical load to the proposed ground bearing slab at Lower Ground Floor.

4.6 Opening within Rear Elevation

It is proposed to form a new wide opening within the existing load bearing rear elevation at Lower Ground Floor, to provide improved access to the new Lower Ground Floor extension. The existing masonry above will be supported on a new steel frame.

Deflections will be limited at mid span to limit the risk of movement within the masonry elevation above.

4.7 Waterproofing

The overall waterproofing strategy is to be confirmed by the architect.

The new lower ground sub-structure is to be formed using water-resistant concrete that uses a SIKA additive, or similar approved.

The basement walls have been designed to limit crack widths to 0.3mm in accordance with typical manufacturer guidance for water proof additives.

Hydrophilic water bars are to be laid across all construction joints within the basement.

4.8 Below Ground Drainage

The design of the below ground drainage is to be by others. RC pits will need to be formed within the suspended basement slab to maintain a waterproof barrier and resist heave forces arising from the clay strata below.

4.9 Ground Movement and Damage Impact Assessment

The retaining walls have been designed so that the lateral deflections under normal loading combinations will limit any damage to the neighbouring properties to a maximum of Category 1, as outlined in the CIRIA Report 760 on embedded retaining walls.

Category 1 means that possible slight damage that will only require redecoration and possibly repointing.

A Ground Movement Assessment has been undertaken by MAUND GEO-CONSULTING LTD that has reviewed both lateral and vertical settlements, which confirms that the proposals sit within the limits noted above.

For further information, reference should be made to the GMA report.

5.0 Site Geology and Geotechnical Parameters

The geotechnical parameters used within the structural design for the basement is noted below.

The following soil profile has been taken from CGL's Basement Impact Assessment report from 2017, where on site investigations were undertaken.

Soil strata was recorded below the Lower Ground Floor:

- 0.0 to 0.6m – Made Ground
- 0.6m to 8.5m – Weathered London Clay becoming stiff

Water table was not struck within the window sample

The proposed basement has been designed to be positioned within the Weathered Clay formation.

The following geotechnical design parameters have been used:

- An allowable bearing pressure of 90kN/m^2 has been advised for foundations within the weathered clay layer within CGL's report. Additional capacity has been assumed when accounting for removal of overburden pressures due to excavation.

- Angle of shearing resistance for:
  - Made ground – 30 degrees
  - London Clay – 21 degrees (ka) The London Clay formation is taken as normally consolidated and ko pressures taken as 0.69.

- Active earth pressures have been assumed for cantilever retaining walls.

- At rest earth pressures taken for propped cantilever walls.

- Water levels assumed to act at 1m BGL in the accidental condition.

- Heave pressures are assumed to be 50% of the overburden, on the basis that the instant heave forces will occur during the construction.

- DS-3 and AC-2s class taken for new structure within clay layer.

6.0 Construction Methodology

6.1 Temporary Works

The anticipated temporary works and associated construction sequence required to safely form the new basement structure are indicated within Appendix B.

The final temporary works design and methodology will be the responsibility of the Main Contractor. Baker Chatterton will review any temporary works proposals prior to works commencing.

All cConstruction works are to be undertaken by a competent contractor and will be closely controlled in accordance with relevant building regulations and design codes. All ground works and underpinning are to be in accordance with BS EN 1197-1.

6.1.1 Outline Temporary Works Proposals

To form the underpins, the Contractor will have to form local excavations against the existing walls. These excavations are to be shored with trench sheeting restrained by regularly spaced acrow props.

Once underpinning works are complete, temporary propping will be required to restrain the existing masonry party walls at Lower Ground Floor, as well as the proposed basement retaining walls, to allow the site to be excavated and the basement box completed.

It is proposed to install temporary flying shores to the base of the existing party wall footings at the existing ground level to prevent movement during construction.

The head of the basement underpins are to be restrained by a temporary waler beam to the perimeter of the basement, propped at regular centres by flying shores. The base of the walls will be restrained by propping the RC toe to the underpin.

The rear wall of the basement will be cast in one go, assuming the earth can be safely battered back.

6.2 Basement Construction Sequence

The following construction sequence is given below. Baker Chatterton will visit site at the key stages to monitor the construction and ensure works are in keeping with the agreed methodologies.

Stage 1
Provide temporary propping to existing outrigger over the proposed basement, install props to base of existing party walls and demolish the walls below.

Stage 2
Excavate locally to form underpins. Lower trench sheeting and install acrow props as you dig down.

Stage 3
Cast mass concrete underpin, dry packing above to underside of existing footing. Cast RC liner wall and toe.

Stage 4
Backfill local excavation with excavated soil, compacting in layers. Remove trench sheeting and propping as you go.

Repeat stages 2 to 4 until all underpins are complete. Refer to Section 5.3

Stage 5
Locally excavate trench, shoring with trench sheeting and acrow props, to allow props to be installed against RC toes.

Stage 6
Excavate the rest of the site and cast the remaining ground bearing basement slab.

Stage 7
Cast the upstand retaining wall to restrain the existing masonry walls and construct the Lower Ground floor structure. Once the permanent works are constructed, remove the remaining temporary props.

6.3 Underpin Construction Notes

The Contractor should adhere to the following when undertaking underpinning works.

- New underpins assumed to be cast in typical underpin sequence: 1-3-5-2-4-6 - as indicated on plan
- Concrete underpinning to be carried out in maximum 1m bay lengths, as shown on GAs.
- Any reinforcing bars required to tie into the bottom slab are to be installed and left projecting into the soil until such time that they can be cast in.
- All pins are to be tied together with horizontal lapping bars. Bars are to be left projecting a minimum of 500mm into soil until adjacent pin can be cast.
- Contractor to allow a minimum of 3 days days after casting pin before moving onto the adjacent. Min 7 days between adjacent pins.
- The Engineer and Building Inspector are to be notified when excavations are ready to receive concrete and their approval obtained before concrete is placed.
- The excavations are to be kept dry at all times and the bottom is to be bottomed out immediately before concrete is placed.
- Pins to be temporarily propped until Basement and Lower Ground floor has been cast and sufficiently cured.
- The concrete is to be placed within 75mm of the underside of the existing foundations. After 24 hours the gap is to be packed with Fosroc Conbextra GP flowable grout and left for 48 hours before commencing the excavation on the next bay in the sequence.

6.4 Outline Monitoring Proposals

A structural monitoring strategy will be developed to ensure that the underpinning and ground works do not cause excessive movements to the neighbouring properties.

The Contractor is to carry out a pre-commencement condition survey of the existing party walls and front and rear facades to 22, 24 and 26 St Pancras Way.

6.4.1 Monitoring Locations

The Contractor is to install monitoring points to the rear façade and party walls. Final locations to be confirmed and agreed with the Party Wall Surveyors.

6.4.2 Trigger Levels

Trigger levels are to be based on a traffic light system “Green, Amber and Red”.

The trigger levels will be based on the GMA, and follow the following logic.

Green Trigger Action

- All ‘green’ readings shall be tabulated and reported to Engineer and Employer no later than weekly or within 48 hours of completion of greater interval regimes.
- Monitoring to be stepped up to weekly.
- The Contractor should highlight to the engineer the works that caused the movement and actions should be taken to limit further movement.

Amber Trigger Action

- All ‘amber’ readings shall be reported within 24 hours.
- General photographs of the site are to be issued to the surveyors and engineers for immediate review
- The project engineer and Surveyors are to be informed immediately and to meet on site within 10 working days to review the construction and agree further actions at the meeting with the contractor to immediately implement these as applicable.

Red Trigger Action

- Alll works are to stop and any excavations stabilised immediately.
- All ‘red’ readings shall be immediately notified by telephone to the key individuals.
- General photographs of the site are to be issued to the surveyors and engineers for immediate review

- The project engineer and Surveyors are to be informed immediately and to meet on site ideally within 48 hours but no later than 5 working days to determine how to review and agree way forward.

6.4.3 Monitoring Frequency

Recordings taken fortnightly initially. Then to become weekly during excavation works.

6.5 Site Management – Noise, Dust and Vibration Reduction

The works are required to be undertaken in accordance with all statutory legislation relating to construction works.

The Contractor will be required to demonstrate a positive attitude and commitment toward minimising environmental disturbance to local residents and will be required to be registered with the Considerate Contractors Scheme.

Noise, dust and vibration will be controlled by employing Best Practicable Means (BPM) as prescribed in the following legislative documents and the approved code of practice BS 5228:

- The Control of Pollution Act 1972
- The Health & Safety at Work Act 1974
- The Environmental Protection Act 1990
- Construction (Design and Management) Regulations 1994
- The Clean Air Act 1993

Certain measures to be adopted by the contractor include:

- Coordinated delivery times to avoid peak traffic.
- Ensuring all plant has sound reduction measures (mufflers, baffles or silencers).
- Strict adherence to the site working hours.
- Breaking out of existing slabs will be undertaken by saw cutting before breaking.
- All areas to be kept clean
- When breaking out and cutting the existing structure, the working area is to be kept suitably wetted, to minimise dust creation.

Appendix A – Proposed Drawings

BASEMENT CONSTRUCTION MONITORING NOTES
Movement monitoring to existing retaining walls required during construction to minimise risk of damage to neighbouring properties.

Contractor to undertake a condition survey of the property and the adjacent neighbouring walls prior to commencing site.

The Contractor is to notify the engineer if any changes to the walls condition occur during the works.

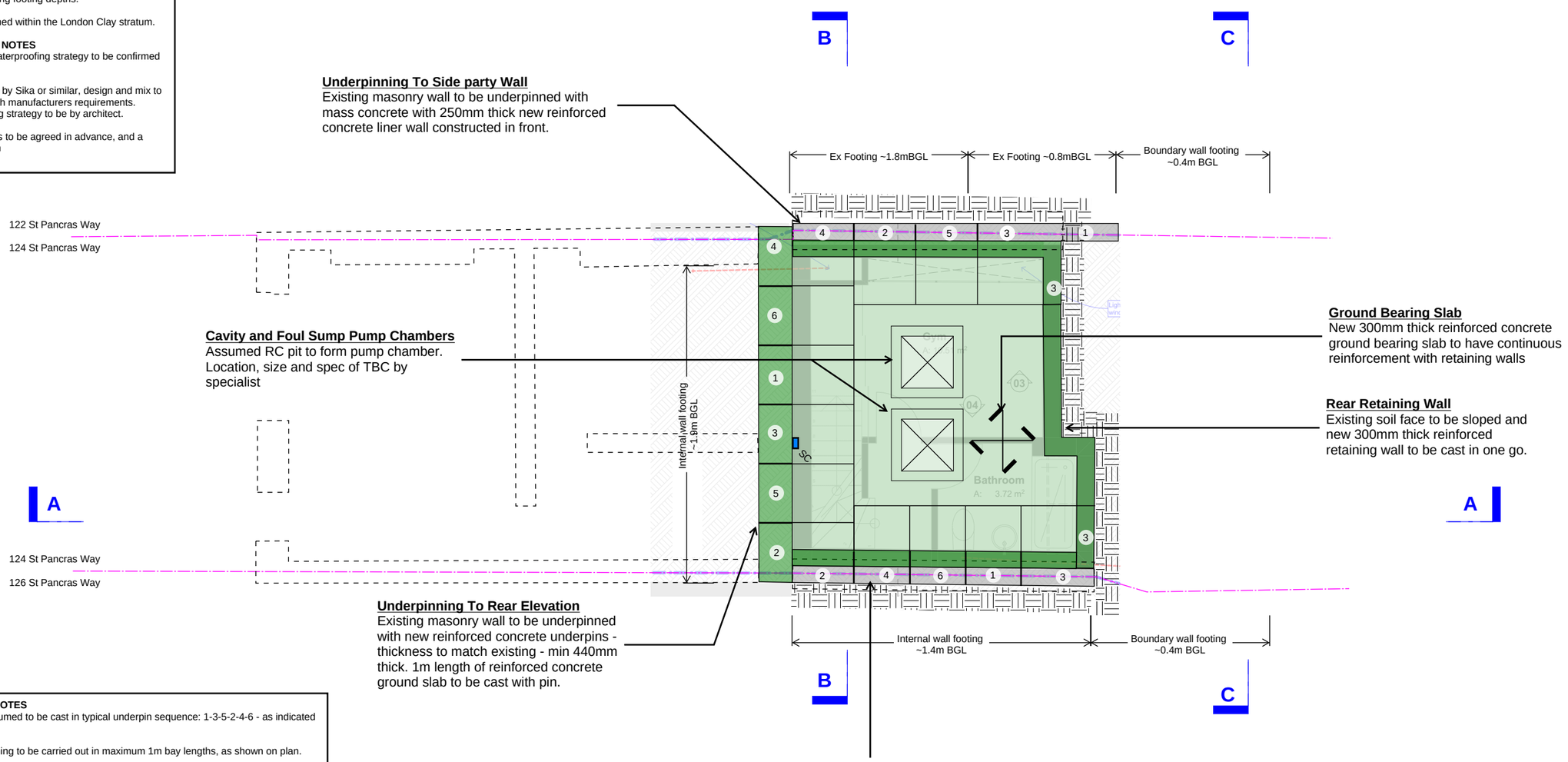
SITE GROUND INFORMATION
Contractor should refer to CGL Site Investigation report for information on the; site geology and hydrology; soil contamination; existing footing depths.

Basement to be formed within the London Clay stratum.

WATERPROOFING NOTES
Overall basement waterproofing strategy to be confirmed by architect.

Waterproof concrete by Sika or similar, design and mix to be in accordance with manufacturers requirements. Overall waterproofing strategy to be by architect.

All construction joints to be agreed in advance, and a waterstop bar cast in



Underpinning To Side party Wall
Existing masonry wall to be underpinned with mass concrete with 250mm thick new reinforced concrete liner wall constructed in front.

Cavity and Foul Sump Pump Chambers
Assumed RC pit to form pump chamber. Location, size and spec of TBC by specialist

Ground Bearing Slab
New 300mm thick reinforced concrete ground bearing slab to have continuous reinforcement with retaining walls

Rear Retaining Wall
Existing soil face to be sloped and new 300mm thick reinforced retaining wall to be cast in one go.

Underpinning To Rear Elevation
Existing masonry wall to be underpinned with new reinforced concrete underpins - thickness to match existing - min 440mm thick. 1m length of reinforced concrete ground slab to be cast with pin.

Underpinning To Side party Wall
Existing masonry wall to be underpinned with mass concrete with 250mm thick new reinforced concrete liner wall constructed in front.

UNDERPINNING NOTES
New underpins assumed to be cast in typical underpin sequence: 1-3-5-2-4-6 - as indicated on plan

Concrete underpinning to be carried out in maximum 1m bay lengths, as shown on plan.

Any reinforcing bars required to tie into top or bottom slabs are to be installed and left projecting into the soil until such time that they can be cast in.

All pins are to be tied together with horizontal B10 lapping bars. Bars are to be left projecting a minimum of 500mm into soil until adjacent pin can be cast.

Contractor to allow a minimum of 3 days days after casting pin before moving onto the adjacent. Min 7 days between adjacent pins.

The Engineer and Building Inspector are to be notified when excavations are ready to receive concrete and their approval obtained before concrete is place

The excavations are to be kept dry at all times and the bottom is to be bottomed out immediately before concrete is placed.

Pins to be temporarily propped until Basement and Lower Ground floor has been cast and sufficiently cured.

The concrete is to be placed within 75mm of the underside of the existing foundations. After 24 hours the gap is to be packed with Fosroc Conbextra GP flowable grout and left for 48 hours before commencing the excavation on the next bay in the sequence.

Proposed Lower Ground Floor Plan

BAKER STRUCTURAL DESIGN CHATTERTON

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Project:
124 St Pancras Way

Drawing Number:
J416-BC-SK-3080

Issued:
07.23

Drawn by:
DJC

Drawing Title:
Proposed Basement Floor

Rev:
P2

Scale:
NTS

Symbols Key
- Denotes moment connection
- Denotes floor span
- Denotes rafter span
- Denotes cranked beam

Abbreviations
J"x" - Timber Joists
DJ - Double Joists bolted together
TrJ - Triple Joists bolted together
TB"x" - Timber Beam
TC"x" - Timber Column
W"x" - Wall type
SB"x" - Steel Beam
SC"x" - Steel Column
L"x" - Lintel over
PS"x" - Concrete padstone
CU - Column Under

Notes:
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2. All dimensions to be checked on site by contractor
3. Drawing to be read in conjunction with general notes drawing
4. Where discrepancy occurs between specification and drawing, Engineer to be notified immediately
5. Temporary words design, method statement and construction sequence to be determined by contractor
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7. Contractor may allow for splicing of steelwork to aid erection if necessary, final design by contractor, to be coordinated with BC Structural Design.
8. Refer to architects details for fire protection of all elements
9. All foundations assumed to be founded a minimum of 1.0m BGL on natural undisturbed ground – to be checked by Building Control or an Approved Inspector – assumed bearing capacity – 100kN/m2. If adjacent to existing foundation, excavation to be stepped at 45degrees to avoid undermining. Foundations to be 450mm deep MC and a minimum of 450mm wide UNO.
10. All setting out to Architects information

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The Contractor is to notify the engineer if any changes to the walls condition occur during the works.

SITE GROUND INFORMATION
Contractor should refer to CGL Site Investigation report for information on the; site geology and hydrology; soil contamination; existing footing depths.

Basement to be formed within the London Clay stratum.

WATERPROOFING NOTES
Overall basement waterproofing strategy to be confirmed by architect.

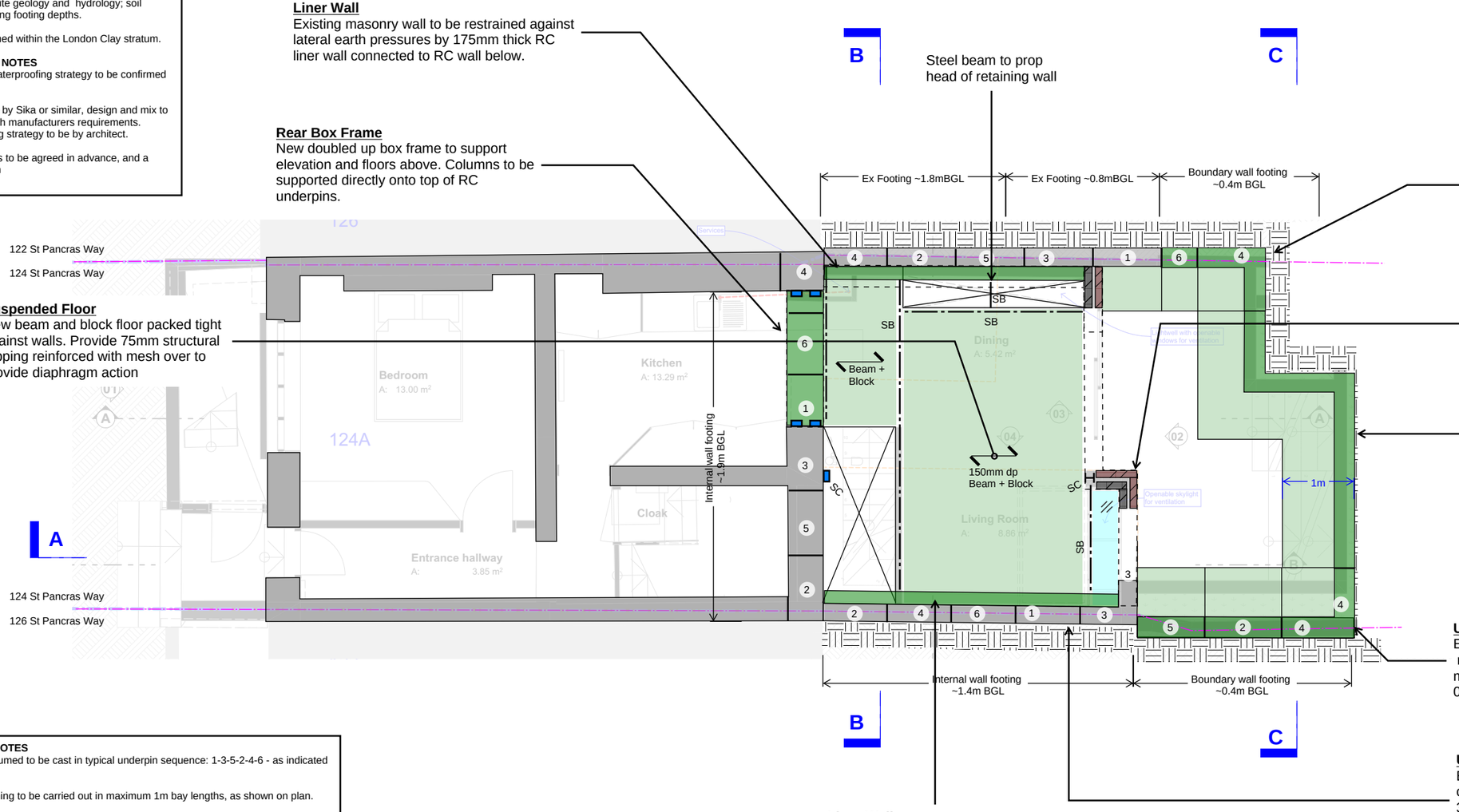
Waterproof concrete by Sika or similar, design and mix to be in accordance with manufacturers requirements. Overall waterproofing strategy to be by architect.

All construction joints to be agreed in advance, and a waterstop bar cast in

Liner Wall
Existing masonry wall to be restrained against lateral earth pressures by 175mm thick RC liner wall connected to RC wall below.

Rear Box Frame
New doubled up box frame to support elevation and floors above. Columns to be supported directly onto top of RC underpins.

Suspended Floor
New beam and block floor packed tight against walls. Provide 75mm structural topping reinforced with mesh over to provide diaphragm action



Underpinning To Side Boundary Wall
Existing masonry wall to be underpinned with new reinforced concrete underpin walls - thickness to match existing, min 300mm thick - with 1m wide x 0.3m thk RC toe to be cast in one go.

Load bearing masonry cavity wall to be constructed off basement wall below.

Rear Retaining Wall
Existing soil face to be sloped and new 300mm thick reinforced retaining wall with 1m wide x 0.3m thk RC toe to be cast in one go. Allow for granular backfill behind and weep holes

Underpinning To Side Boundary Wall
Existing masonry wall to be underpinned with new reinforced concrete underpin walls - thickness to match existing, min 300mm thick - with 1m wide x 0.3m thk RC toe to be cast in one go.

Underpinning To Side Party Wall
Existing masonry wall to be underpinned with new reinforced concrete underpin walls - thickness to match existing - min 330mm thick. Walls to be supported on 700mm wide x 400mm thick mass concrete strip footings below. 1m length of reinforced concrete ground slab to be cast with pin.

Liner Wall
Existing masonry wall to be restrained against lateral earth pressures by 175mm thick RC liner wall connected to RC wall below.

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Proposed Lower Ground Floor Plan

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Drawing Number:
J416-BC-SK-3090

Drawing Title:
Proposed Lower Gr Floor

Issued:
07.23

Drawn by:
DJC

Rev:
P2

Scale:
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Symbols Key
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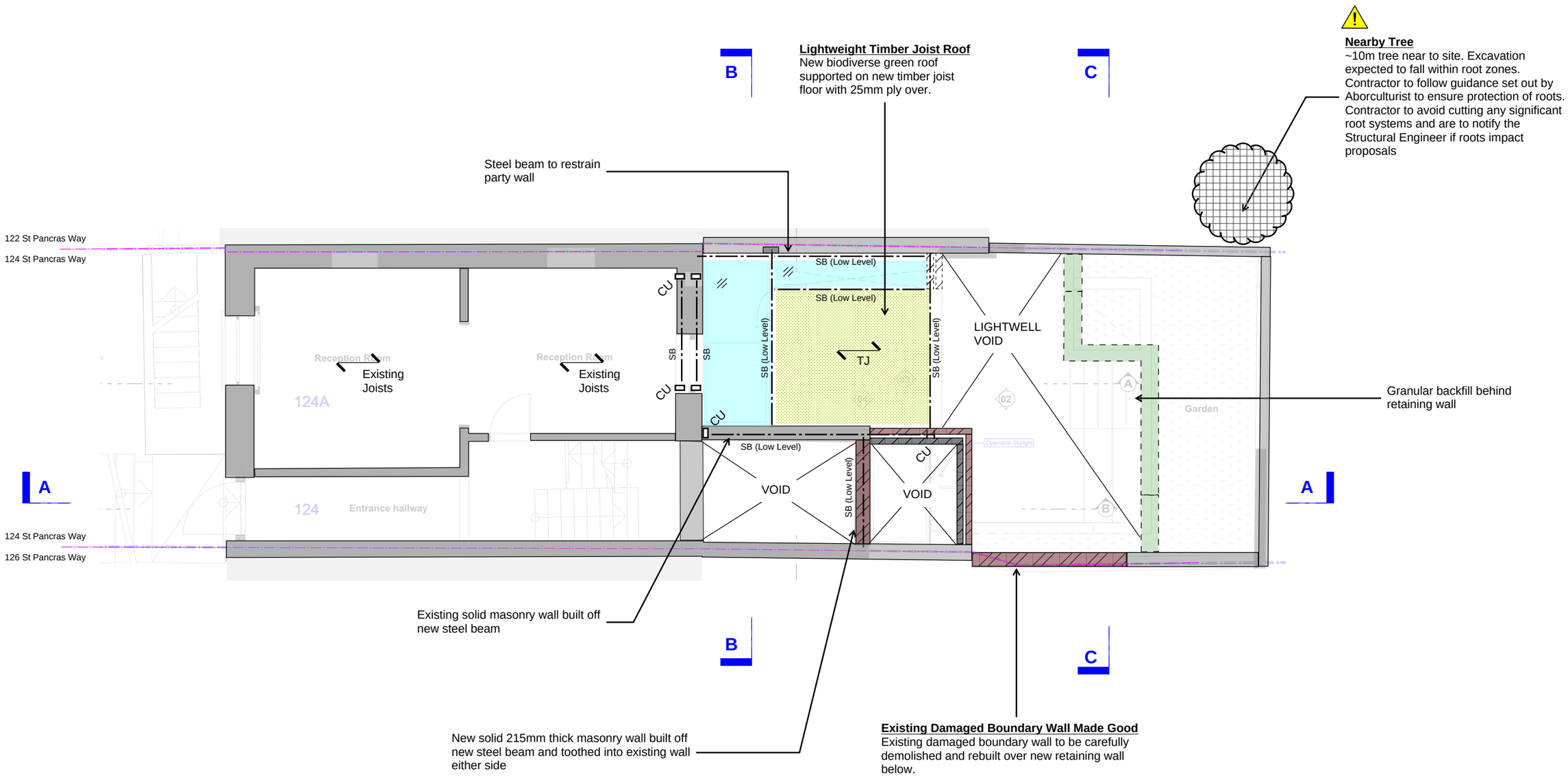

Proposed Ground Floor Plan

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Project:
124 St Pancras Way

Drawing Number:
J416-BC-SK-3100

Drawing Title:
Proposed Ground Floor

Issued:
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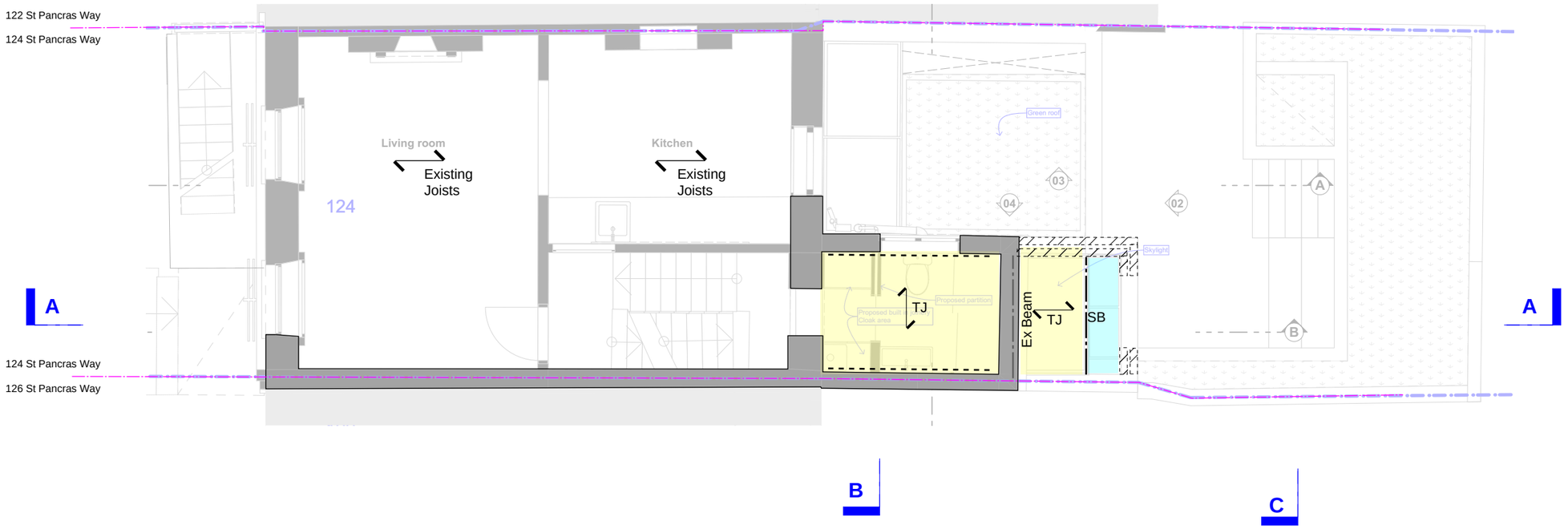

Proposed First Floor Plan

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Project:
124 St Pancras Way

Drawing Number:
J416-BC-SK-3110

Drawing Title:
Proposed First Floor

Issued:
07.23

Drawn by:
DJC

Rev:
P2

Scale:
NTS

Symbols Key

- Denotes moment connection
- Denotes floor span
- Denotes rafter span
- Denotes cranked beam

Abbreviations

J"x" - Timber Joists
DJ - Double Joists bolted together
TrJ - Triple Joists bolted together
TB"x" - Timber Beam
TC"x" - Timber Column
W"x" - Wall type
SB"x" - Steel Beam
SC"x" - Steel Column
L"x" - Lintel over
PS"x" - Concrete padstone
CU - Column Under

Notes:

1. Do not scale from these drawings
2. All dimensions to be checked on site by contractor
3. Drawing to be read in conjunction with general notes drawing
4. Where discrepancy occurs between specification and drawing, Engineer to be notified immediately
5. Temporary words design, method statement and construction sequence to be determined by contractor
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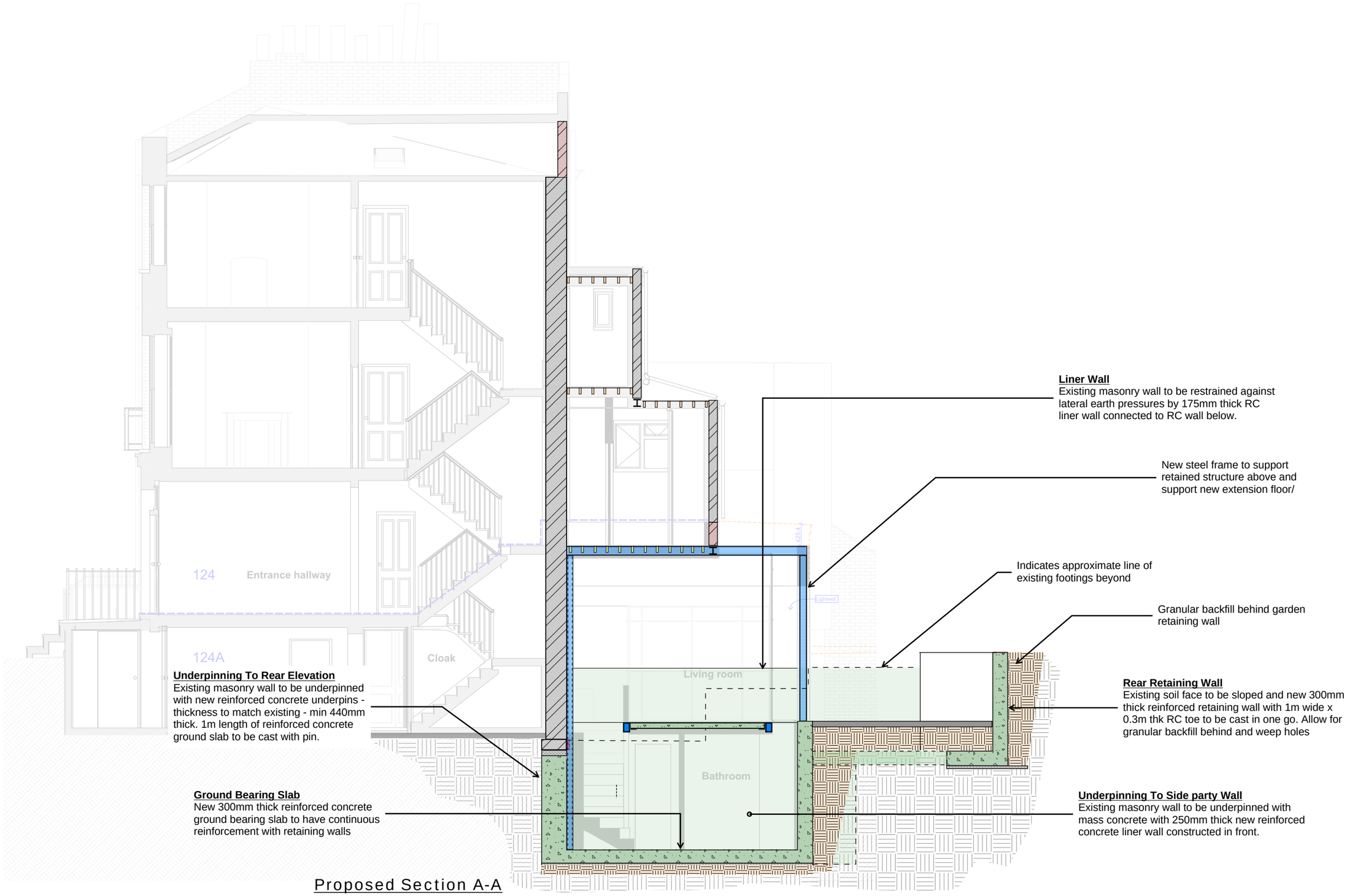
8. Refer to architects details for fire protection of all elements
9. All foundations assumed to be founded a minimum of 1.0m BGL on natural undisturbed ground – to be checked by Building Control or an Approved Inspector – assumed bearing capacity – 100kN/m2. If adjacent to existing foundation, excavation to be stepped at 45degrees to avoid undermining. Foundations to be 450mm deep MC and a minimum of 450mm wide UNO.
10. All setting out to Architects information



Liner Wall
Existing masonry wall to be restrained against lateral earth pressures by 175mm thick RC liner wall connected to RC wall below.

New steel frame to support retained structure above and support new extension floor/

Indicates approximate line of existing footings beyond

Granular backfill behind garden retaining wall

Underpinning To Rear Elevation
Existing masonry wall to be underpinned with new reinforced concrete underpins - thickness to match existing - min 440mm thick. 1m length of reinforced concrete ground slab to be cast with pin.

Rear Retaining Wall
Existing soil face to be sloped and new 300mm thick reinforced retaining wall with 1m wide x 0.3m thk RC toe to be cast in one go. Allow for granular backfill behind and weep holes

Ground Bearing Slab
New 300mm thick reinforced concrete ground bearing slab to have continuous reinforcement with retaining walls

Underpinning To Side party Wall
Existing masonry wall to be underpinned with mass concrete with 250mm thick new reinforced concrete liner wall constructed in front.

Proposed Section A-A

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Project:
124 St Pancras Way

Drawing Number:
J416-BC-SK-3200

Issued:
07.23

Drawn by:
DJC

Drawing Title:
Proposed Section A-A

Rev:
P2

Scale:
NTS

Symbols Key
- Denotes moment connection
- Denotes floor span
- Denotes rafter span
- Denotes cranked beam

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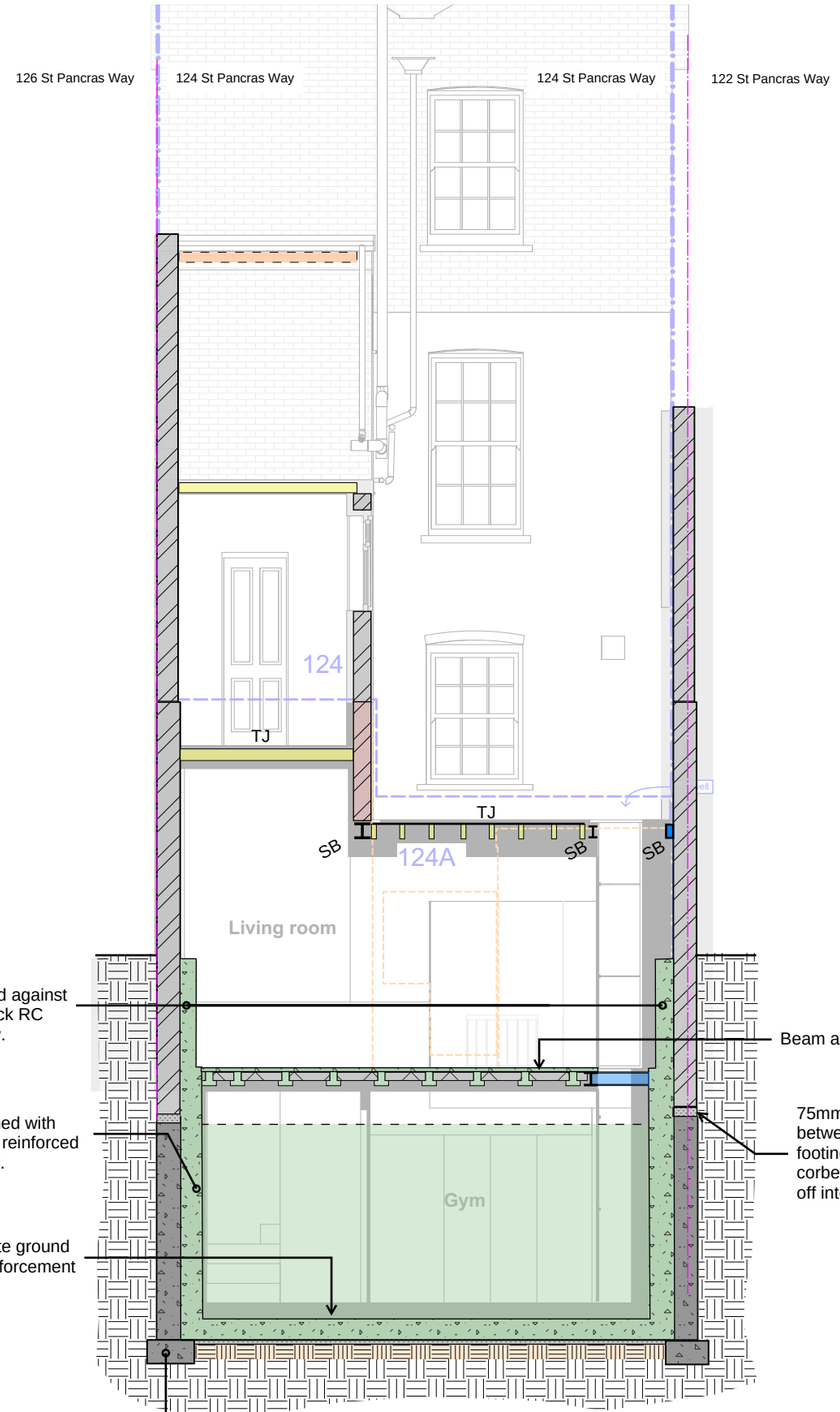
10. All setting out to Architects information



Liner Wall
Existing masonry wall to be restrained against lateral earth pressures by 175mm thick RC liner wall connected to RC wall below.

Underpinning To Side party Wall
Existing masonry wall to be underpinned with mass concrete with 250mm thick new reinforced concrete liner wall constructed in front.

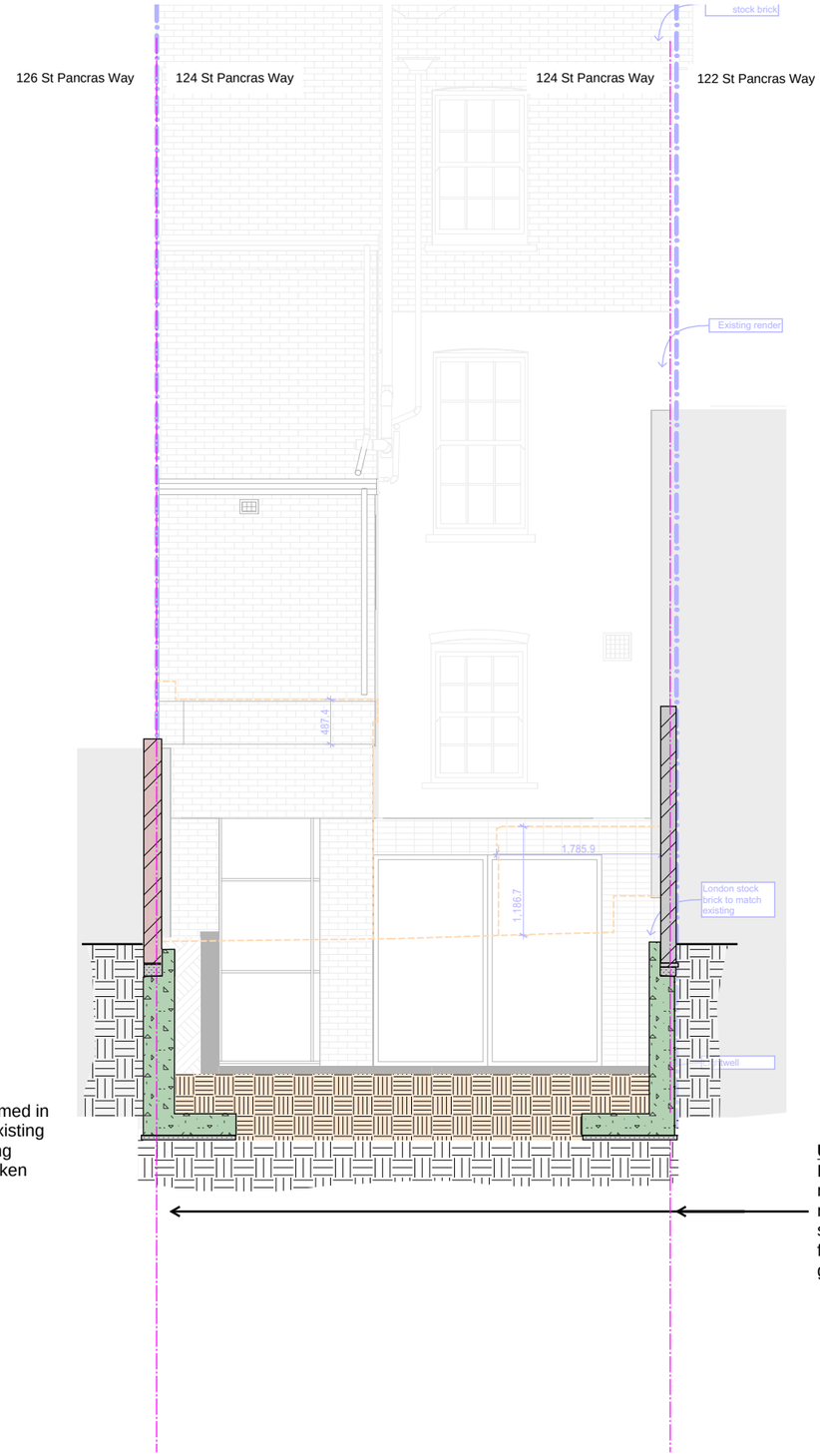
Ground Bearing Slab
New 300mm thick reinforced concrete ground bearing slab to have continuous reinforcement with retaining walls

Mass concrete footings to match width of existing footing

Beam and block floor

75mm dry pack well rammed in between underpin and existing footing. Existing projecting corbel to be carefully broken off internally

Proposed Section B-B



Underpinning To Side Boundary Wall
Existing masonry wall to be underpinned with new reinforced concrete underpin walls - thickness to match existing - min 300mm thick. Walls to be supported on 300mm thick mass concrete strip footings below. 1m length of reinforced concrete ground slab to be cast with pin.

Proposed Section C-C

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Project:
124 St Pancras Way

Drawing Number:
J416-BC-SK-3201

Issued:
07.23

Drawn by:
DJC

Drawing Title:
Proposed Section BB & CC

Rev:
P2

Scale:
NTS

Symbols Key
- Denotes moment connection
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- Denotes rafter span
- Denotes cranked beam

Abbreviations
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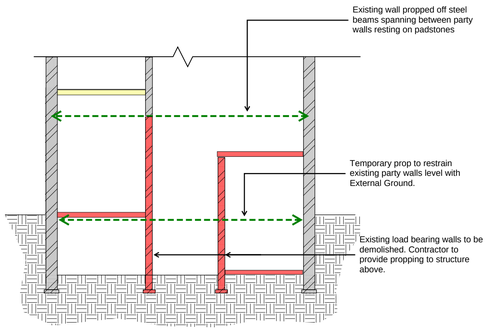
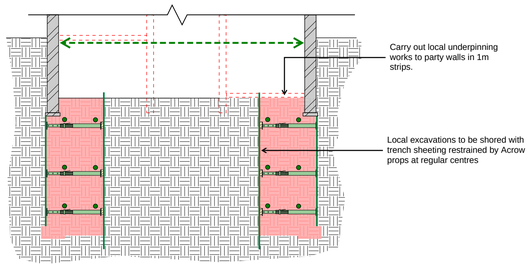
10. All setting out to Architects information

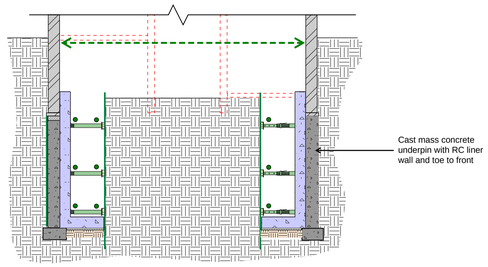
Appendix B – Outline Temporary Works Proposals



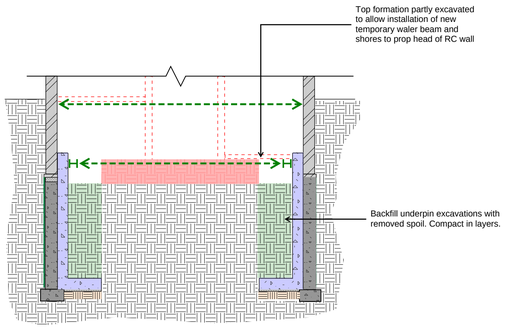
Stage 1



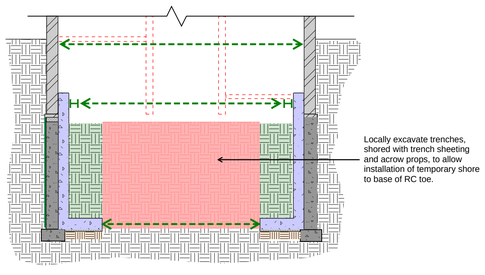
Stage 2



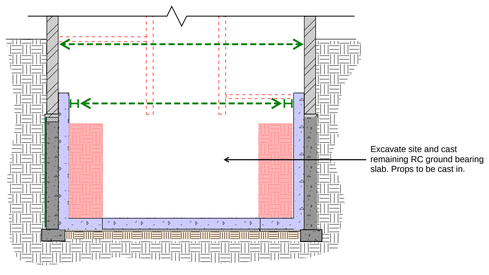
Stage 3



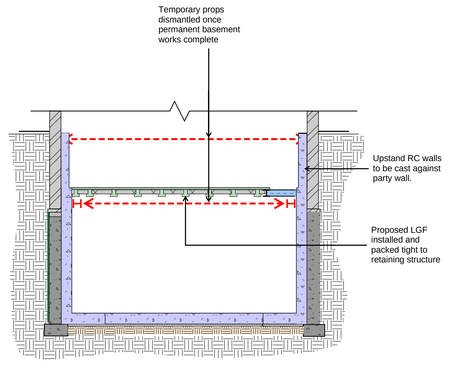
Stage 4



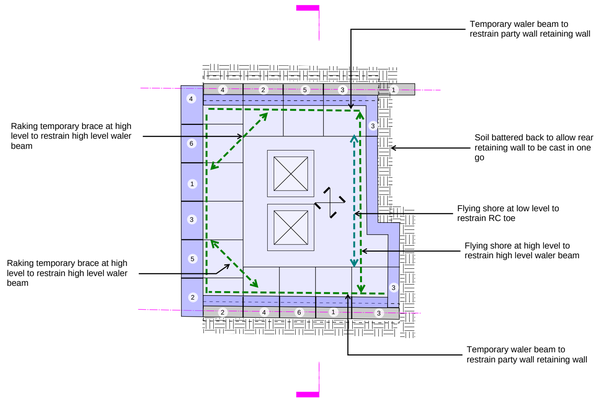
Stage 5



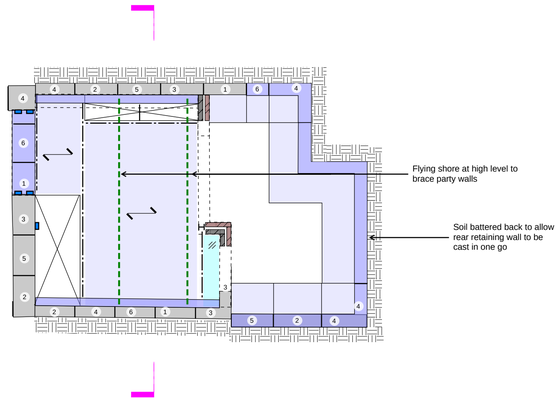
Stage 6



Stage 7



Basement Plan - Temporary Works Arrangement



Lower Ground Floor Plan - Temporary Works Arrangement

Notes:
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10. All setting out to Architects information

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Project:
124 St Pancras Way

Drawing Title:
Temporary Works

Drawing Number:
J416-BC-SK-4000

Issued: **07.23** Drawn by: **DJC**

Rev: **P1** Scale: **NTS**

Appendix C – Retaining Wall Calculations

Project name:	**124 St Pancras Way**				
Project Number:	**J416**	**Sheet:**		**Revision:**	**C1**
Date:	**18/07/2023**	**Engineer:**	**DJC**	**Checked:**	**AB**
Location:					

BAKER CHATTERTON STRUCTURAL DESIGN

New Basement Extension Assessment

It is proposed to extend the existing Lower Ground Floor below part of the rear garden and construct a basement level beneath the new extension
The new extension will require the rear elevation, the party walls and the boundary wall to be underpinned with new reinforced concrete walls
There will also be a new earth retaining wall to the rear garden elevation, not positioned on a boundary line.

On site soil investigations have been undertaken by CGL in 2017 who provided an interpretive report with findings
The basement structure will be located within London Clay strata

No water was struck in the 8.5m deep window sample.

The depths of the existing footings surrounding basement are as follows:

Main rear elevation	
122/124 SPW Party wall -Lower	1.8m NGL
122/124 SPW Party wall - Higher	0.8m BGL
122/124 SPW Boundary wall	Assumed 0.5m BGL
124/126 SPW Party wall	1.4m BGL
124/126 SPW Boundary wall	Assumed 0.5m BGL

The new reinforced concrete retaining walls to the basement will be designed to act as propped cantilevers with a fixed connection to the basement ground floor reinforced concrete slab
Restraint at the head of the wall to the LGF will be provided bu the LGF beam and block floor
Therefore, at rest earth pressures to be assumed for the basement structure as movements are limited.

The new retaining walls below the boundary walls will be treated as pure cantilevers
Therefore, active earth pressures will be assumed given that the head of the wall can rotate.

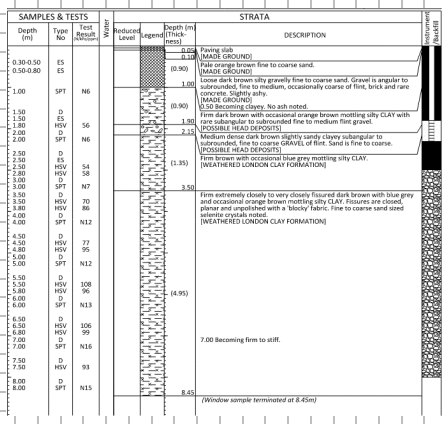
The structures will be assessed as one-way spanning 1-d elements using GSA oasys software

The basement slab structure will be stiff enough to spread loads from retaining walls across the extent of the floor to avoid peak bearing stresses
Retaining walls will not slide as they are all tied together at their base

The basement slab will resist heave pressures and accidental hydostatic uplift pressures

The site is noted as having 2.1m of made ground over weathered clay
The clay is considered to be normally consolidated based on a head of 2.1m

No water was recorded in window sample to depth of 8m.



Design Parameters

Soil paratemeters -

Soil density	Made ground	18	kN/m2		
	Clay	20	kN/m2		
Angle of shear resistance -					
	Made ground	30	degrees	*0.5236*	rad
	Ka	**0.33**			
	Clay	21	degrees	*0.36652*	rad
	Ka	**0.47**			
	Ko	**0.69**	for normally consolidated clay		
Allowable Bearing Pressure in weathered clay		90	kN/m2		
Water table -		1	m BGL	in accidental condition only given no water found in excavation	

Concrete parameters

All concrete to be C32/40
Long term effective stiffness (EI) to be taken conservatively as 25% to account for logn term creep and cracking of slab

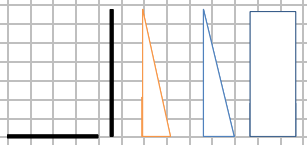
Project name:	**124 St Pancras Way**				
Project Number:	**J416**	**Sheet:**	**1**	**Revision:**	**C1**
Date:	**18/07/2023**	**Engineer:**	**DJC**	**Checked:**	**AB**
Location:					

BAKER CHATTERTON STRUCTURAL DESIGN

Retaining Wall - Rear Elevation Underpinning

Underpin below existing rear elevation
Existing masonry wall 440mm thick at LGF level
Cantilever wall free to rotate at head - therefore active pressures considered

Wall height =	2.4	m
retained soil height =	2.4	m
Base support condition	Fixed	
support condition	Free	

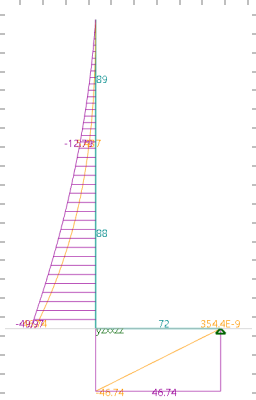


Soil Properties

Soil behind wall =	made ground		
Soil Density =	18	kN/m3	
Angle of shear resist. =	21	degrees	0.37 radians
Ka =	0.47		

Height of water table below Ground = 1 m — water table below proposed SSL - only consider in accidental condition as acting at existing slab level - conservative

Loading	Depth 0 m BGL	Depth 1.0 m BGL	Depth 2.4 m BGL
F, Earth pressure =	**0.0 kN/m**	**8.5 kN/m**	**20.4 kN/m**
F, Water pressure @ base (accidental) =	**0.0 kN/m**	**0.0 kN/m**	**14.0 kN/m**
Surcharge at Ground =	*10.0 kN/m2*	*10.0 kN/m2*	*10.0 kN/m2*
F, Surcharge pressure at base =	**4.7 kN/m**	**4.7 kN/m**	**4.7 kN/m**

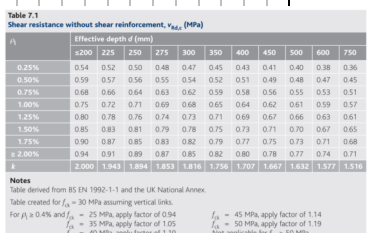


Forces
Wall to be reviewed in GSA - see output

	Stem		Base	
M,ed ULS =	47	kNm/m	47	kNm/m
Shear, ULS =	50	kN/m	50	kN/m

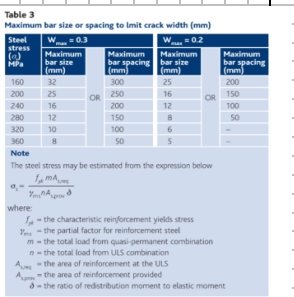
Concrete Section Design

					Stem		Base		
Concrete grade	C	32	/40						
Reinforcement grad	B	500	B						OKAY
Depth of section =					440.0	mm	300.0	mm	
Cover =					85.0	mm	60.0	mm	
Effective Depth =					355.0		240.0		
k =					0.01165		0.0255		
Z =					337.25	mm	228	mm	
As,req =					320	mm2	474	mm2	
As, prov:					**565**	**mm2**	**565**	**mm2**	
No. of bars =					5		5		
Diameter					12	mm	12	mm	
Shear Stress V,ed =					0.14826	N/mm2	0.2193	N/mm2	
Vrd,max =					**3.4**	**N/mm2**	**3.4**	**N/mm2**	
V,rd,c =					**0.37**	**N/mm2**	**0.45**	**N/mm2**	
% reinforcement provided =					0.2%		0.2%		
k =					1.75059		1.91287		
spacing of links =					0	mm	0	mm	OKAY
Min Shear reinforcement =					0	mm2	0	mm2	
Asw, prov:					**0**	**mm2**	**0**	**mm2**	
No. of legs =									
Diameter =					8	mm	8	mm	



Cracking
Limited to W,max =0.3

f,yk =	**500.00**		**500.00**
M,quasi =	33.57		33.57
Mquasi / MULS =	0.71		0.71
redistribution factor =	0.85		0.85
Stress in bars =	175.95	N/mm2	260.25 N/mm2
B12 okay - OKAY			



Project name:	**124 St Pancras Way**				
Project Number:	**J416**	**Sheet:**	**1**	**Revision:**	**C1**
Date:	**18/07/2023**	**Engineer:**	**DJC**	**Checked:**	**AB**
Location:					

BAKER CHATTERTON STRUCTURAL DESIGN

Retaining Wall - 122/124 Party Wall Elevation Underpinning - Low Level

Wall to sit infront of mass concrete underpin and be propped at LGF and cantilever up to restrain existing masonry wall
The wall is stiff below LGF so allow for Ko forces to develop
Cantilever flexible enough that Ka can be used

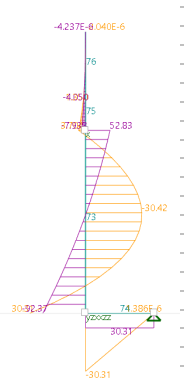
Wall height =	4	m	
retained soil height =	4	m	
Base support condition	Fixed		
LGF Prop	simple	at 1.4m BGL	
Top of wall	free		

Soil Properties

Soil behind wall =	made ground at head, clay below		
Soil Density =	18	kN/m3	
Angle of shear resist. =	30	degrees	0.52 radians
Ka =	0.33		
ko =	0.69	for normal consolidated clay	

Height of water table below Ground = 1 m water table below proposed SSL - only consider in accidental condition as acting at existing slab level - conservative

Loading	Depth 0 m BGL		Depth 1.0 m BGL		Depth 1.4 m BGL		Depth 4.0 m BGL	
F, Earth pressure =	**0.0**	**kN/m**	**6.0**	**kN/m**	**17.4**	**kN/m**	**49.7**	**kN/m**
F, Water pressure @ base (accidental) =	**0.0**	**kN/m**	**0.0**	**kN/m**	**4.0**	**kN/m**	**30.0**	**kN/m**
Surcharge at Ground =	*10.0*	*kN/m2*	*10.0*	*kN/m2*	*10.0*	*kN/m2*	*10.0*	*kN/m2*
F, Surcharge pressure at base =	**3.3**	**kN/m**	**3.3**	**kN/m**	**6.9**	**kN/m**	**6.9**	**kN/m**



Forces
Wall to be reviewed in GSA

B20@ 150mm centres in tension face suitable for wall

	Lower Wall + Stem		Upper Wall	
M,ed ULS =	30	kNm/m	9	kNm/m
Shear, ULS =	93	kN/m	15	kN/m

Concrete Section Design

					Lower Wall + Stem		Upper Wall		
Concrete grade	C	32	/40						
Reinforcement grad	B	500	B						
				Depth of section =	250.0	mm	175.0	mm	OKAY
				Cover =	60.0	mm	60.0	mm	
				Effective Depth =	190.0		115.0		
				k =	0.02597		0.02032		
				Z =	180.5	mm	109.25	mm	
				As,req =	382	mm2	181	mm2	
				As, prov:	**1571**	**mm2**	**565**	**mm2**	
				No. of bars =	5		5		
				Diameter	20	mm	12	mm	
				Shear Stress V,ed =	0.51524	N/mm2	0.1373	N/mm2	OKAY
				Vrd,max =	**3.4**	**N/mm2**	**3.4**	**N/mm2**	
				V,rd,c =	**0.72**	**N/mm2**	**0.61**	**N/mm2**	
				% reinforcement provided =	0.9%		0.5%		
				k =	2		2		
				spacing of links =	0	mm	0	mm	OKAY
				Min Shear reinforcement =	0	mm2	0	mm2	
				Asw, prov:	**0**	**mm2**	**0**	**mm2**	
				No. of legs =					
				Diameter =	8	mm	8	mm	

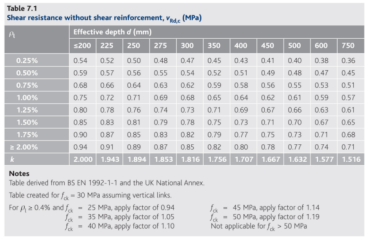


Table 7.1
Shear resistance without shear reinforcement, $v_{Rd,c}$ (MPa)

ρ_l	Effective depth d (mm)										
	≤200	225	250	275	300	350	400	450	500	600	750
0.25%	0.54	0.52	0.50	0.48	0.47	0.45	0.43	0.41	0.40	0.38	0.36
0.50%	0.59	0.57	0.56	0.55	0.54	0.52	0.51	0.49	0.48	0.47	0.45
0.75%	0.68	0.66	0.64	0.63	0.62	0.59	0.58	0.56	0.55	0.53	0.51
1.00%	0.75	0.72	0.71	0.69	0.68	0.65	0.64	0.62	0.61	0.59	0.57
1.25%	0.80	0.78	0.76	0.74	0.73	0.71	0.69	0.67	0.66	0.63	0.61
1.50%	0.85	0.83	0.81	0.79	0.78	0.75	0.73	0.71	0.70	0.67	0.65
1.75%	0.90	0.87	0.85	0.83	0.82	0.79	0.77	0.75	0.73	0.71	0.68
≥ 2.00%	0.94	0.91	0.89	0.87	0.85	0.82	0.80	0.78	0.77	0.74	0.71
k	2.000	1.943	1.894	1.853	1.816	1.756	1.707	1.667	1.632	1.577	1.516

Notes
Table derived from BS EN 1992-1-1 and the UK National Annex.
Table created for f_{ck} = 30 MPa assuming vertical links.
For $\rho_l \geq 0.4\%$ and f_{ck} = 25 MPa, apply factor of 0.94; f_{ck} = 35 MPa, apply factor of 1.05; f_{ck} = 40 MPa, apply factor of 1.10; f_{ck} = 45 MPa, apply factor of 1.14; f_{ck} = 50 MPa, apply factor of 1.19; Not applicable for f_{ck} > 50 MPa

Cracking
Limited to W,max =0.3

					Lower Wall + Stem		Upper Wall	
				f,yk =	**500.00**		**500.00**	
				M,quasi =	21.43		6.14	
				Mquasi / MULS =	0.71		0.71	
				redistribution factor =	0.85		0.85	
				Stress in bars =	75.54	N/mm2	99.38	N/mm2
				B20 - OKAY				

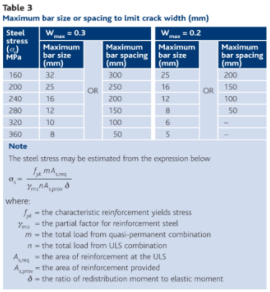


Table 3
Maximum bar size or spacing to limit crack width (mm)

Steel stress (σ_s) MPa	W_{max} = 0.3 Maximum bar size (mm)		Maximum bar spacing (mm)		W_{max} = 0.2 Maximum bar size (mm)		Maximum bar spacing (mm)	
160	32		300		25		200	
200	25	OR	250	OR	16	OR	150	
240	16		200		12		100	
280	12		150		8		50	
320	10		100		6		–	
360	8		50		5		–	

Note
The steel stress may be estimated from the expression below

$$\sigma_s = \frac{f_{yk} m A_{s,req}}{\gamma_{m,ft} n A_{s,prov} \delta}$$

where:
f_{yk} = the characteristic reinforcement yields stress
$\gamma_{m,s}$ = the partial factor for reinforcement steel
m = the total load from quasi-permanent combination
n = the total load from ULS combination
$A_{s,req}$ = the area of reinforcement at the ULS
$A_{s,prov}$ = the area of reinforcement provided
δ = the ratio of redistribution moment to elastic moment

Project name:	**124 St Pancras Way**				
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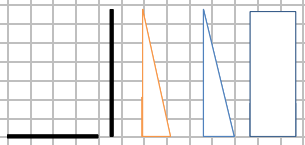
Date:	**18/07/2023**	**Engineer:**	**DJC**	**Checked:**	**AB**
Location:					

BAKER CHATTERTON STRUCTURAL DESIGN

EXTERNAL Retaining Wall - 122/124 and 124/126 Party Wall and rear garden retaining wall

External retaining wall below boundary wall
Wall to have drainage holes - to avoid water at back
See next page for global checks on soil and toe

Wall height =	1.8	m
retained soil height =	1.8	m
Base support condition	Fixed	
support condition	Free	

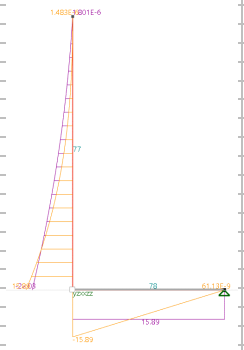


Soil Properties

Soil behind wall =	made ground			
Soil Density =	18	kN/m3		
Angle of shear resist. =	30	degrees	0.52	radians
Ka =	0.33			

Height of water table below Ground = 1 m — water table below proposed SSL - only consider in accidental condition as acting at existing slab level - conservative

Loading	Depth 0 m BGL		Depth 1.8 m BGL	
F, Earth pressure =	**0.0**	**kN/m**	**10.8**	**kN/m**
F, Water pressure @ base (accidental) =	**0.0**	**kN/m**		**kN/m**
Surcharge at Ground =	*10.0*	*kN/m2*	*10.0*	*kN/m2*
F, Surcharge pressure at base =	**3.3**	**kN/m**	**3.3**	**kN/m**



Forces

B16 @ 150mm centres in tension face suitable for wall

	Stem		**Base**	
M,ed ULS =	16	kNm/m	16	kNm/m
Shear, ULS =	22	kN/m	22	kN/m
	ka Value		ka Value	

Concrete Section Design

Concrete grade	C	32	/40						
Reinforcement grad	B	500	B		**Stem**		**Base**		OKAY
				Depth of section =	330.0	mm	300.0	mm	
				Cover =	85.0	mm	60.0	mm	
				Effective Depth =	245.0		240.0		
				k =	0.00833		0.00868		
				Z =	232.75	mm	228	mm	
				As,req =	158	mm2	161	mm2	
				As, prov:	**565**	**mm2**	**565**	**mm2**	
				No. of bars =	5		5		
				Diameter	12	mm	12	mm	
				Shear Stress V,ed =	0.09452	N/mm2	0.09649	N/mm2	
				Vrd,max =	**3.4**	**N/mm2**	**3.4**	**N/mm2**	
				V,rd,c =	**0.45**	**N/mm2**	**0.45**	**N/mm2**	
				% reinforcement provided =	0.2%		0.2%		
				k =	1.90351		1.91287		
				spacing of links =	0	mm	0	mm	OKAY
				Min Shear reinforcement =	0	mm2	0	mm2	
				Asw, prov:	**0**	**mm2**	**0**	**mm2**	
				No. of legs =					
				Diameter =	8	mm	8	mm	

Table 7.1
Shear resistance without shear reinforcement, $v_{Rd,c}$ (MPa)

ρ_l	Effective depth d (mm)										
	≤200	225	250	275	300	350	400	450	500	600	750
0.25%	0.54	0.52	0.50	0.48	0.47	0.45	0.43	0.41	0.40	0.38	0.36
0.50%	0.59	0.57	0.56	0.55	0.54	0.52	0.51	0.49	0.48	0.47	0.45
0.75%	0.68	0.66	0.64	0.63	0.62	0.59	0.58	0.56	0.55	0.53	0.51
1.00%	0.75	0.72	0.71	0.69	0.68	0.65	0.64	0.62	0.61	0.59	0.57
1.25%	0.80	0.78	0.76	0.74	0.73	0.71	0.69	0.67	0.66	0.63	0.61
1.50%	0.85	0.83	0.81	0.79	0.78	0.75	0.73	0.71	0.70	0.67	0.65
1.75%	0.90	0.87	0.85	0.83	0.82	0.79	0.77	0.75	0.73	0.71	0.68
≥ 2.00%	0.94	0.91	0.89	0.87	0.85	0.82	0.80	0.78	0.77	0.74	0.71
k	2.000	1.943	1.894	1.853	1.816	1.756	1.707	1.667	1.632	1.577	1.516

Notes
Table derived from BS EN 1992-1-1 and the UK National Annex.
Table created for f_{ck} = 30 MPa assuming vertical links.
For $\rho_l \geq 0.4\%$ and f_{ck} = 25 MPa, apply factor of 0.94
f_{ck} = 35 MPa, apply factor of 1.05
f_{ck} = 40 MPa, apply factor of 1.10
f_{ck} = 45 MPa, apply factor of 1.14
f_{ck} = 50 MPa, apply factor of 1.19
Not applicable for f_{ck} > 50 MPa

Cracking

Limited to W,max =0.3	**f,yk =**	**500.00**		**500.00**
	M,quasi =	11.43		11.43
	Mquasi / MULS =	0.71		0.71
	redistribution factor =	0.85		0.85
	Stress in bars =	86.79	N/mm2	88.60
	b16 - OKAY			

Table 3
Maximum bar size or spacing to limit crack width (mm)

Steel stress (σ_s) MPa	W_{max} = 0.3 Maximum bar size (mm)		W_{max} = 0.3 Maximum bar spacing (mm)		W_{max} = 0.2 Maximum bar size (mm)		W_{max} = 0.2 Maximum bar spacing (mm)	
160	32		300		25		200	
200	25	OR	250		16	OR	150	
240	16		200		12		100	
280	12		150		8		50	
320	10		100		6		–	
360	8		50		5		–	

Note
The steel stress may be estimated from the expression below

$$\sigma_s = \frac{f_{yk}\, m A_{s,req}}{\gamma_{m,n} n A_{s,prov} \delta}$$

where:
f_{yk} = the characteristic reinforcement yields stress
$\gamma_{m,n}$ = the partial factor for reinforcement steel
m = the total load from quasi-permanent combination
n = the total load from ULS combination
$A_{s,req}$ = the area of reinforcement at the ULS
$A_{s,prov}$ = the area of reinforcement provided
δ = the ratio of redistribution moment to elastic moment

EXTERNAL Retaining Wall - 122/124 and 124/126 Party Wall and rear garden retaining wall

REVIEW OF GLOBAL CHECKS
1.Overturning
2. Sliding

Note that the retaining walls are all tied into return walls - Toe to be designed to act as a deep beam to prevent sliding

Proposed Wall

Stem thk =	0.3	m
Stem height =	1.8	m
Base thk =	0.3	m
Toe length =	1	m

Vertical loading

Overturning Check

Vertical loads, SLS =	**30.7**	**kN/m**		
			Dist to Centreline of Toe	
Stem weight =	*13.5*	*kN/m*	0.35	m
base weight =	*7.5*	*kN/m*	0	m
Weight of boundary wall =	*9.675*	*kN/m*	0.35	m
Overturning moments, SLS =	**11.2**	**kNm/m**		
Restoring moments, SLS =	**8.11**	**kNm/m**		
Compressive Stress =	**30.68**	**kN/m2**		
Bending Stress =	**1.33**	**kN/m2**		
Allowable bearing stress =	**90.00**	**kN/m2**	therefore, okay	

Sliding Check

Sliding force, ULS =	22	kN/m
Span between returns =	3	m
Moments in Toe =	74.25	kNm
Shear in Toe =	33	kN

Design of toe to ensure sufficient strength to transfer lateral forces at base

Concrete Section Design

Concrete grade	C	32	/40			
Reinforcement grad	B	500	B	width =	300	mm
				Depth of section =	1000.0	mm
				Cover =	85.0	mm
				Effective Depth =	915.0	
				k =	0.00924	
				Z =	869.25	mm
				As,req =	87	mm2
				As, prov:	**226**	**mm2**
				No. of bars =	2	
				Diameter	12	mm
				Shear Stress V,ed =	0.12655	N/mm2
				Vrd,max =	4.63	N/mm2
				V,rd,c =	**0.16569**	**N/mm2**
				% reinforcement provided =	0.0%	
				k=	1.46752	

Project name:	**124 St Pancras Way**				
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Date:	**18/07/2023**	**Engineer:**	**DJC**	**Checked:**	**AB**
Location:					

BAKER STRUCTURAL DESIGN **CHATTERTON**

BASEMENT FLOOR SLAB

The ground bearing slab to resist uplift forces arising from heave and accidental hydrostatic pressure independently
The two way spanning slab in the basement will spread load to all four sides
The connections to the perimeter are to be conservatively treated as pinned.

Slab span 2.7 m

LOADING

Heave

Where the max excavation below the basement is approximately 2.4 m
assuming soil density = 20 m
and 50% of heave pressures dissipate during construction
Heave pressures on slab = 24 kN/m2

Where accidental ground water level is taken at LGF level - after which the row of terraces would flood
Hydaulic water pressures = 24 kN/m2

Forces

Wall to be reviewed in GSA
Refer to Concrete Centre spreadsheet for moment design of both 200mm and 440mm thk elements
B16 @ 150mm centres in tension face suitable for wall

For shear assessment - see below
M,ed ULS = 30 kNm/m
Shear Ved = 44 kN/m

Concrete Section Design

Concrete grade	C	32	/40			
Reinforcement grad	B	500	B	**Slab**		OKAY
Depth of section =				330.0	mm	
Cover =				45.0	mm	
Effective Depth =				285.0		
k =				0.01136		
Z =				270.75	mm	
As,req =				251	mm2	
As, prov:				**565**	**mm2**	
No. of bars =				5		
Diameter				12	mm	
Shear Stress V,ed =				0.16155	N/mm2	
Vrd,max =				**3.4**	**N/mm2**	
V,rd,c =				**0.41**	**N/mm2**	
% reinforcement provided =				0.2%		
k =				1.83771		
spacing of links =				0	mm	OKAY
Min Shear reinforcement =				0	mm2	
Asw, prov:				**0**	**mm2**	
No. of legs =						
Diameter =				8	mm	

Table 7.1
Shear resistance without shear reinforcement, $v_{Rd,c}$ (MPa)

ρ_l	Effective depth d (mm)										
	≤200	225	250	275	300	350	400	450	500	600	750
0.25%	0.54	0.52	0.50	0.48	0.47	0.45	0.43	0.41	0.40	0.38	0.36
0.50%	0.59	0.57	0.56	0.55	0.54	0.52	0.51	0.49	0.48	0.47	0.45
0.75%	0.68	0.66	0.64	0.63	0.62	0.59	0.58	0.56	0.55	0.53	0.51
1.00%	0.75	0.72	0.71	0.69	0.68	0.65	0.64	0.62	0.61	0.59	0.57
1.25%	0.80	0.78	0.76	0.74	0.73	0.71	0.69	0.67	0.66	0.63	0.61
1.50%	0.85	0.83	0.81	0.79	0.78	0.75	0.73	0.71	0.70	0.67	0.65
1.75%	0.90	0.87	0.85	0.83	0.82	0.79	0.77	0.75	0.73	0.71	0.68
≥ 2.00%	0.94	0.91	0.89	0.87	0.85	0.82	0.80	0.78	0.77	0.74	0.71
k	2.000	1.943	1.894	1.853	1.816	1.756	1.707	1.667	1.632	1.577	1.516

Notes
Table derived from BS EN 1992-1-1 and the UK National Annex.
Table created for f_{ck} = 30 MPa assuming vertical links.
For $\rho_l \geq 0.4\%$ and f_{ck} = 25 MPa, apply factor of 0.94
f_{ck} = 35 MPa, apply factor of 1.05
f_{ck} = 40 MPa, apply factor of 1.10
f_{ck} = 45 MPa, apply factor of 1.14
f_{ck} = 50 MPa, apply factor of 1.19
Not applicable for f_{ck} > 50 MPa

Cracking

Limited to W,max =0.3
f,yk = 500.00
M,quasi = 21.09
Mquasi / MULS = 0.71
redistribution factor = 0.85
Stress in bars = 137.67 N/mm2
b12 - OKAY

Table 3
Maximum bar size or spacing to limit crack width (mm)

Steel stress (σ_s) MPa	W_{max} = 0.3			W_{max} = 0.2		
	Maximum bar size (mm)		Maximum bar spacing (mm)	Maximum bar size (mm)		Maximum bar spacing (mm)
160	32		300	25		200
200	25	OR	250	16	OR	150
240	16		200	12		100
280	12		150	8		50
320	10		100	6		–
360	8		50	5		–

Note
The steel stress may be estimated from the expression below

$$\sigma_s = \frac{f_{yk}}{\gamma_{m,s}} \frac{m A_{s,req}}{n A_{s,prov} \delta}$$

where:
f_{yk} = the characteristic reinforcement yields stress
$\gamma_{m,s}$ = the partial factor for reinforcement steel
m = the total load from quasi-permanent combination
n = the total load from ULS combination
$A_{s,req}$ = the area of reinforcement at the ULS
$A_{s,prov}$ = the area of reinforcement provided
δ = the ratio of redistribution moment to elastic moment