8 Basement Construction Sequence

For Basement Construction - refer to Scheme Drawings in Appendix 1.

8.1 Assumptions

The following assumptions have been made in the assessment of the structure:

- The final temporary works scheme will be the responsibility of the appointed contractor, who will work to an agreed method statement approved through the Party Wall Awards.
- The ground conditions described in the CGL Investigation report are indicative of the ground conditions under the existing building.
- A soft strip demolition at commencement to expose and confirm existing structure.

8.2 Stability of Surrounding Buildings

Stability of the surrounding buildings will be ensured both during the demolition phase and during the construction phase. This will be achieved through the following measures:

- A full ground movement assessment has been carried out by CGL, this has assessed the effect of the works. This analysis will inform the design and phasing of the works, so that a suitable temporary works design and sequence can be installed to limit damage to surrounding properties.
- All works will be carried out in an agreed sequence, working to a method statement approved by all parties.
- Movement monitoring will be installed to all surrounding properties, so that actual movements during demolition and construction can be monitored with appropriate trigger levels and precautionary measures adopted.

8.3 Outline Construction Sequence

The following section describes our envisaged sequence for the construction of the basement based on the construction and temporary works techniques described in the previous section. The contractor may put forward alternative solutions to suit the programme and method of working. Regardless no structural works will commence without a detailed temporary works design, drawing and calculation package in place including all necessary method statements.

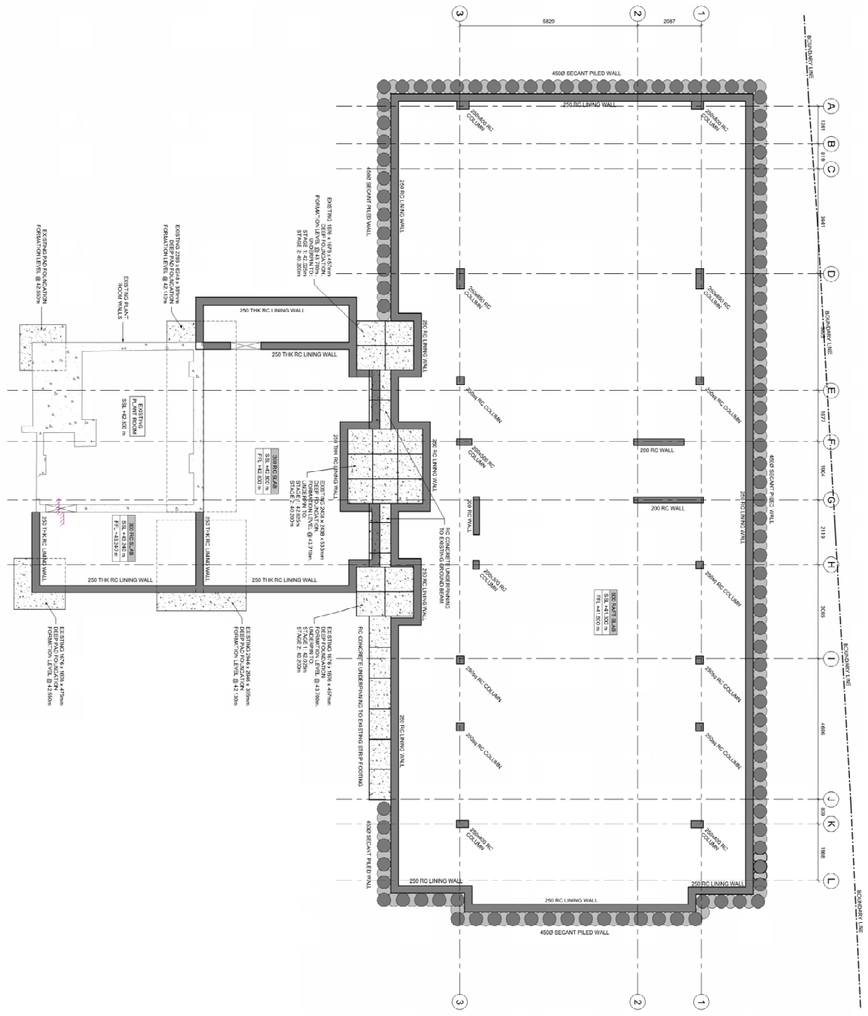


Figure 17 Lower Ground Floor general structural arrangement

STAGE 1 – SITE SET UP

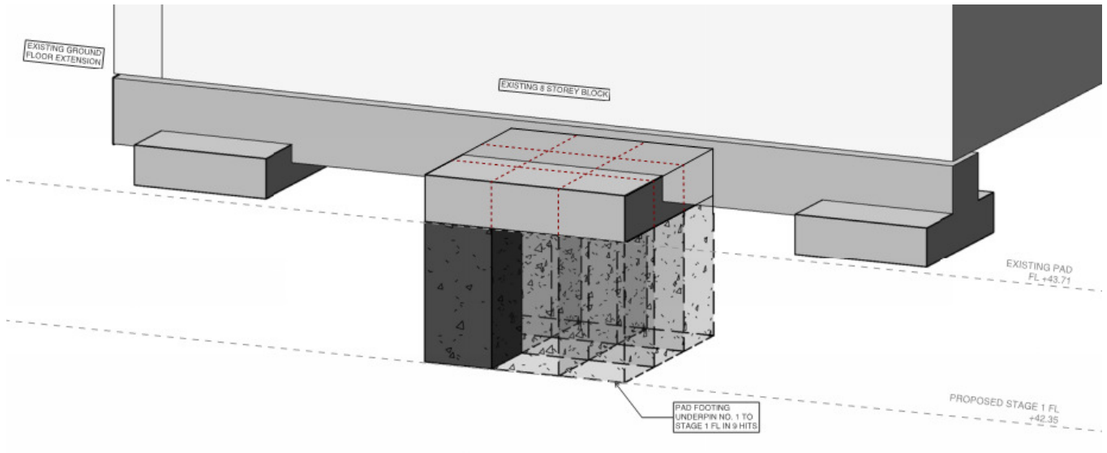
- Mobilisation and prepare site with all necessary hoarding and associated health and safety and security requirements.
- Locate all existing services and identify those affected by the new works and take necessary actions as required by M+E engineer, drainage engineer and Thames Water.
- Check all boundary conditions are as to be expected and report any variations to the engineer.
- Submit temporary works proposals to engineer for comment.

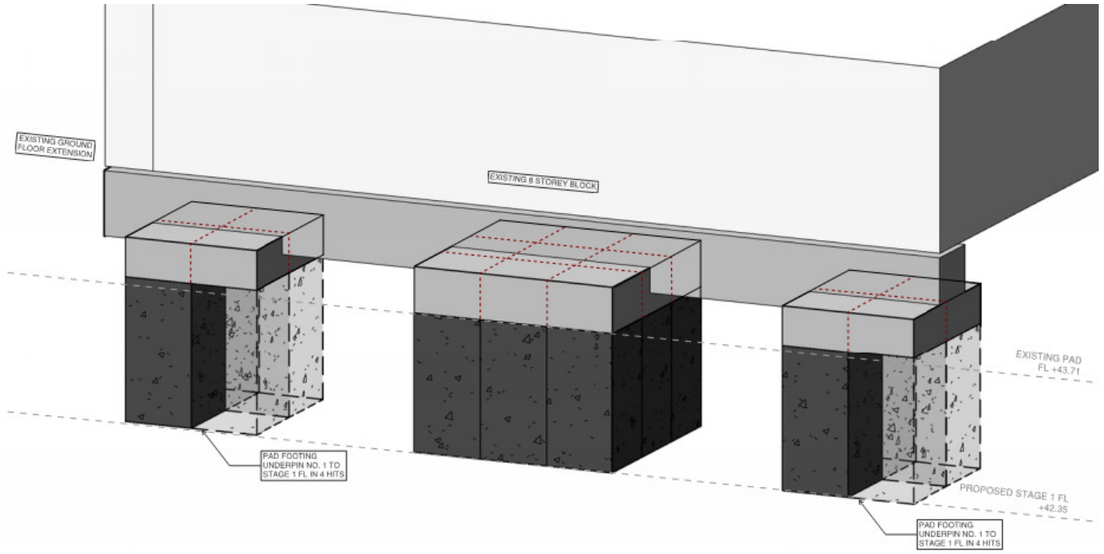
STAGE 2 – INSTALLATION OF PILES

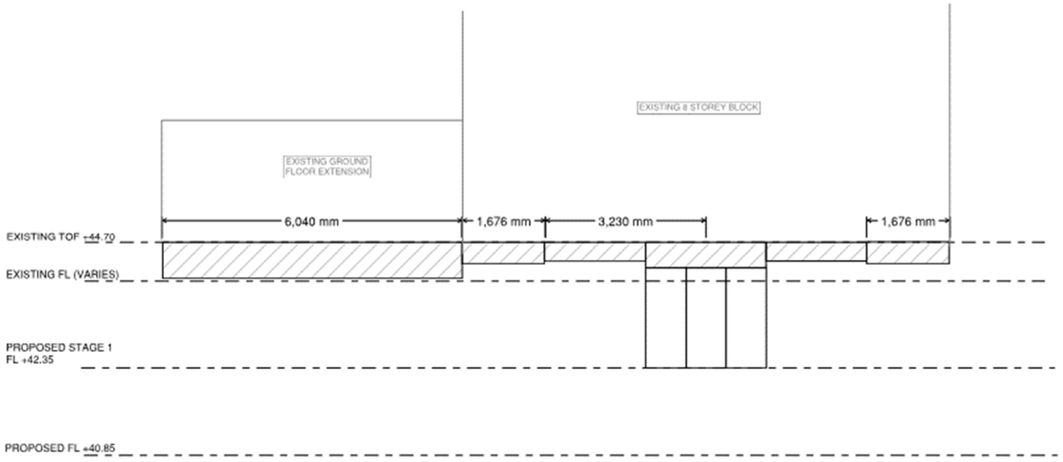
- Install secant pile wall. Prop as set out in contractor method statement.
- Construct pile capping beam with starter bars for liner wall.
- Commence excavation to facilitate access to existing pad footings to be underpinned in next stage.

STAGE 3 – EXCAVATION OF BACKFILL IN UNDERCROFT BELOW EXISTING BLOCK

- Cut small opening in existing tank room wall.
- Carry out hand excavation of soil to facilitate cutting of larger opening.
- Repeat until enough soil is excavated to allow access to pad footing for underpinning, while maintain 45 degree bearing zone to ensure the pad it supported at all times.

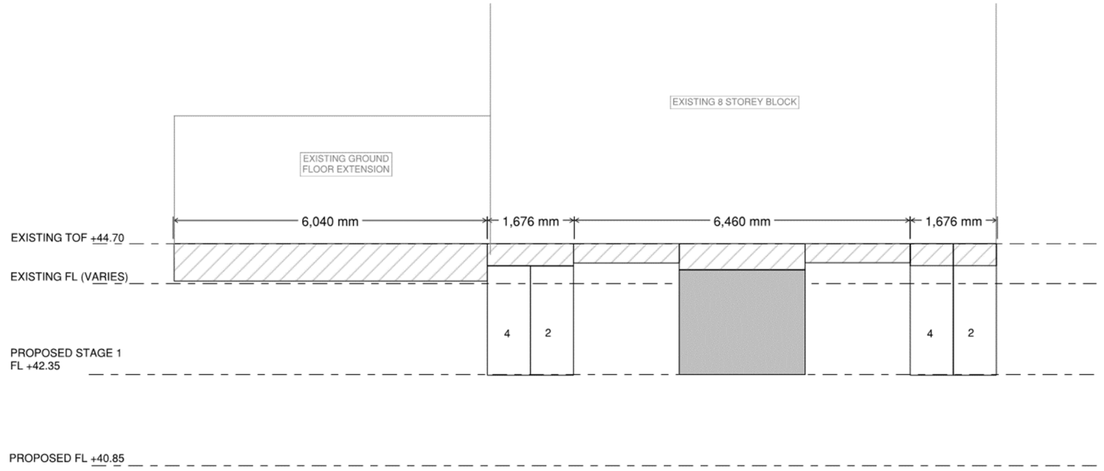






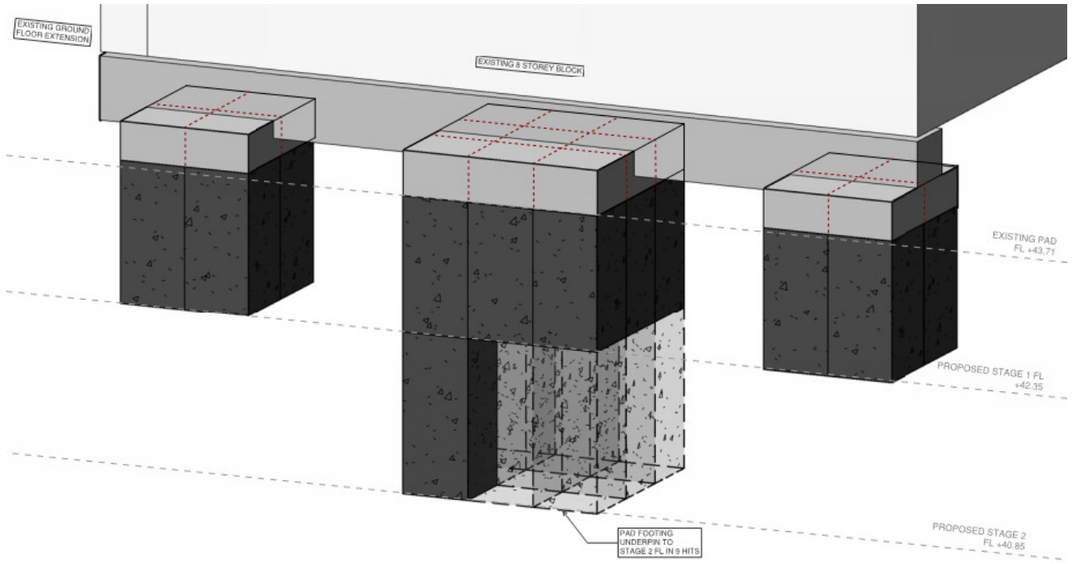
STAGE 4 –UNDERPIN OF CENTRAL FOOTING TO STAGE 1 FORMATION LEVEL +42.35

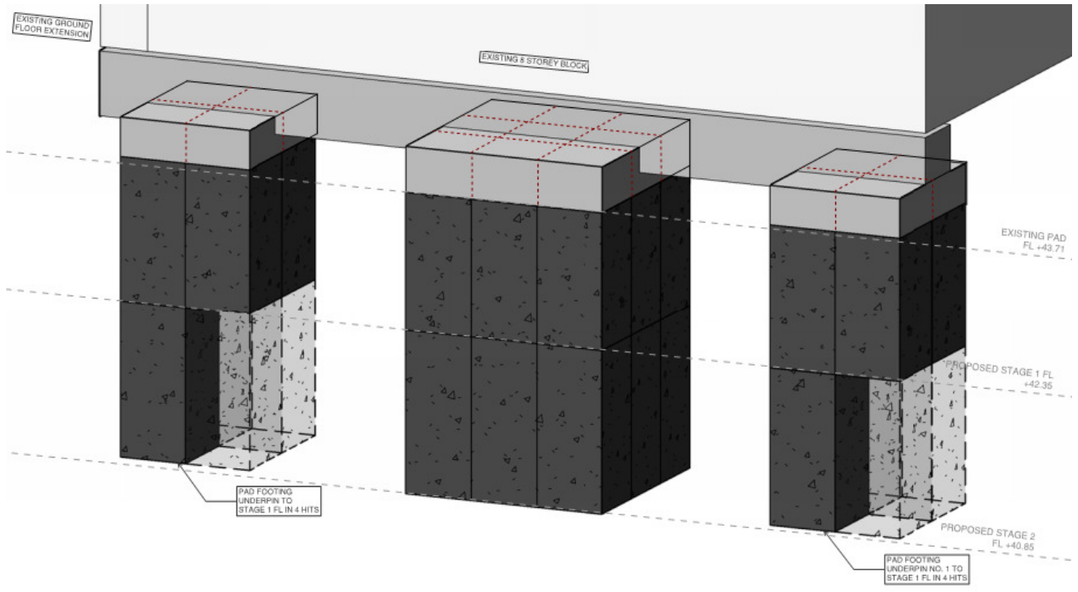
- The central pad footings will be underpinned in 9 hits on plan, and 2 hits vertically.
- 1st series of the underpins will be excavated with the necessary temporary work installed.
- Casting of the No.1 pins will commence in accordance with the specification.
- Underpins 2-9 will be completed sequentially and in accordance with the underpinning specification to ensure the pad is supported at all times with underpins which have achieved adequate strength.
- Provide continuous temporary restraints to underpins at min 2 levels.
- Excavated soil is removed throughout the process



STAGE 5 – UNDPERPIN OF CORNER FOOTINGS TO STAGE 1 FORMATION LEVEL +42.35

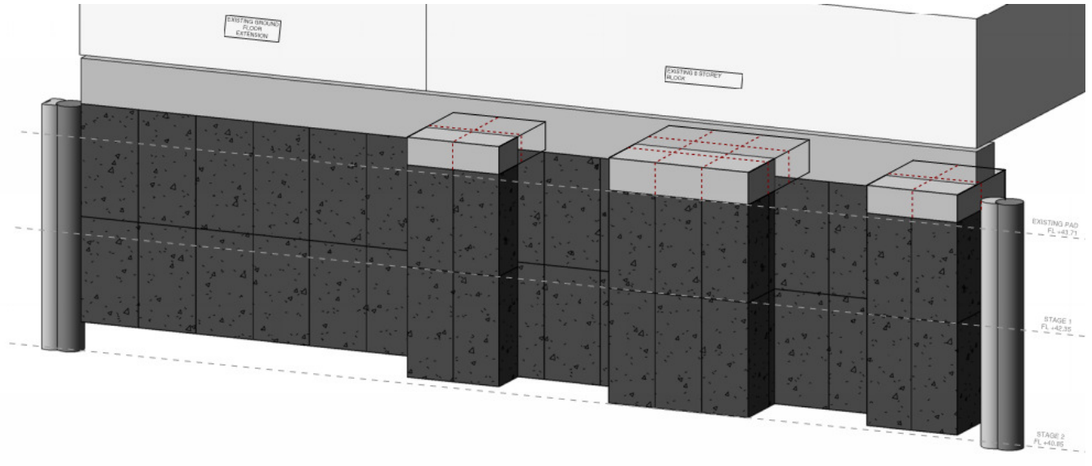
- The corner pad footings will be underpinned in 4 hits on plan, and 2 hits vertically. The pads will be underpinned separately to stage 1 formation level +42.025.
- 1st series of the underpins will be excavated with the necessary temporary work installed.
- Casting of the No.1 pins will commence in accordance with the specification.
- The No. 2, 3 and 4 underpins will be completed sequentially and in accordance with the underpinning specification.
- Provide continuous temporary restraints to underpins at min 2 levels.
- Excavated soil is removed throughout the process





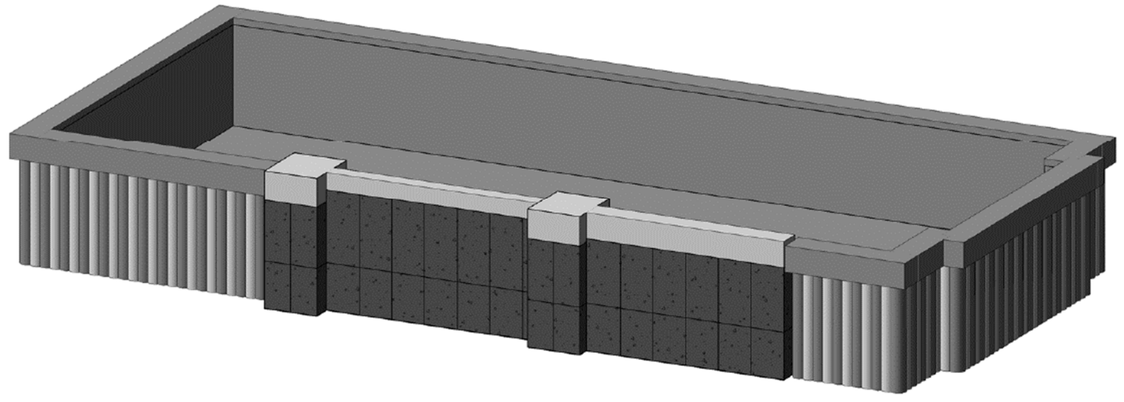
STAGE 6– COMPLETE UNDERPINS TO FINAL PROPOSED FORMATION LEVEL +40.85

- Underpin central pad footing to proposed formation level in 9 hits as previously.
- Underpin the corner pad footing to final formation level in 4 hits as previously.
- Extend underpins of strip footing to proposed formation level sequentially as per the first stage of underpinning.
- Provide continuous temporary restraints to underpins at min 3 levels.
- Excavated soil is removed throughout the process.



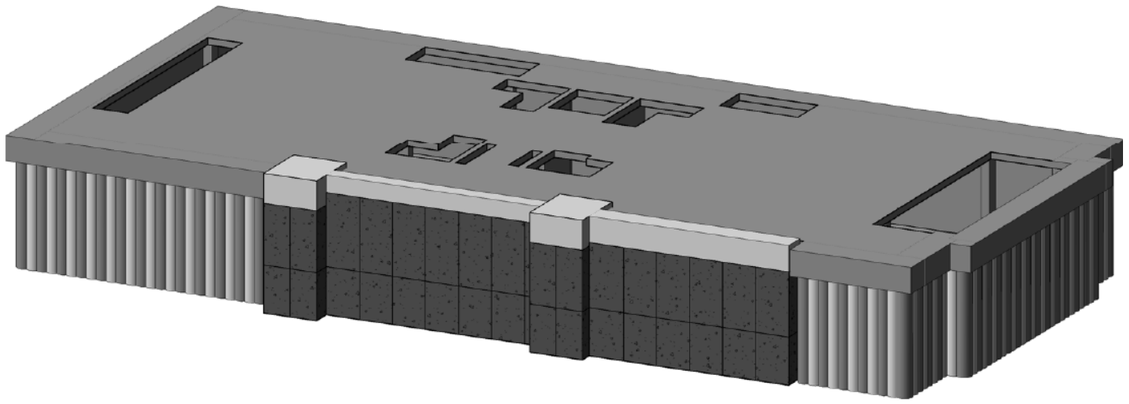
STAGE 8 – CAST BASEMENT SLAB AND WALLS

- Once the excavation reaches the formation level throughout prepare the basement raft slab reinforcement including starter bars for the RC walls and columns extending up, pour concrete and allow curing.
- Prepare shuttering and reinforcement for new perimeter and internal walls and columns from basement to lower ground floor level, pour concrete and allow curing.



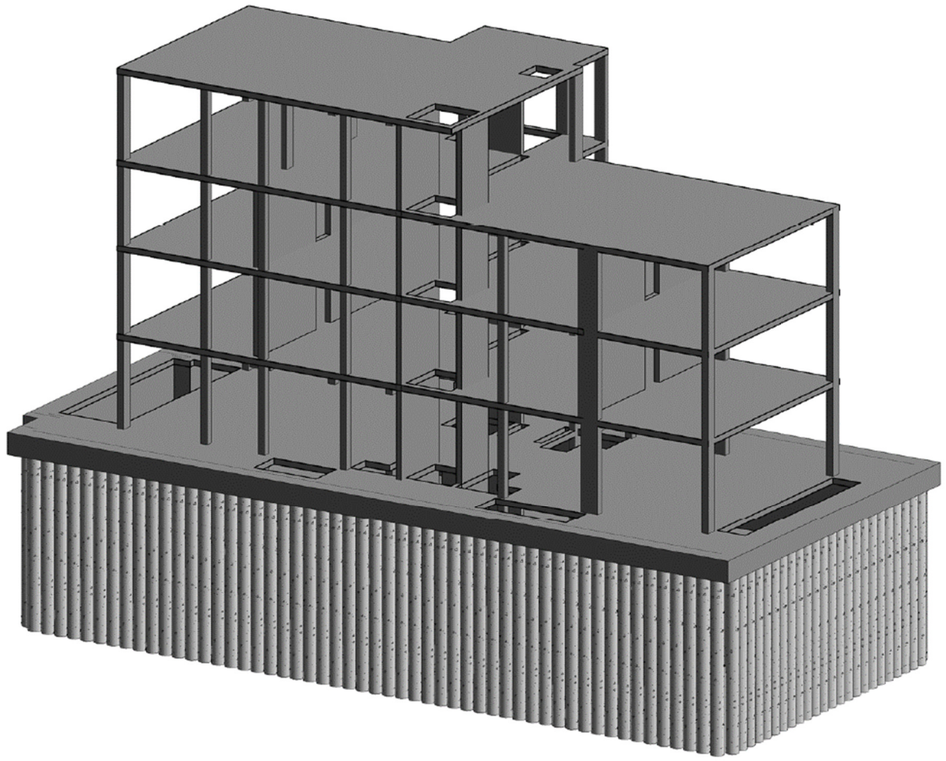
STAGE 8 – CAST GOUND FLOOR SLAB AND REMOVE PROPPING

- Prepare the suspended ground floor slab reinforcement, pour concrete and allow curing.
- At this stage the propping installed at basement level can be removed
- Prepare shuttering and reinforcement for new perimeter and internal walls and columns from ground floor level, pour concrete and allow curing.



STAGE 8 – BEGIN CONSTRUCTION OF SUPERSTRUCTURE

- Continue with the RC frame until the structure is completed.



9 Ground Movement Assessment

A ground movement assessment has been carried out by CGL Ltd as part of their Basement Impact Assessment. See Appendix 2 for the full report.

The key construction activities that will result in ground movement during the works are:

1. Contiguous pile wall installation and deflection during excavation
2. Possible settlement due to underpinning of existing Barrie House structure
3. Possible short and long-term heave due to unloading of London Clay Formation
4. Possible settlement due to building loads of the proposed development

The amount of ground movement caused by these activities relates to the ground conditions, together with the care and sequence with which the works are carried out. This analysis is based on the sequence of construction described previously. Should the Contractor propose to carry out the works in a different sequence to that assumed in our design then a further assessment of the predicted movement will be required, and the proposal only accepted if there is no significant change to the scale of predicted movement.

All projects which involve an appreciable level of excavation will cause a degree of movement and the CGL assessment has helped to quantify this for the project.

Critical sections were selected for each of the neighbouring properties for individual assessment as shown in Figure 18.
As expected, the assessment has indicated that some minor ground movement is likely to occur under the adjacent properties:

- 72 Kingsland
- 16 Kingsland

The maximum movements predicted for both installation of the wall and excavation are approximately 5 mm vertical settlement and 4 mm horizontal ground movement when propping is employed as proposed.

Assessment of movement was also carried out along the pedestrian pavement and roads of Little Chester Street and Chester Mews, with a negligible impact being concluded.

Further results, damage category assessment and conclusions from the report are shown in the Sections 7.4, 7.5 and 7.6.

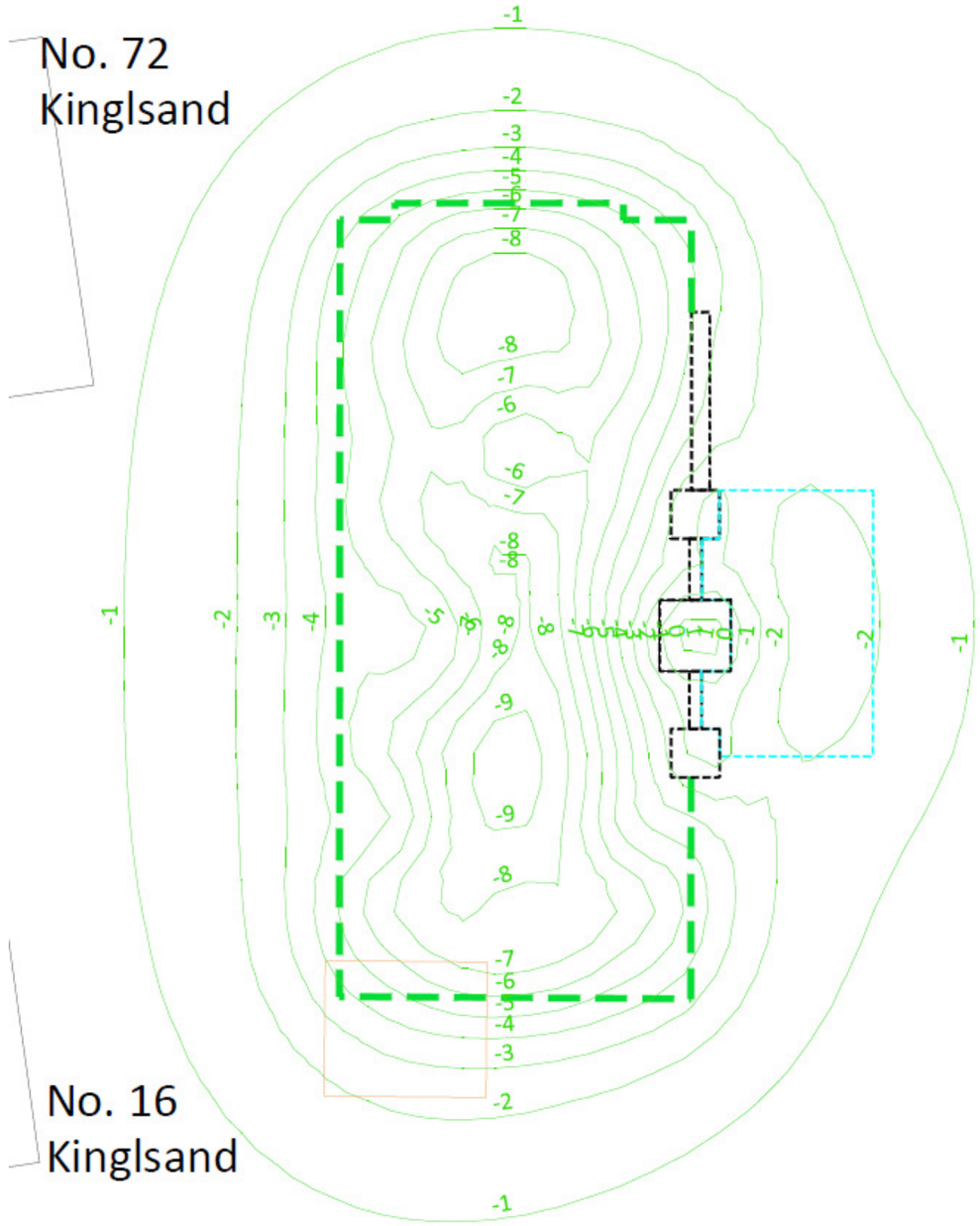


Figure 18 Total vertical ground movements from CGL's Ground Movement Assessment

10 Ground Movement and Potential Damage

The excavation and construction methodology proposed for the basement works are not envisaged to have a significant impact on the existing fabric of the adjoining properties, and will not exceed the accepted damage category limit of Damage Category 1 (very slight).

The Contractor will be aware of the care required in carrying out the works and how the likely movements depend on the sequence of works. Should the Contractor propose to carry out the works in a different sequence to that assumed in our design then a further assessment of the predicted movement will be required, and the proposal only accepted if there is no significant change to the scale of predicted movement.

10.1 Damage Assessment

CGL's analysis has shown that the likely maximum ground movement will be of the order of 1-3.5mm vertically downwards and 1-3.5mm horizontally toward the basement (with propping).The amount of movement will then reduce with distance away from the new basement. These ground movements will extend under the adjoining properties. The cracks which are predicted within the CGL's report (Appendix 2) show that most walls will fall within the 0 - Negligible with some in 1 - Very Slight categories as measured against the Burland Scale (Figure 19).

Whilst these movements are small, the differential movement across the width of the adjoin properties could lead to cracks appearing in the walls and in the finishes. As explained in this report the scale of movement predicted could lead to hairline cracks in the walls, though many of the adjoining buildings appear to have a lime based mortar in their brickwork walls and this may be able to take up this small movement without cracking. Finishes to floors, walls, and ceilings however can be more susceptible to cracking as a result of this movement, especially brittle finishes.

The Contractor will be required to carry out detailed monitoring of the adjoining properties to record ground movements, and take action should the movement not be as expected. Trigger levels will be set to identify limits on monitored results and to define actions if these limits are reached. The traffic light approach will be adopted with green, amber, and red trigger levels set.

The new structure is designed to be self-stabilising and independent of adjoining buildings while providing support and lateral restraint.

10.2 Mitigation Measures

Measures to mitigate potential damage as a result of ground movements include:

1. CFA bored piles to limit ground disturbance and vibration.
2. Large diameter piles to increase stiffness of the retaining wall and limit deflection
3. Propping of the retaining wall during construction to limit deflection
4. Temporary works to ensure stability of existing structures.
5. Movement monitoring and trigger levels

On this basis, the damage that will occur as a result of such an excavation should fall well within the acceptable limit to not exceed damage category 2.

Category of damage	Description of typical damage	Approximate crack width (mm)	Limiting tensile strain ε_{lim} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed 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 weathertightness. 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 lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness 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, floor 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	

Damage Category Chart (CIRIA C580)

Figure 19 Burland Crack Damage Scale

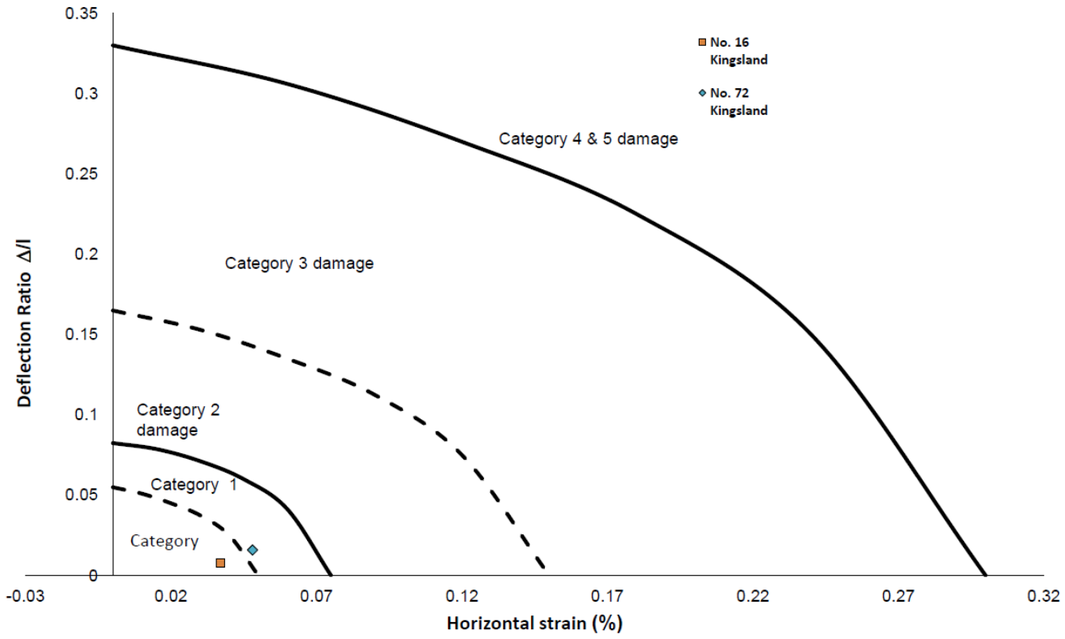


Figure 20 CGL Damage Category Results

Summary of Cumulative Horizontal Movements

Property	*Horizontal movements from piled wall installation and basement excavation (mm)*	*Cumulative horizontal movements (mm)*	*Maximum horizontal strain (%) over property*
No.72 Kingsland	3.7	5.9	0.048
No. 16 Kingsland	2.5	4.4	0.037

Summary of Cumulative Vertical Movements

Property	*Vertical movements from piled wall installation and basement excavation (mm)*	*Vertical movements from unloading / reloading of soil (mm)*	*Cumulative vertical movements (mm)*	*Maximum vertical deflection ratio over property*
No.72 Kingsland	-2.6	negligible	-2.6	0.016
No. 16 Kingsland	-1.8	negligible	-1.8	0.008

Note. +ve = heave, -ve = settlement

Figure 21 CGL Ground Movement Assessment Summary

10.3 Monitoring

As part of the works it will also be required to monitor the existing building, both during underpinning of the existing building and also during excavation/ construction of the new structures.

A third-party monitoring company will be required to carry out this monitoring, which is to ensure actual ground movements during construction are in line with the predicted ground movements. Proposed monitoring points will be confirmed during the next phase of the works.

Monitoring works will need to be commenced 1 month before demolition works start on site, to help establish a baseline and record pre-construction movements. A minimum of 4 readings should be obtained during this period.

As works commence readings are to be taken on a weekly basis, this frequency of reading will be retained until the main excavation phase commences. During the main excavation phase readings should be increased to twice weekly. Providing ground movements are in line with predictions, the monitoring will then be reduced to a weekly frequency and maintained at this level until 1 month after completion of the basement box. Readings will then be reduced to a monthly basis until completion of the main structural works.

If the monitoring shows that actual movements look likely to exceed the anticipated figures, action will need to be taken by the contractor, in order to bring them under control – further details can be found in the next section.

The proposal could involve stopping the works on site, however this is unlikely providing the contractor is proceeding diligently on site. An action plan of what to do if movements appear to be excessive will need to be agreed with the contractor, details of which will need to be reflected in the method statement for the works.

The construction methodology will aim to limit damage to the existing building and neighbouring buildings to Category 0 (negligible).

10.4 Movement Trigger Levels

10.4.1 Trigger levels are used to identify limits on the monitored results and to confirm/ identify actions if these levels are reached. The traffic light system will be adopted, with green, amber and red trigger levels set.

10.4.2 The setting of appropriate trigger levels is to consider the following factors:

- The amount of predicted movement
- Accuracy of the monitoring equipment
- Normal/ preconstruction movements of the buildings
- Likely damage resulting from the predicted movement.

10.4.3 The underpinning specifications give performance specifications for the temporary works, which limit movements and damage criteria to appropriate levels for the type and age of buildings surrounding the site.

10.4.4 The accuracy of the monitoring equipment for reading horizontal and vertical movements is to be limited to +/- 1mm.

10.4.5 The impact of normal movements of a building, such as thermal movements will need to be judged during the monitoring. The extent of this will need to be assessed during the early stages of the monitoring. To this end trigger levels will be set at monitoring points close to the ground where the effects of thermal movements are reduced.

10.4.6 Proposed trigger levels will be specific to the walls permissible displacement to ensure the damage category remains with the 0 to 1 range (Negligible to Very Slight). The values will need to be discussed post planning with the appointed Party Wall surveyors and contractor to ensure a practical construction sequence can be adopted.

10.5 Actions to be taken by the design team and the contractor if these trigger levels are reached are summarised in the table below:

Actions		
Alert Level	Design Team	Contractor
Green	Continue to review monitoring as normal	Continue work as programmed and monitor as normal
Amber	a) Review monitoring results with contractor b) Review contractors amber action plan c) Make comments on contractor's proposals and discuss with CA	Contractor to implement amber level action plan. This should include the following: a) Recheck monitoring to confirm readings b) Review method of working and highlight any activity relating to measured movements c) Propose revised methodology in to reduce trend in increasing movements d) Agree revised proposals wit CA prior to implementing. e) Increase frequency of monitoring
Red	a) Review monitoring results with contractor b) Review contractors red level action plan c) Make comments on contractor's proposals and discuss with CA d) Carry out condition survey with PW surveyor on affected buildings.	Contractor to implement his red level action plan. This should include the following: a) Stop work b) Recheck monitoring to confirm readings c) Install additional temporary works where required. d) Submit new methodology/ proposals to stop further movements. e) Agree revised proposals with CA prior to implementing f) Increase frequency of monitoring

10.6 Monitoring Points

The monitoring locations shown below are suggested locations, to be confirmed at a later stage. Monitoring points will be set 250mm above existing ground floor level where possible.

= Monitoring Point

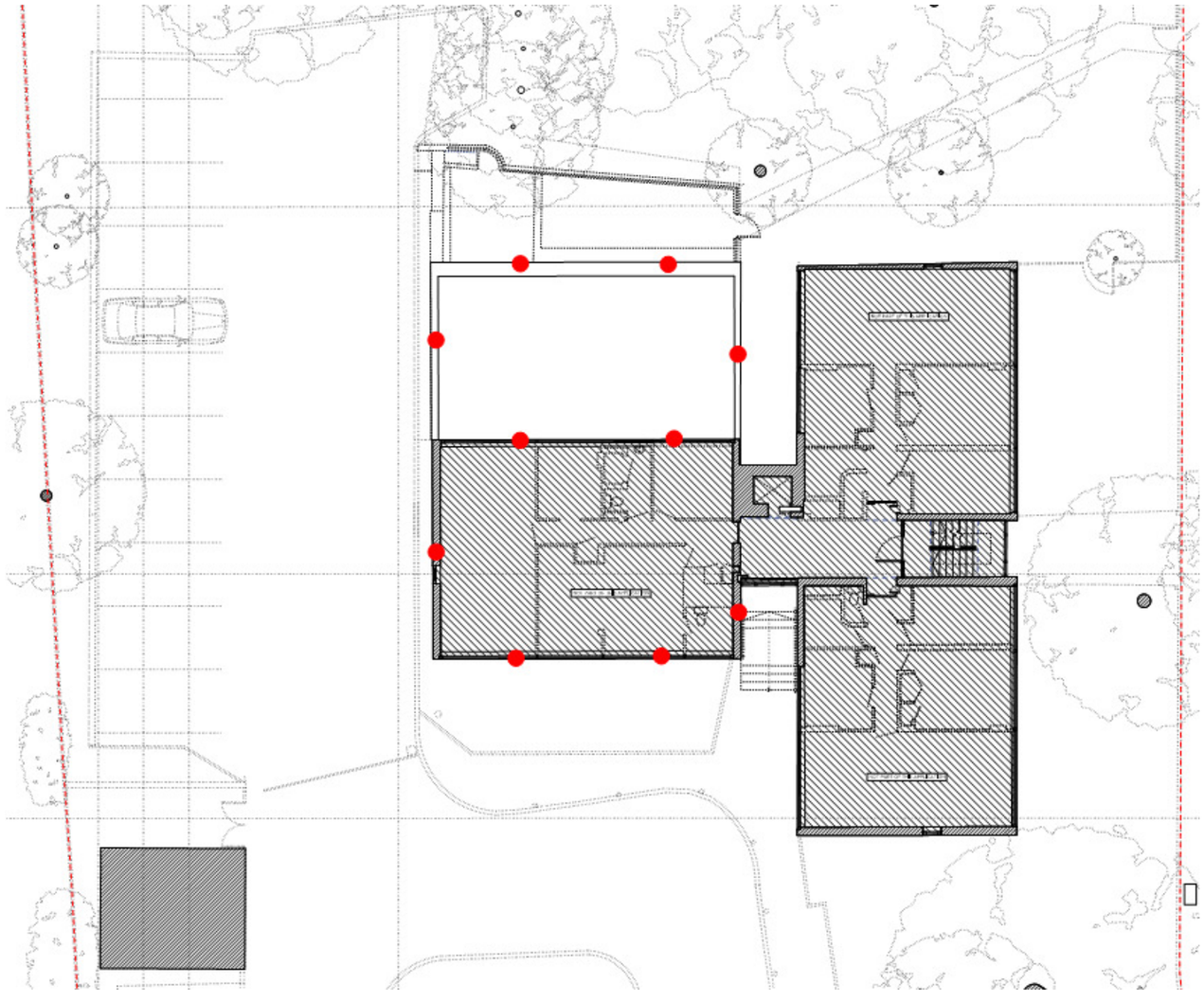


Figure 22 Existing First Floor with indicative monitoring locations

11 Construction Activities

11.1 Assumptions

The following assumptions have been made during the design of the substructure of the building:

- Final design of temporary works and construction phasing will need to be developed further by the appointed contractor and following further opening up works on site.
- Method Statements for the proposed demolition and sequencing of the temporary propping will need to be agreed prior to commencement of all works, to ensure proposals do not adversely impact the structure of the retained buildings.

11.2 Noise

Measures which will be employed to control noise include:

1. Deliveries to and from the site to be agreed and to form part of an approved Traffic Management Plan

2. Strict adherence to site working hours.

3. A noise barrier will be installed prior to work commencing.

4. Restrictions on the equipment that can be used will be in place to prevent noise pollution, and equipment which will not be permitted include:
    a. Vibration compactors
    b. Hammer or vibration piling rigs
    c. Diesel powered concrete mixers
    d. Diesel powered paving breakers, jack hammers, hoists, and conveyor belts.

5. Diesel powered compressors and generators will be restricted to equipment which is acoustically contained and meets the required noise levels.

6. Large plant such as concrete mixer trucks will not be permitted on the site.

7. All equipment must not generate noise at a level above 70 dB at the site perimeter of the wall with a first Action Level Trigger of 73 dB. It is proposed that in exceptional circumstances a noise level of 75dB may occur if this is done for very limited hours and only once all of the adjoining residents have been informed. This is on the basis of the guidelines set out in BS 5228 Part 1: 2009.

8. In the case where the removal of large concrete items is required, the concrete is to be broken up by means of coring a series of holes and then using hydraulic bursting equipment to split it apart prior to removal.

9. The breaking out of concrete is to be done with small handheld electrically powered units. This is subject to the restrictions aforementioned.

10. The site office and staff accommodation is to be located within the confines of the site.

11. Hiring of equipment shall be done for reputable companies who can provide well maintained equipment.

12. Cutting of steelwork will not be permitted on-site

13. Unnecessary revving of engines will not be permitted on-site.

14. All noise-generating machinery will be turned off when not being used

11.3 Vibration

In addition to the measure already mentioned, the following measures are to be imposed on site and addressed within the contract documentation.

1. Piling works will not be permitted on-site.

2. Sheet piling works will not be permitted on-site.

3. Vibration compactors will not be permitted.

4. All equipment onsite will not generate vibration above a PPV of 0.3mm/s when recorded at the line of the perimeter noise barrier. In exceptional circumstances there may be a requirement to exceed this to a level of 1.0mm/s. As above this will only be permitted for a very small number of hours and only once the local residents have been informed. This is in line with the guidance set out in BS 5998 Part 2: 2009.

11.4 Dust

As above, the measures listed here will be introduced at the site and be a requirement in the contract documentation:

1. The barrier required to mitigate noise will also function as a dust barrier

2. The site will be hosed down in dry periods to prevent dust from forming and drifting into adjacent properties.

3. Materials which could become airborne such as sand are to be covered with tarpaulins to prevent them being picked up by the wind.
    1.
4. All loading and unloading of soils and sandy materials will take place within the site barrier with all material dropped within the loading bay being swept clean.

5. Any vehicle wheels are to be hosed down and the road and pedestrian carriageway in front of the site is to be washed daily.

6. The building being clad in scaffolding will reduce any dust from the removal of plaster from leaving the site boundary.

12 Design Criteria

12.1 Design Life

The design life of the building can be defined as the period of use intended by the designer as agreed with the client. It should be noted that the design life of a buildings component parts might not be the same as the design life of the building. As such three categories arise for defining durability of building elements:

- *replaceable* shorter life than the building life with replacement envisaged
- *maintainable* with periodic treatment will last the life of the building
- *lifelong* will last the life of the building.

The design life for the building is assumed to be 60 years and as such can be categorised as 'Normal Life' to BS 7543.

The structural concrete frames and new foundations are designed to be lifelong; however obvious defects should be repaired during the building life and a defined maintenance plan should be adopted.

12.2 Loading

12.2.1 Dead Loading

The following loads have been assumed for the weight of the structure/finishes and facades, allowances do not included the self-weight of the supporting primary steelwork:

Building	Build-up description	Loading
RC Basement	600 mm RC slab Finishes	15.0 1.5
		16.5 kN/m^2
RC Floors	200mm RC slab Finishes Ceiling & Services	5.0 0.5 0.15
		5.65 kN/m^2
RC Roof	200mm RC slab Sedum Roof Ceiling & Services Waterproofing +Finishes	5.0 1.5 0.15 0.25
		6.9 kN/m^2

12.2.2 Imposed Loading

Area	UDL (kN/m^2)	Point Load (kN)	BS6399:1 1996 Table 1 ref.
Typical Floors (Domestic)	1.5	1.4	A
Floors (Garage)	2.5	9.0	F
Floors (Plant)	7.5	4.5	E
Roof	0.75	1.4	

12.2.3 Wind Loading/ Climate

The structure will be designed using the following wind load information in accordance with BS 6399: Part 2. Code of Practice for Wind Loads. Trade Contractor's design to include specific wind analysis for element under consideration. Values below are for global wind analysis only.

Wind design parameters	
Basic wind speed, V_b	21.0 m/s
Altitude factor, S_a	1.05
Seasonal factor, S_s	1.0
Directional factors, S_d	1.0
Dynamic wind pressure	0.835kN/m^2

12.3 Materials

The following structural materials are to be used for the project:

Steel grade	S355
Concrete grade	C40
Reinforcement high yield	f_y=500N/mm2

12.4 Durability

Concrete elements will be designed to the recommendations in BS EN 19921-1 Design of Concrete Structures and BS 8500 Concrete – Complementary British Standard to BS EN 206-1, and concrete mixes specified to suit the "normal" structural performance level. Where concrete elements are in contact with the ground, special considerations may have to be adopted depending on the recommendations of the Geotechnical Site Investigation.

12.5 Robustness

The design of the building assumes a categorisation of building type as Consequence Class 2B Upper Risk Group.

The design of the structure will be to recommendations made in BS EN 1991-1-7 General Actions – Accidental Action. The building will be designed to satisfy stability requirements of the relevant codes, and will be provided with effective horizontal and vertical ties. Alternatively, it may be preferable to check that with the notional removal of a supporting column the building remains stable and area of collapse does not exceed the building regulation requirements.

12.6 Fire Rating (tbc)

For the purpose of the structural design the following is assumed:

Element	Rating (minutes)
Concrete ground and suspended floors	60
Steel frame	60
Roof	60

12.7 Protected Trees and Root Protection Areas

No protected trees have been identified.

12.8 Design Guides

The following Codes of Practice and design guides have been used in the assessment of the development to this stage.

Reference	Title
BS 648	Schedule of weights of building materials
BS 5950	Structural use of steelwork in building. Part 1: Code of practice for design in simple and continuous construction: hot rolled sections. Part 2. Specification for materials, fabrication and erection: hot rolled sections.
BS 6399	Loadings for buildings. Part 1: Code of practice for imposed floor loading Part 2. Code of practice for wind loads. Part 3. Code of practice for imposed roof loads
BS 7543	Durability of buildings and building elements, products and components
BS 8002	Earth retaining structures.
BS 8004	Foundations
BS 8110	Structural use of concrete. Part 1. Code of practice for design and construction. Part 2. Code of practice for special circumstances
BS 8500-1:2002	Concrete – Contemporary British Standard to BS EN 206-1
BS EN 206-1	Concrete: Specification, performance, production and conformity
CIRIA R149	Protecting Development from Methane 1995
NHBC Chapter 4.2	Building near trees
NHBC Chapter 4.4	Strip and trench fill foundations
Structural Engineer's Pocket Book	General Design Guidance
TRRL LL1132	The structural design of bituminous roads

Vehicle Impact Loads: Any vulnerable parts of the basement car park and building structure will be assessed in accordance with the requirements of BS EN 1991-1-7 Section 4.3 Accidental actions caused by road vehicles.

13 Below Ground Drainage

The proposed development will incorporate a new surface water and foul water drainage network to serve the development. This will outfall to the existing Public Sewers running in the adjacent Broxwood way, utilising the existing connection where possible.

Due to the proposed basement a foul water pump is required to serve this level and any foul water runs which cannot be served by gravity. This pump will incorporate 24hour storage as required by Building Regulations Part H. The outfall main from this pump will then connect to the gravity connection to the Public Sewer.

A CCTV survey will be carried out to ascertain the line and condition of the existing connection with any proposed mitigation measures carried out as part of the works.

Surface water from the proposed development will be routed to this existing connection also. A sedum roof will be incorporated into the development to promote the use of SUDS within the site and reduce peak run-off rates during storm events. Due to space limitations and the existing soil properties, infiltration of surface water to the ground is not proposed. This will ensure that there is no impact on groundwater sources in the area.

The impermeable area of the site will not be increased as a result of the proposed development. In this regard, the peak run-off rates from the site will not increase. This is in line with London Plan and Thames Water policy and ensure that there is no adverse effect on the receiving infrastructure.

Agreement will be made with Thames Water to connect to their Public Sewers.

The drainage for this site is not connected to any adjacent property and as stated above will have its own induvial connection to the public sewers.

APPENDIX 1
Structural Scheme Drawings