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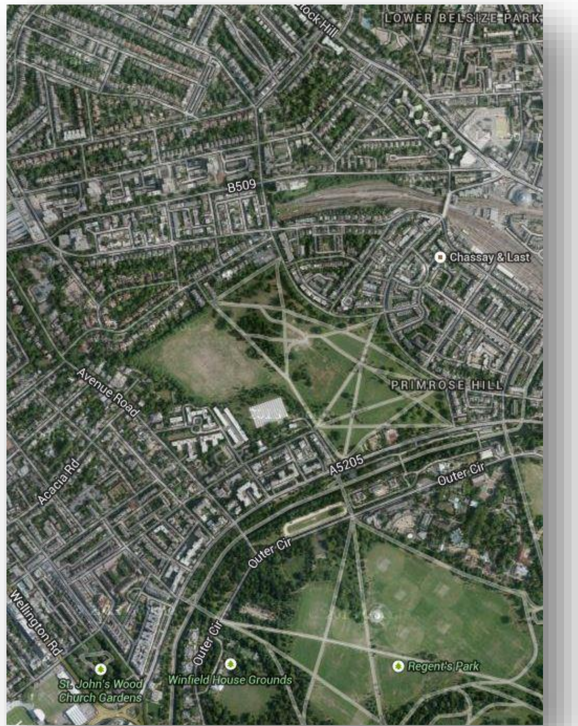

31 ELSWORTHY ROAD
LONDON NW3

Construction Method Statement for Subterranean Development

MBP-8255-October 2021

Preamble

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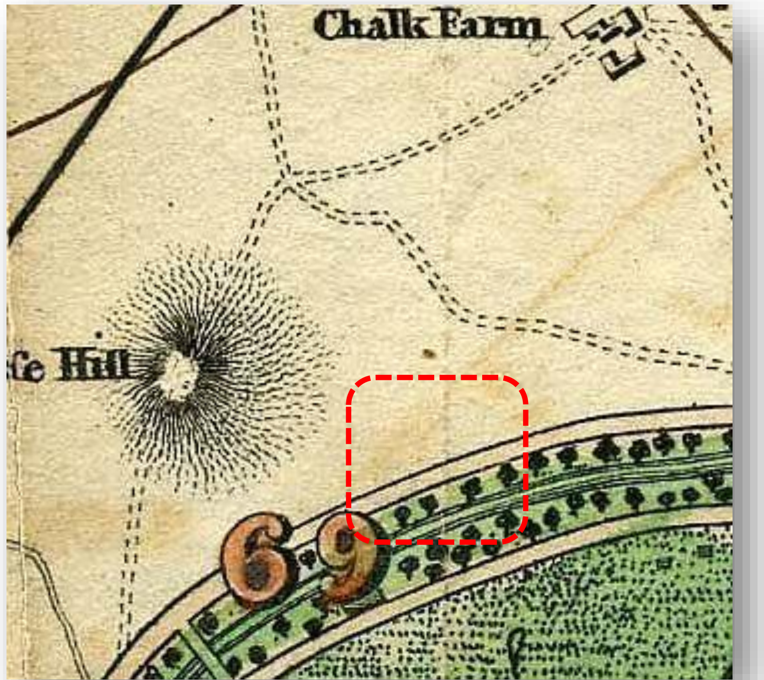


Pigot and Co's Metropolitan Guide1820

1.0 PREMISE

Nº. 31 Elsworthy Road is a mid-terrace residential property, a typical London Townhouse and one of eight remaining on the north side of the street. The dwelling, as the others, is arranged over four levels, from lower-ground to second with a traditional London butterfly roof. Its rafters spanning from party walls to a timber gutter beam, in turn supporting roof boards and slate tiles.

Under the development proposed a new single-level of basement will be constructed beneath the property, extending into the rear garden, from the back wall of the main house to garden boundary wall at the rear of the property.

This report describes the likely structural solution for constructing this development, the interaction of the subterranean extension to the lower ground floor with the local geology and hydrogeology and its impact on surrounding buildings. Construction techniques are highlighted along with particular requirements for temporary works and excavations.

2.0 THE SITE AND AREA

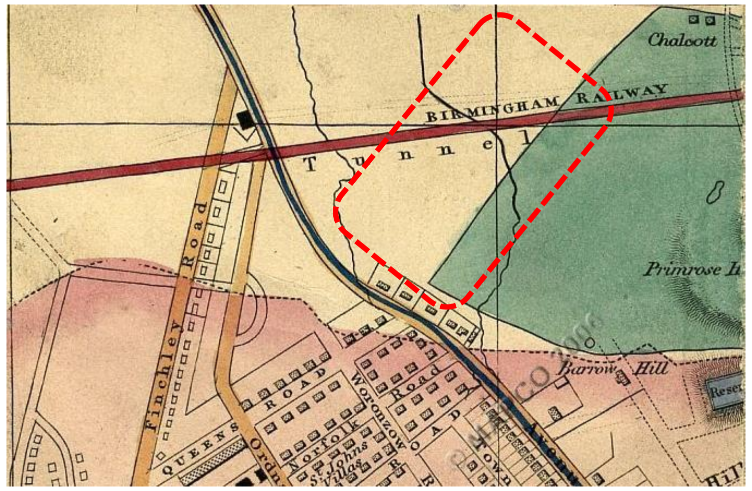
Elsworthy Road borders the north of Primrose Hill and is named for the Contractor employed by Eton Collage which was endowed the Manor of Chalcots [now Chalk Farm) by King Henry VI, for whom the next street north from Elsworthy Road is named. It was not, however, until the mid-19th Century that the college began development of the area and Pigot & Co's Metropolitan Guide of 1820 shows the area undeveloped at the beginning of that Century. Development of Swiss Cottage itself dates from 1826 when Finchley Road was established from Regent's Park to Ballard's Lane, the cost of which was met by a turnpike. One of the first buildings by the Toll Gate was Swiss-style Tavern, which became a bus terminus in 1859 and a metropolitan underground station in 1868, a change which prompted the development of the surrounding are from rural to urban, including Elsworthy Road.

Primrose Hill, which Elsworthy Road borders, was a medieval forest cleared during the reign of Elizabeth 1 for meadowland and it was used for various purposes including, during WWII, as a heavy anti-aircraft battery. A 3,500 ft railway tunnel connecting Swiss Cottage & Chalk Farm was built through the hill in 1834.

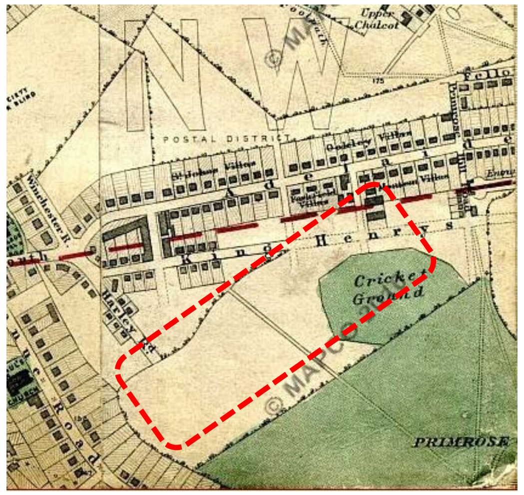
Cross's New Plan of London from 1850 records Finchley Road, Primrose Hill and the railway tunnel but none of the streets that were to be formed on the North Boundary of the Hill.

By 1864, however, substantial more development had taken place as recorded by Stanford's Library Map of London from that year, which records King Henry Road and Adelaide Road but where Elsworthy Road will be is still meadowland; it is unlikely that the land was cultivated though and instead uses for leisure, sport and shooting practice. Four years later, Weller's regarded Map of London records the same streets and plan for Elsworthy Road along its current line, which is recorded and named on Stanford's Map of 1897.

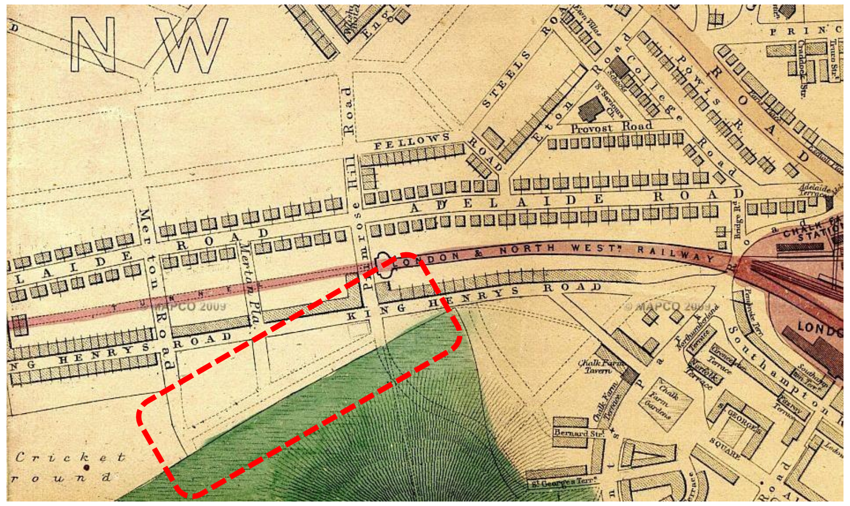
OS Maps from 1866 and from 1936 record in detail the development of the area and of Elsworthy Road which doubled in the first three decades of the 10th Century.



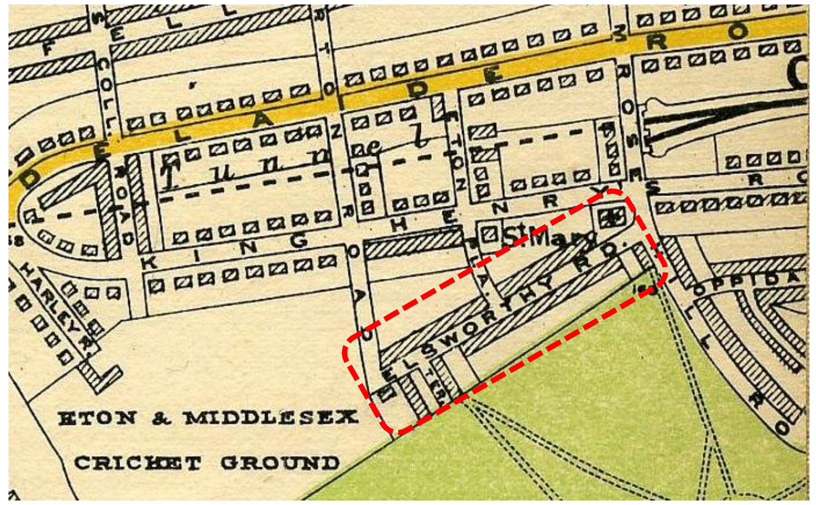
Cross's New Plan of London 1850



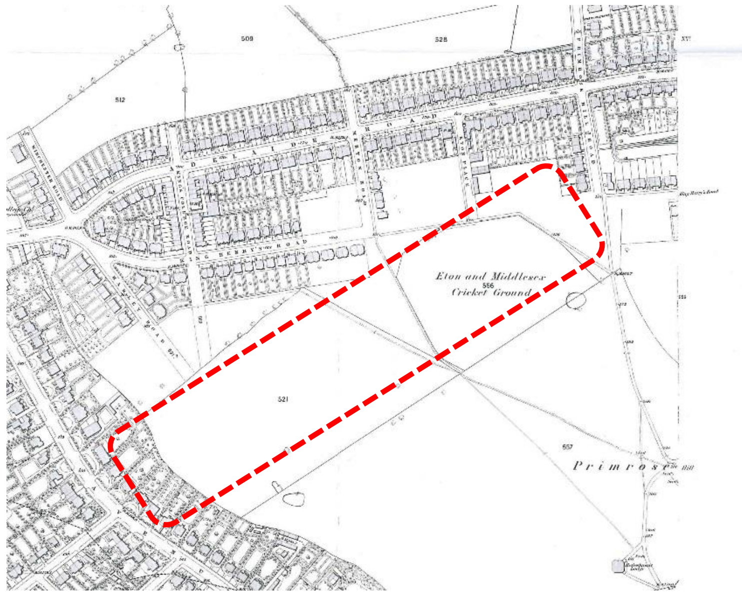
Stanford's Library Map 1864



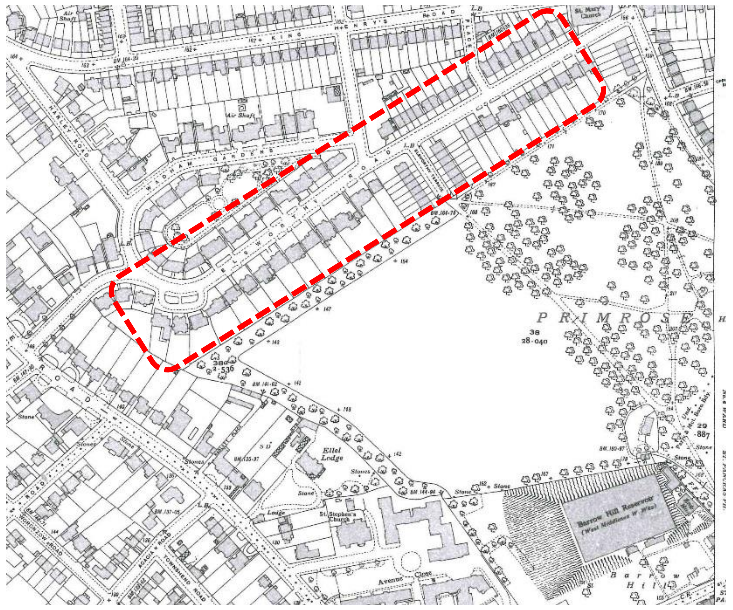
Edward Weller's Map of London 1868

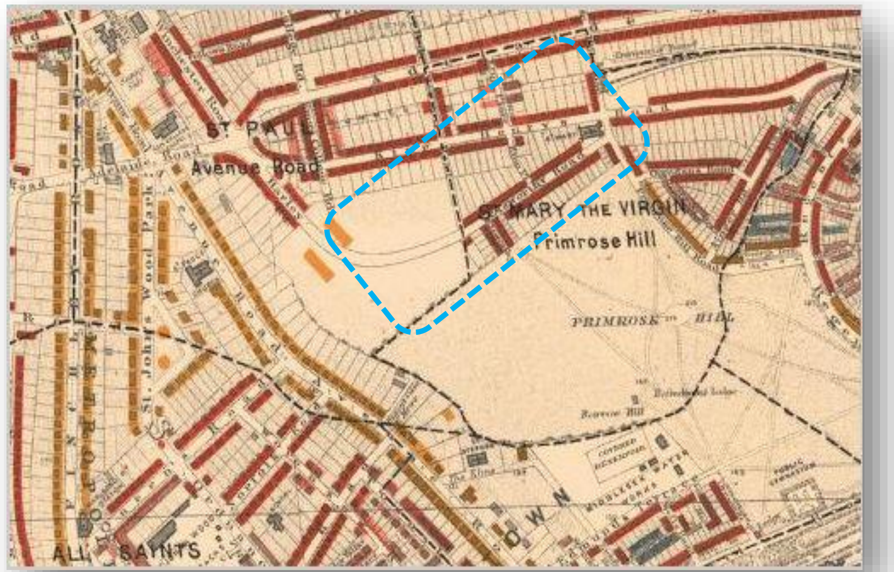


Stanford Map of London 1897



OS Map of London 1871


OS Map of London 1933



Booth's Poverty Map 1889


Bomb Survey

Booth's poverty map of 1898 records the residents of this area, understandably, as "Upper-Middle Class, Upper Class & Wealthy" and the layouts of the area and the surrounding streets much as they are today, albeit with Elsworthy Road in its first stage of development. Given the intention of the houses, i.e. homes for the upper classes, the build would have been to a very good-to-high standard using high-quality materials (e.g. well-seasoned timber, better-manufactured brick and stone source from a good quarry) and experienced tradesmen and craftsmen.

This area of London suffered damage from ordnance in WWII and many buildings in the area were subject to a number of hits. Properties on Elsworthy Road were completely destroyed or damaged beyond repair, though most emerged unscathed.

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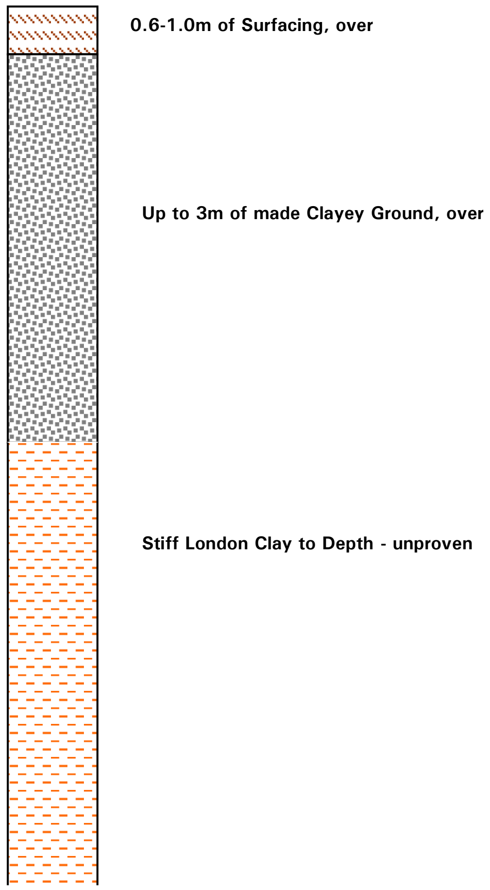
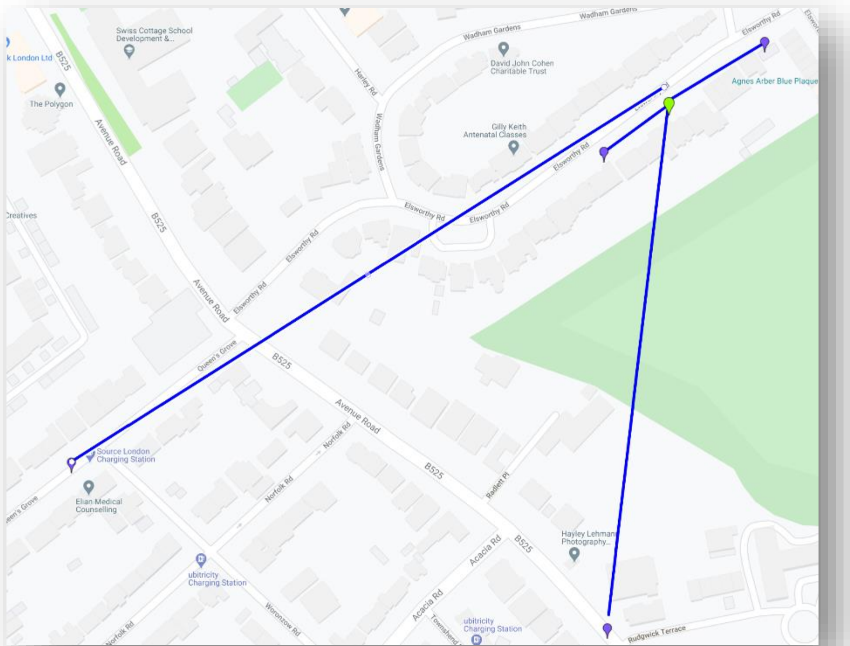
It was common when the railway network was built to disperse arisings from cutting excavations over adjacent land, which was often poorly compacted and led to settlement problems when that land was developed: The railway line nearby passes through a tunnel that was bored through Primrose Hill rather built in a cut so this is unlikely to have been the case here.

Records suggest that the development of this area, generally, was undertaken with some consideration and deliberation, using good practices and competent materials. The area was light agricultural, grazing or hunting land before it was a leisure area and then developed and has not been used in the past for industrial purposes, nor has it been repeatedly developed so the ground is likely to be relatively free from contamination and obstruction such as old foundations and cellars.

There are a significant number of mature trees in this area, in the rear gardens of the properties and on the road, all of which are capable in these ground conditions of influencing and affecting the design of the proposed basements which, in turn, must be detailed to avoid distressing the trees or their roots.



Soil Profile of Site-Specific SI



SI Map near 31, Elsworthy Road

3.0 LOCAL GEOLOGY & HYDROGEOLOGY

The geology of London and the Thames Basin lies above a deep concave layer of chalk which outcrops to the north as the Chilterns and to the south as the North Downs. The material within the chalk basin comprises Thanet Sands at depth overlain by the Lambeth Beds formerly known as the Woolwich and Reading Beds) which are generally a mixture of sand and clay. Above this is London Clay which Is approximately 50m deep generally and which outcrops at the surface around Notting Hill and north of it, encompassing Chalk Farm, Swiss Cottage and St John's Wood. In places there are deposits of Langley Silt (sometimes called brickearth) which is a mixture of silts, clays and sands. These formed the basic material for London stock bricks. Typically this overlies the sands and gravels. Because of its use for making bricks, Langley Silt has been excavated in many areas and the resulting pits backfilled generally with poor quality material. In some locations, the sands and gravels may also have been excavated for use in general construction associated with the development and expansion of London in the late 19th century, particularly for the new infrastructures, though this is less the case in this area where the Langley Silts are thin, if present. On top of these natural deposits there is often a layer of fill or made ground the result of many years of human occupation which, in parts of Central London can be 4 to 6m thick.

However, other than in localised areas, LBC, like RBKC was only been built on for the last 150 years, so there is less fill, typically no more than 1 to 2m. As part of the initial development of an area, houses were developed with a raised ground floor level and a lower ground floor which provided access to the rear garden. As a general guide, the garden level is likely to relate relatively closely to the pre-development ground levels in the area, with the road levels raised between one and two metres above this. Excavated material from foundations, drain runs etc was used to build up the general level of the roads. Vaults were constructed under the pavements originally for the storage of coal for terrace housing, which was not the case with detached houses such as No. 31. Soil investigations on Elsworthy Road record a fairly-consistent band of made-ground, imported from elsewhere which suggests that the area levelled to the boundary of Primrose Hill.

The near-surface soil profile in this area of London is well-known and we know from several soil investigations we have commissioned:

From an MBP Borehole on Elsworthy Road
- **2-3m of MADE GROUND over increasingly-stiff LONDON CLAY TO DEPTH**

From an MBP Borehole on Avenue Road:
- **3.0m OF MADE GROUND over ver-stiff LONDON CLAY TO DEPTH**

From an MBP Borehole in Loudoun Road :
- **0.2m OF MADE GROUND over SANDY GRAVEL to 1.0m, over COMPACT SANDY GRAVELS Becoming dense with depth to 7m**

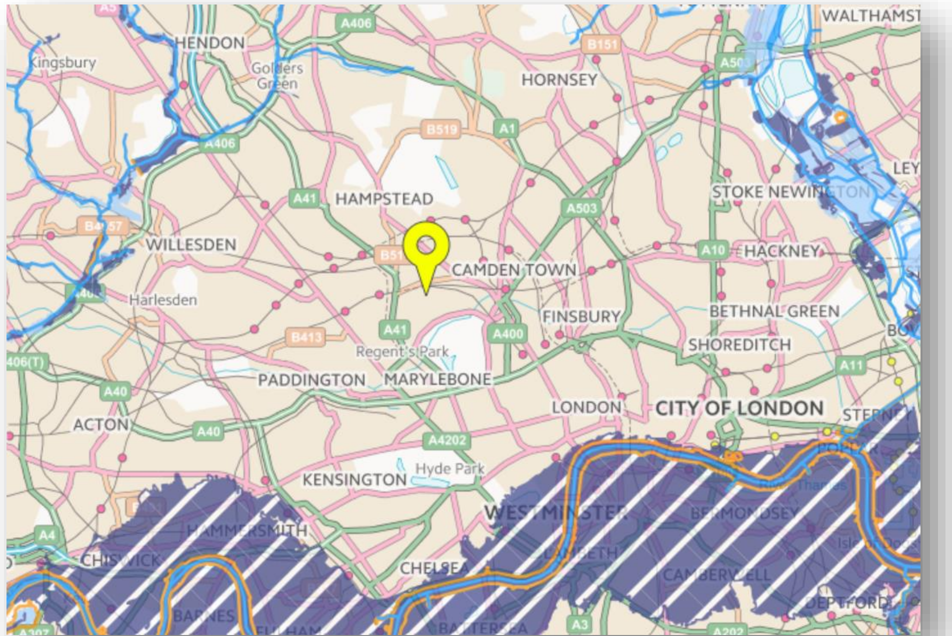
From an MBP Borehole in Elsworthy Road:
- **1.0m OF MADE GROUND over fine to coarse SAND and GRAVEL to depth over LONDON CLAY TO DEPTH**

Each of these investigations is within 1,000m of No. 31, Elsworthy Road and are representative of the near-surface geology in the area and can be expected with a high degree certainty at the site.

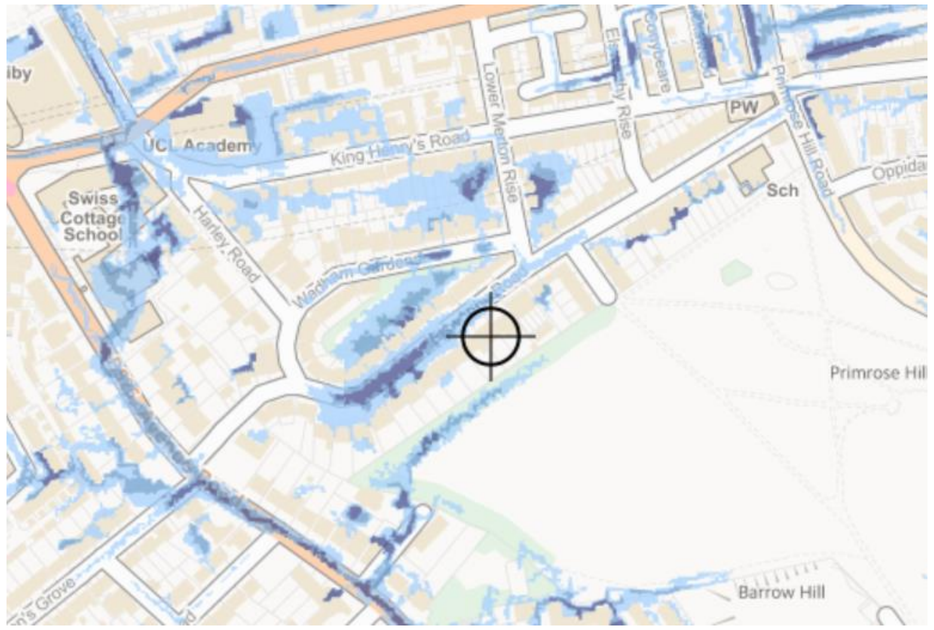
A site-specific investigation completed by **SCL on July 2nd 2013** confirmed the near-surface to be identical to those summarised above with only a thin band of made ground over the increasinlgy stiff clay, proven to -15m. The site log from that SI is included as an Appendix.

Groundwater was not encountered within the clay during the site investigation but some seepage was within the made ground, possibly from a perch within that layer so the proposed construction will not extend beneath the prevailing groundwater level in this area.

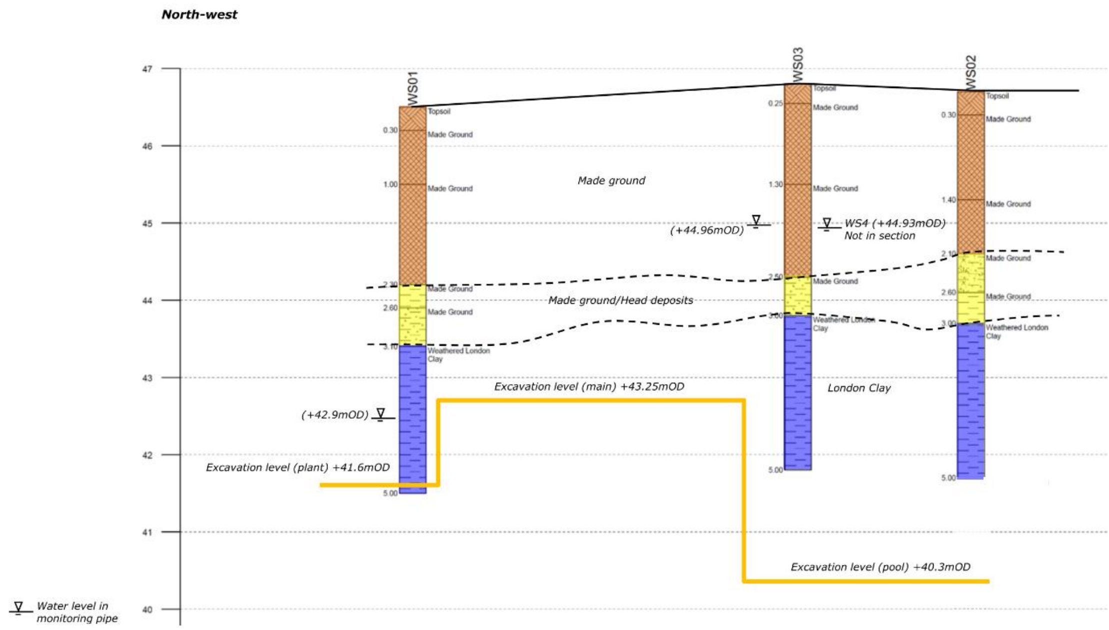
Lost Rivers of London



Flooding from the Sea



Flooding from Surfacse Water



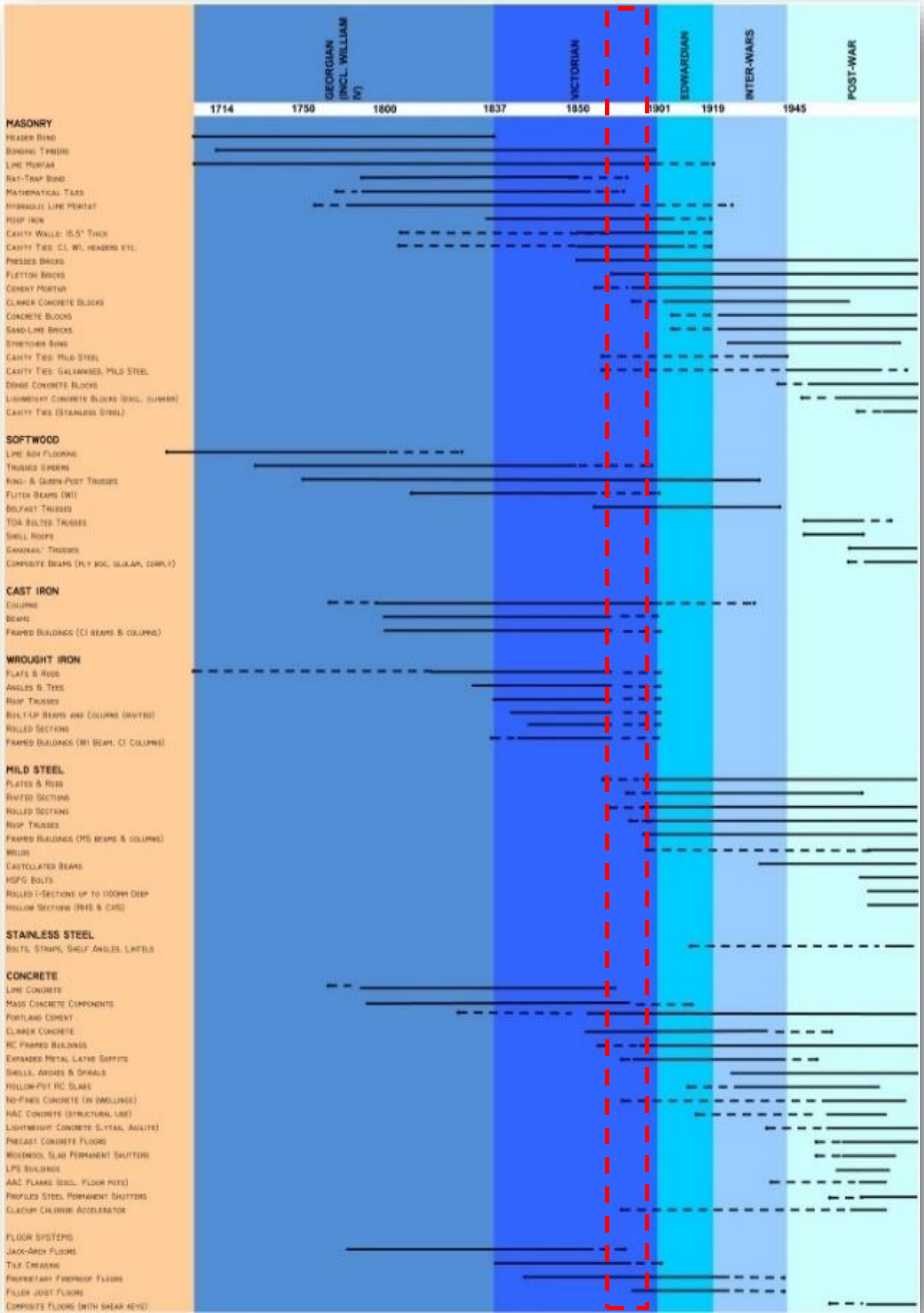
The London basin contains a Lower Aquifer which lies deep below ground within the Thanet Sands and Chalk and an Upper Aquifer within the River Terrace Deposits where they overly the London Clay. It is fed from the chalk outcrops to the north and south of the Thames Valley. However, because of the impermeable London Clay which lies beneath the gravel terraces there is a local perched water table which is fed by precipitation within the Thames Valley, known as London's Upper Aquifer and a significant contributor to the water in the upper aquifer is burst or leaking water mains. The water on this upper aquifer tends to flow slowly across the surface of the London Clay depending on the permeability of the overlying sands and gravels. London's development has altered what were natural open ditches which flowed into tributaries of the River Thames; Counters Creek and the River Westbourne. However, the upper aquifer water levels do not vary significantly as water drains away into the Thames basin. The flows across the surface of the London Clay have historically eroded shallow channels in the surface of the clay which tend to be filled with sand and gravel. These can have an influence on local ground water levels and ground water flows.

There are numerous 'lost' rivers running below the ground in London, and the Tyburn did run close by on its route to the Serpentine. The site is not, however, within the catchment of the Hampstead Heath Pond Chains

The Environment Agency Flood Maps record that the site lies very-much in Flood Zone 1, which is to be expected given its elevation, is significantly outside Flood zone 3, and therefore is not considered to be at risk of flooding from the river or sea. The depth of the proposed basement will not affect The London Aquifer which is to be found around 100m below the London Clay. This area does have experience of surface flooding, as the map below indicates, and although improvements to the drainage systems have reduced this risk, the specification, detailing and installation of the waterproofing systems will reflect this level of risk.

The design of the foundations will be to the current design standards (British or Euro) which require the water table to be considered to a reasonable height, so allowing for the impact and influence of burst water mains etc and the basement will be designed for a ½ depth of water for similar reasons.

The impact of the basement on the local hydrogeology, drainage and SuDs, including groundwater flows, is addressed further in Appendix C of SCL's report 10588 which concludes that there will be no risk of hydrogeological issues nor a need for further investigation.

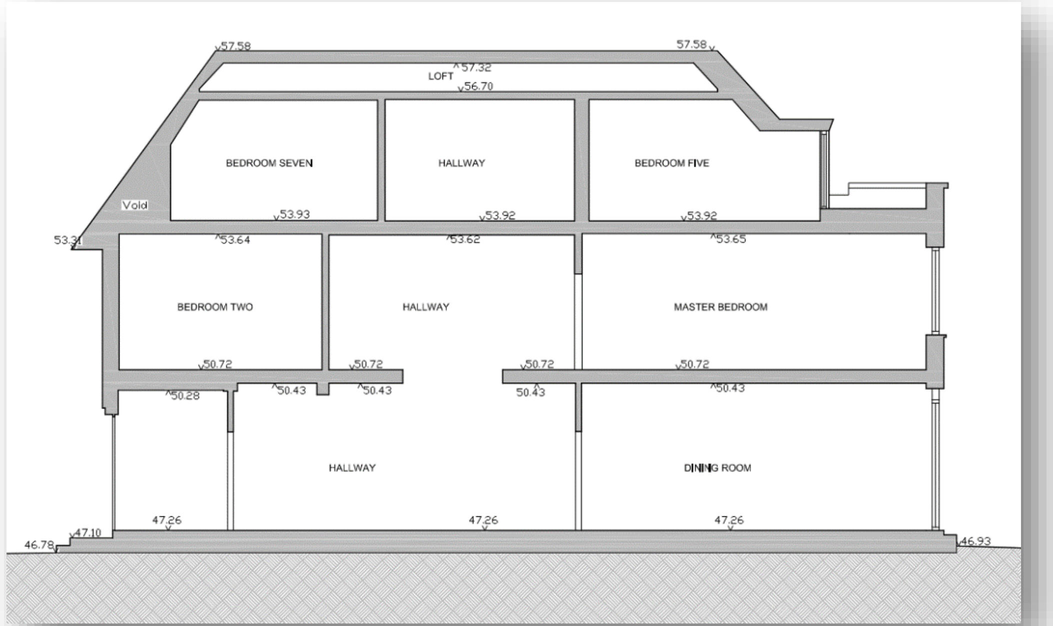


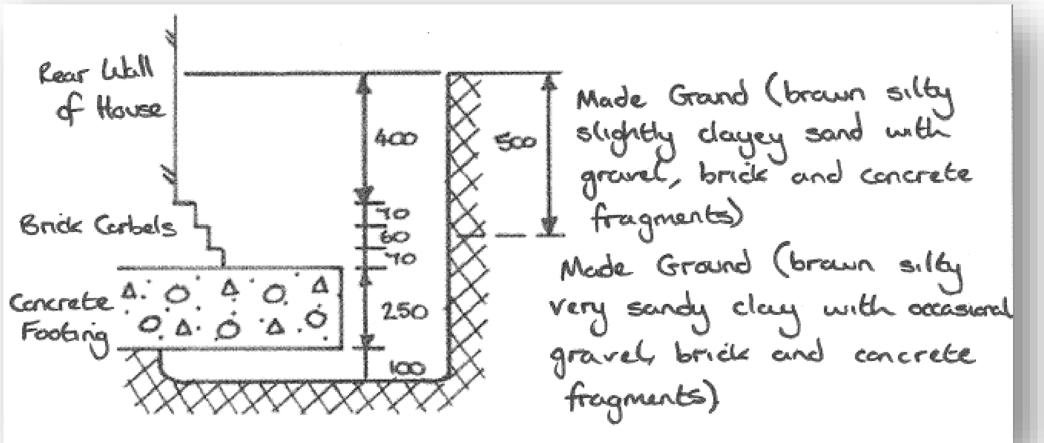
Construction Timeline

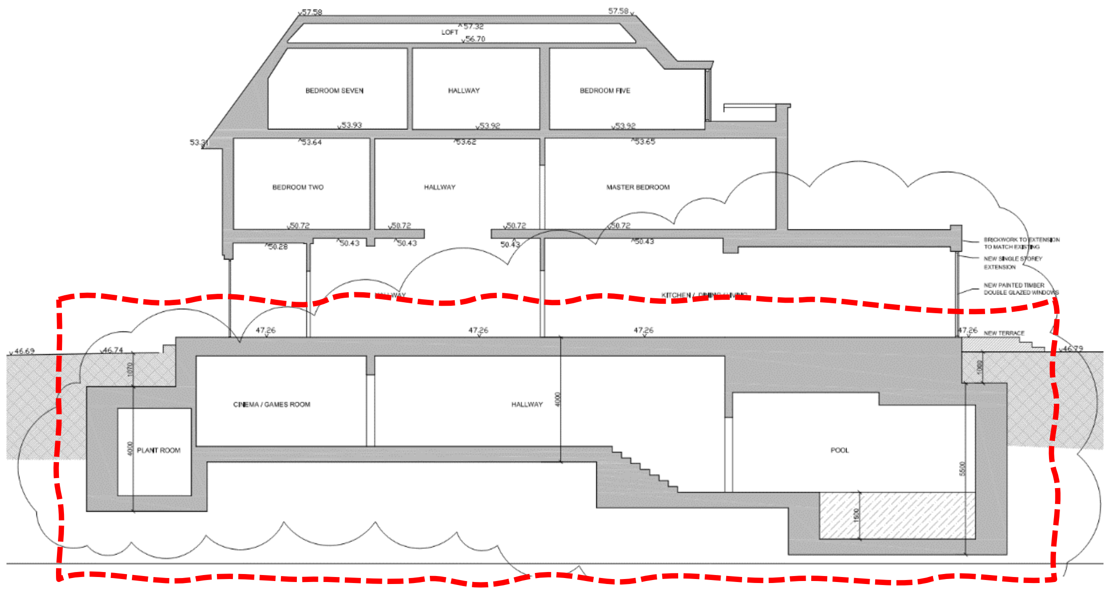
4.0 THE EXISTING BUILDING

The existing building is most-likely the first and only construction on this site and, if any buildings were sited here, they were of slight construction and low impact. It has, like similar period properties, loadbearing masonry walls, with brick corbel foundations formed off the underlying sandy clay, which support timber upper floor joists and pitched roof built from timber rafters rather than trusses and finished in slate.

The building is in good condition and benefits from good maintenance, upkeep and repair. At existing lower ground level the original loadbearing walls are still in place; the staircase to ground floor is probably original or in the original position. There is no evidence of distress or damage to the construction or fabric of the building, such as bulges, cracks, disruption, dampness or decay, the floors are level and the walls are plumb and sound. There is therefore no indication or suggestion in the fabric and form of the house that its construction cannot support the proposed works, both in their execution or when complete.







Construction of a Basement within a King-Post Retaining Wall

Construction of a Basement within an Interlocking Steel Sheet Pile Wall

5.0 THE PROPOSED DEVELOPMENT

The proposed development will construct a single level of basement beneath the existing footprint of the current building to the extents of that in length & width and which will extend into the front and rear gardens. The top slab of this basement outwith the house will be more than 1100mm beneath the existing and proposed garden level. The existing ground floor will be replaced in the final scheme to prop the basement walls but could be retained throughout the works to maintain the support and stability that it currently provides to the side, front and rear walls.

BELOW GROUND LEVEL

The proposed basement will be an entirely new construction using reinforced and unreinforced concrete. Beneath the main house the existing walls will be underpinned following traditional techniques and hit-&-miss sequences. In the garden the new walls can be built using a similar technique (the ground will be stable enough when excavated & banked to accommodate this method) but may, alternatively, be constructed by other methods, such as:

- CFA piles serving as both temporary and permanent construction
- Steel sheet piles pressed in to place serving as temporary and permanent construction (when the clutches are welded)
- Within an open excavation supported by a king-post system

All of these options will serve the proposed design but will carry different implications for plant required, lead-in and construction programme and cost and the choice will be negotiated with the intended contractor.

The excavation of around 4.00 m of soil will result in an unloading of approximately 70 kN/m^2, an unloading that will allow a heave of the underlying London Clay, which will comprise an "immediate" elastic component of around 50-75% that can be expected to occur within the excavation and construction period, together with long-term swelling movement that would theoretically occur over a period of many years. The effects of heave will be mitigated to some extent by the loads applied by the existing building, but the movements could yet be noticeable, particularly in the garden where no loads are currently present to minimise movements. In addition, the variation in unloading across the excavation may lead to differential movement and an analysis of these potential movements will be undertaken once the basement design has been finalised. There are no known services in the rear gardens but a survey before works commence will be required to identify, established and protected if necessary, during the construction process.

The new basement slab, along with the ground slab it will support, will be cast in reinforced concrete with the basement slab being groundbearing rather than suspended; a heave analysis during detailed design may require this slab to be formed off void former or be reinforced further to accommodate latent heave forces. Although considerably above the prevailing groundwater level the new construction will be provided with Types A (barrier), B (structurally integrated) or C (drained) protection against ingress of water, as defined by BS 8102:2009 and constructed and detailed to achieve a Grade 3 Level of Performance, as defined by BS 8102:2009.

The pool is located outside the footprint of the existing house so is within the area retained by CFA piling where its formation will be ~1500mm deeper than the rest of the basement.

UNDERPINNING IN A HIT-&-MISS SEQUENCE

Although a lengthy process, underpinning by hit-&-miss-sequencing is a low-impact technique that permits the maximum space to be achieved and has the least impact on existing constructions, boundaries and the like and requires the least amount of plant.

Underpinning To A Masonry Wall

Construction of a Basement Wall by Hit-&-Miss Sequence

Construction of a Basement Wall by Hit-&-Miss Sequence

Any excavation leads to some horizontal movement within the adjoining ground because soil exists in a three-dimensional stress condition that deforms under the influence of those stresses. If lateral stress is relieved by excavation, the soil will expand accordingly in a lateral direction into the new void and simultaneously compress vertically to maintain its volume. The sides of each pit prepared for an underpin will move horizontally into the excavation, resulting in vertical downward movement of the ground around the excavation, as the soil maintains its volume. The amount of this movement depends on a number of factors, including the density, consistency and plasticity of the soil, the existing load condition, and the shoring used as the excavation proceeds and in stiff London Clay is usually very small.

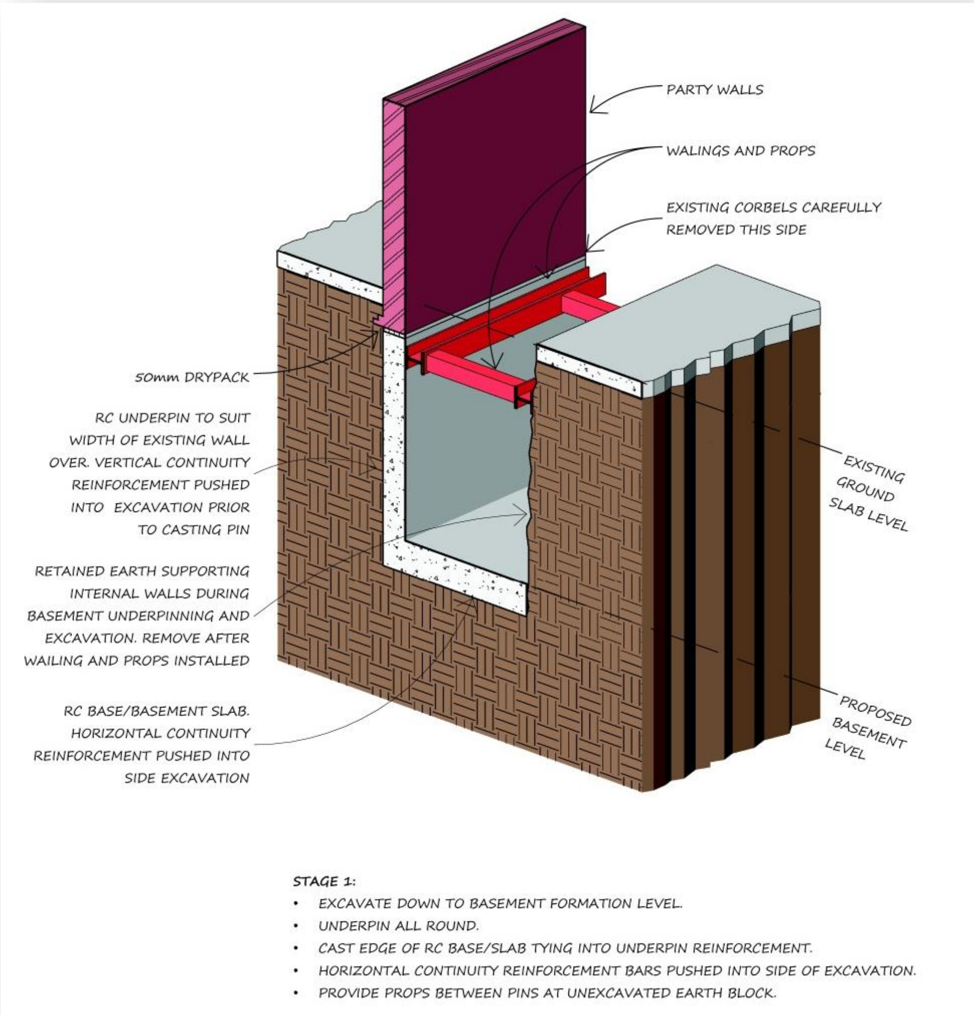
Casting the wall in pins controls the extent of soil exposed, avoids extensive temporary works and they can be controlled in size and sequence to reflect and accommodate the condition and capability of the walls they will be built beneath. Two-stage vertical sequencing can be integrated into the process to further minimise the depth of exposed excavation and therefore minimise the movement required to maintain volume and to control loose material. As each pit or stage of pit is excavated beneath the wall, and prior to concreting, the vertical sides or faces of that excavation are shored up to prevent the adjacent soil collapsing into the new void

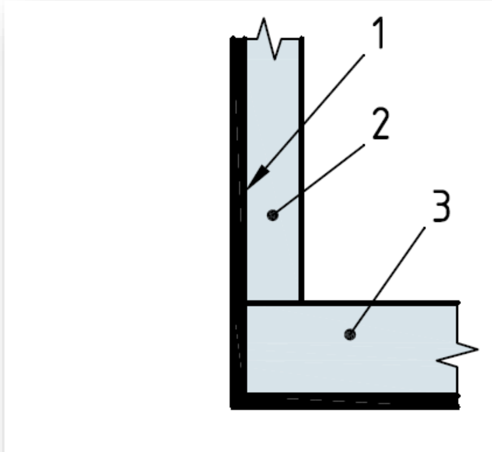
Table 2 **Grades of waterproofing protection**

Grade	Example of use of structure [A)]	Performance level
1	Car parking; plant rooms (excluding electrical equipment); workshops	Some seepage and damp areas tolerable, dependent on the intended use [B)] Local drainage might be necessary to deal with seepage
2	Plant rooms and workshops requiring a drier environment (than Grade 1); storage areas	No water penetration acceptable Damp areas tolerable; ventilation might be required
3	Ventilated residential and commercial areas, including offices, restaurants etc.; leisure centres	No water penetration acceptable Ventilation, dehumidification or air conditioning necessary, appropriate to the intended use

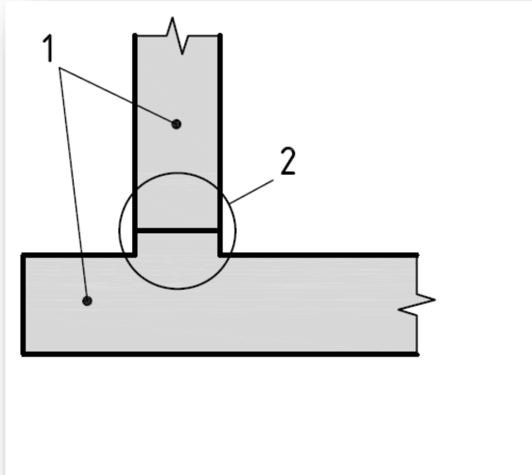
A) The previous edition of this standard referred to Grade 4 environments. However, this grade has not been retained as its only difference from Grade 3 is the performance level related to ventilation, dehumidification or air conditioning (see BS 5454 for recommendations for the storage and exhibition of archival documents). The structural form for Grade 4 could be the same or similar to Grade 3.

B) Seepage and damp areas for some forms of construction can be quantified by reference to industry standards, such as the ICE's *Specification for piling and embedded retaining walls* [1].



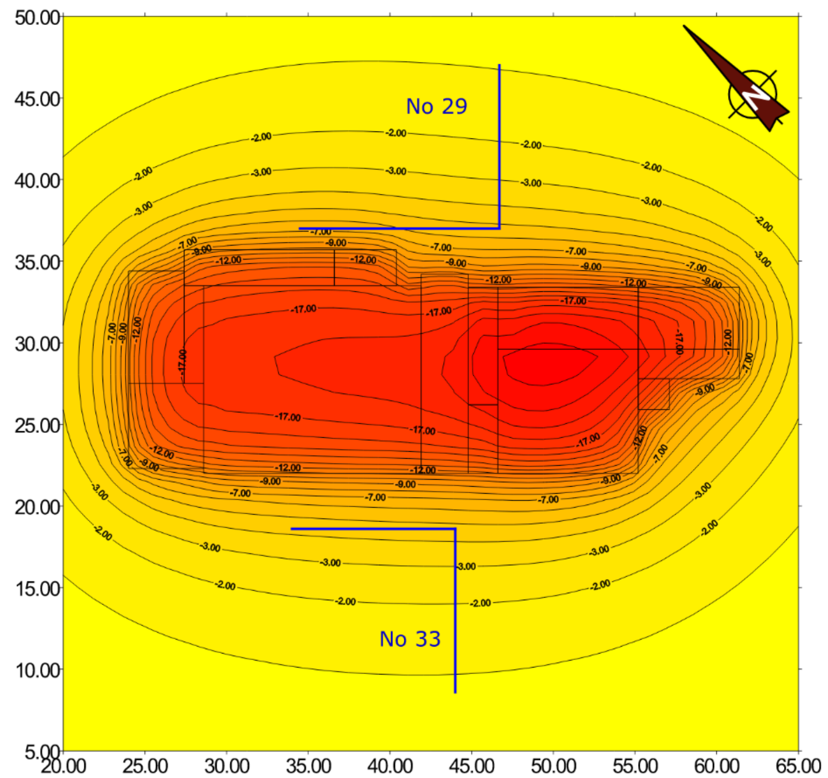


a) Type A (barrier) protection



b) Type B (structurally integral) protection

The material removed will be made ground and the top layer of clay, which will relieve pressure on the London Clay that underlies the site, and we estimate that this relief will not be significant, will not lead to noticeable swelling of the clay and so will not impact significantly on the surrounding buildings and foundations, as concluded in the *Basement Impact Assessment* provided with the site investigation report by SCL. Such heave that may occur will mostly, i.e 80% occur immediately on excavation, identified as the end of construction for this parameter



Heave due to Basement Construction

There is no active groundwater within the proposed construction zone we propose an external waterproofing layer to the underpin walls, which will the first layer of defence in the Grade 3 Performance Waterproofing Specification & suggest a bentonite-impregnated membrane installed between the back of the concrete wall elements and the retained soil, such as VOLCAY supplied by CETCO.

The basement slab will be a reinforced concrete raft cast on a suitable sub-base and will be formed off the underlying London Clay. While neither pad nor strip foundations are intended the slab may need to be thicker beneath the lines of the walls that will be built in loadbearing masonry and support the floors above, which will require a deeper formation.

The existing ground slab will be replaced by a suspended reinforced concrete slab spanning between steel transfer beams, which, when complete, will permanently prop the basement walls below, both insitu and piled.

ABOVE GROUND LEVEL

Internal remodelling of the upper floors will involve extending the ground floor into the garden, removing loadbearing walls and raising a new liftshaft and services riser through the main house. These interventions, which will be designed after planning has been consented, will be accommodated, and supported by the new construction below ground level and have been included within the consideration of its design at this stage.

6.0 DRAINAGE & SUDS

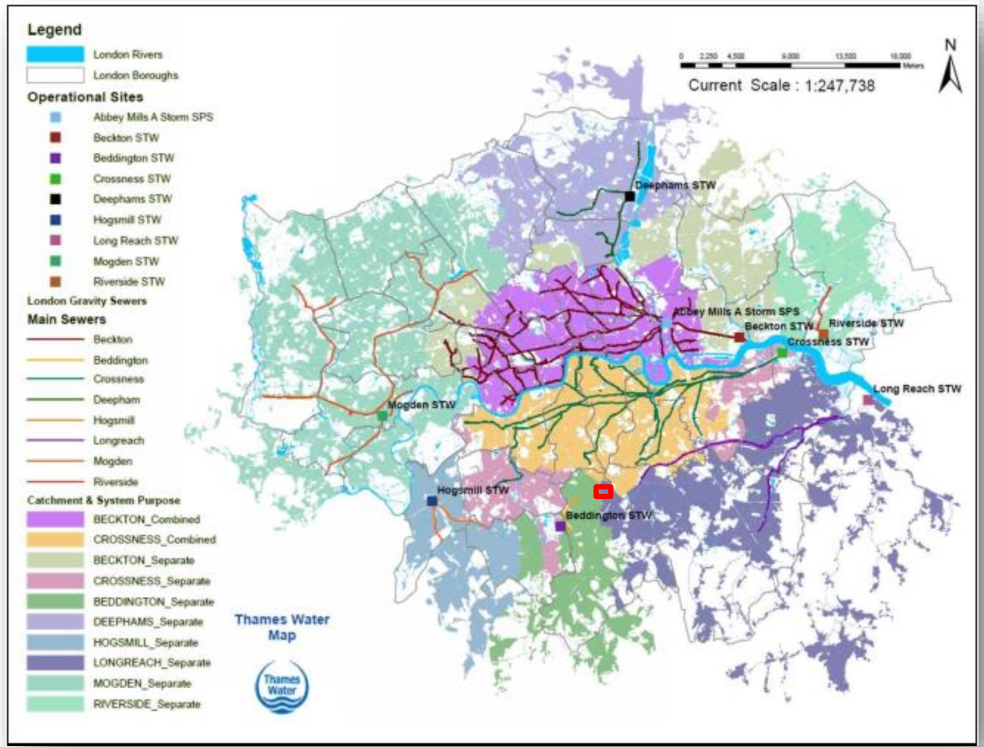
The proposed development will not discharge more run-off from the site, in volume or flow-rate than is the case now or has been in the past: through the retention of a substantial depth of soil over the basement natural run-off will be maintained and enabled. Protection to the basement is nevertheless necessary, and will be provided by a non-return valve in the discharge line that will prevent back-wash from flooding of the local drains entering the basement in particular.

The proposed basement works will occupy the same plan area and whilst it creates additional habitable space it provides the same level of accommodation and occupancy and so will not generate any greater discharge to the existing public sewer. There also will not be an increase in hard-standing and impermeable areas so the amount, timing and quality of surface water run-off to the public sewer will not increase.

The scale and scope of the basement works will require a new below-ground drainage system to be provided by combining gravity flow from the above-ground accommodation and new pumped flow from the basement accommodation. The final connection between this system and the public sewer will include an anti-flood valve to protect the property from surcharges in the public sewers. The system will be designed to cope with local surface flooding, as the site is identified in an Environment Agency Zone of having high risk of flooding from surface water, as well as the required uplift for climate change. The site has soft landscaped areas which will remain unchanged, generating some natural percolation for surface and rain water.

There will also be no increase in surface water run-off and it will be discharged, as it is currently, directly to the public sewer. Foul drainage from the basement will be positively-pumped via a **Flygt Compit Pump Station,** or equally approved, **f**itted with a non-return check valve.

The London Borough of Camden's Flood Risk Management Strategy indicates that the site is within Group 3-005 Critical Drainage Area, which the council's Surface Water Management Plan defines 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 Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure." The Flood Risk Assessment report done by Evans Rivers and Coastal (included as appendix C in Soil Consultants GIR & BIA dated 11th October 2019) assesses the sources of flooding at the site, identifies the risks of each source of flooding and outlines recommendation for the management of these risks.



Combined and separated sewer system (Source: Thames Water/London Sustainable Drainage Action Plan)

Most Suitable	SuDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
	Green roofs	✓	✓	✓
	Basins and ponds 1. Constructed wetland 2. Balancing ponds 3. Detention basins 4. Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices 5. Soakaways 6. Infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains 7. Gravelled areas 8. Solid paving blocks 9. Porous paviours	✓	✓	
Least Suitable	Tanked systems 10. Oversized pipes/ tanks 11. Box storage systems	✓		

SuDS hierarchy (from the London SDA Plan Table 1 & Box 1)

Box 1: London Plan Policy 5:13 Sustainable Drainage

Planning decisions

A. Development should utilise sustainable urban drainage systems (Sustainable drainage) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:
 1 store rainwater for later use
 2 use infiltration techniques, such as porous surfaces in non-clay areas
 3 attenuate rainwater in ponds or open water features for gradual release
 4 attenuate rainwater by storing in tanks or sealed water features for gradual release
 5 discharge rainwater direct to a watercourse
 6 discharge rainwater to a surface water sewer/drain
 7 discharge rainwater to the combined sewer.

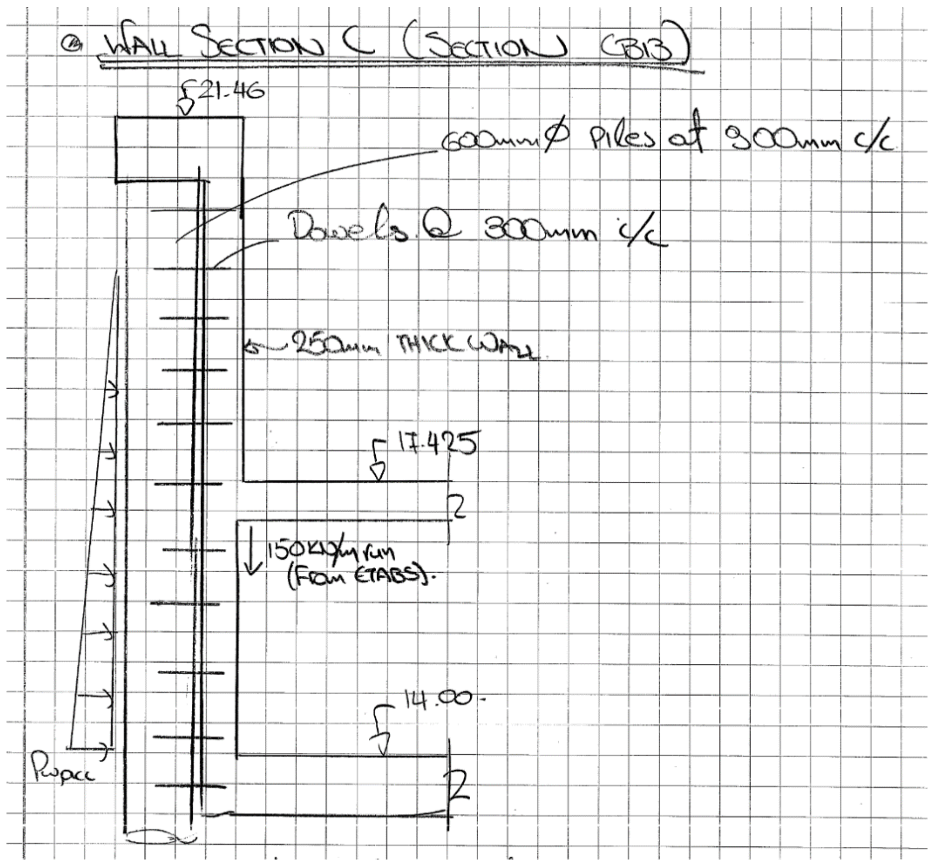
Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

LDF preparation

B. Within LDFs boroughs should, in line with the Flood and Water Management Act 2010, utilise Surface Water Management Plans to identify areas where there are particular surface water management issues and develop actions and policy approaches aimed at reducing these risks.

Damage Category	Description of Typical Damage	Approximate Individual Crack Width
Negligible (0)	Hairline cracks	< 0.1 mm
Very Slight (1)	Very slight damage includes fine cracks which can be easily treated during normal decoration, perhaps an isolated slight fracture in building, and cracks in external brickwork visible on close inspection.	1 mm
Slight (2)	Slight damage includes cracks which can be easily filled and redecoration would probably be required, several slight fractures may appear showing the inside of the building, cracks which are visible externally and some repointing may be required, and doors and windows may stick.	< 5 mm
Moderate (3)	Moderate damage includes cracks that require some opening up and can be patched by a mason, recurrent cracks that can be masked by suitable linings, repointing of external brickwork and possibly a small amount of brickwork replacement may be required, doors and windows stick, service pipes may fracture, and weather-tightness is often impaired.	5 mm to 15 mm or a number of cracks > 3 mm
Severe (4)	Severe damage includes large cracks requiring extensive repair work involving breaking-out and replacing sections of walls (especially over doors and windows), distorted windows and door frames, noticeably sloping floors, leaning or bulging walls, some loss of bearing in beams, and disrupted service pipes.	15 mm to 25 mm but also depends on the number of cracks
Very Severe (5)	Very severe damage often requires a major repair job involving partial or complete rebuilding, beams lose bearing, walls lean and require shoring, windows are broken with distortion, and there is danger of structural instability.	> 25 mm

Table 1: Severity of Cracking Damage[4, 5]



7.0 RISKS TO & IMPACT ON SURROUNDING BUILDINGS

The proposed development is a relatively low-level, low-density construction and it will occupy the same overall footprint and will incorporate the existing boundaries in its envelope.

The surrounding buildings fall in to Group 1a defined by BS ISO 4866:2010, i.e. **Ancient, Historical** or **Old**; the foundations to the new building fall in to Classes B & C and the soil as Type e: from Table B1 of BS ISO 4866 the surrounding buildings fall within Category 6 and can be considered to have a medium resistance to vibration. From Table B.2 of BS ISO 4866 the surrounding buildings fall in to Class 8, which are deemed to have a medium level of resistance to vibration and, conversely, to require no or little protection against vibration for the types of works intended.

- Although the construction will be further below ground level than the existing building it will not be significantly deeper than the lowest level of surrounding buildings.
- The basement construction will not be lower than the prevailing groundwater level in this area so will not interfere with the natural flow of the groundwater.
- The new construction will be formed off and within London Clays, which are firm and have a significant bearing capacity, and the foundations will be designed to reflect the recommended permissible pressures and ensure they will not be compressed by more than 10mm – the GMS predicts consolidation of less than 10mm
- Removal of the existing construction will generate relief and consequent heave in the London Clay, although at levels that are manageable and contained within the plot
- The boundary walls on four sides can be retained safely and easily following industry-standard practices and, by following a pre-determined sequence will allow the basement walls to be constructed without detriment to the existing, surrounding construction.
- Excavations for the pins that will form the new basement walls can be undertaken using a small excavators, which will be low-impact technique and unlikely to generate excessive vibration.
- Piling, either CFA or steel sheet piles, will be set by low-impact means, i.e. coring or hydraulic pressing which will generate little vibration.

SCL's Ground Movement Analysis, provided as Appendix A to this report, determined that the damage categories for the walls of Nos. 29 & 33 are, for the most part, 0 or 1: there are some walls that risk Damage Category 2 where the support system has medium stiffness and DC1 where the support system has high stiffness and to ensure the latter is provided to the retaining wall along the relevant boundary (with No. 29). This will be achieved by compositely connecting the liner wall to a piled wall or specifying thicker, stiffer underpins if those are adopted instead.

To ensure that any damage is limited to category 0 or 1, a controlled and sequenced work process needs to be adopted and a robust temporary support system employed during the works to ensure that lateral movements of the retaining structure are minimised. In the permanent case, the retaining wall is to be designed to have lateral restraint provided by the ground floor and new lower ground floor.

CIRIA Report C760 provides comprehensive consideration and recommendations of ground movements behind embedded retaining wall, from which it has been summarised that the distance from the wall that movements are negligible are a multiple of the wall height. While that data is based on walls constructed by piling, the results are not dissimilar for cast-insitu walls so this data can be used with confidence to suggest that movements consequent of these works will, too, be very slight.

Table 6.1 ***Ground surface movements due to bored pile and diaphragm wall installation in stiff clay***

Wall type	Horizontal movements		Vertical movements	
	Surface movement at wall (per cent of wall depth)	*Distance behind wall to negligible movement (multiple of wall depth)*	*Surface movement at wall (per cent of wall depth)*	*Distance behind wall to negligible movement (multiple of wall depth)*
Bored piles				
Contiguous	0.04	1.5	0.04	2
Secant	0.08	1.5	0.05	2

The same report suggests parameters for assessing ground movement due to excavation in front of bored piles which gives further confidence that such movements at this site as consequence of the proposed works will be very slight.

Table 6.3 ***Ground surface movements due to excavation in front of bored pile, diaphragm wall and sheet pile walls wholly embedded in competent ground (stiff clays)***

Movement type	High support stiffness (high propped wall, top-down construction)		Low support stiffness (cantilever or low-stiffness temporary props or temporary props installed at low level)	
	Surface movement at wall (per cent of max excavation depth)	*Distance behind wall to negligible movement (multiple of max excavation depth)*	*Surface movement at wall (per cent of max excavation depth)*	*Distance behind wall to negligible movement (multiple of max excavation depth)*
Horizontal	0.15	4	0.4	4
Vertical	0.1	3.5	0.35	3.5

Conveyor to remove arisings

Small Disposal Waggon for Removing Arisings

8.0 CONSTRUCTION METHODS & SEQUENCE

The excavation for, and construction of the basement will need to be completed without involving or disturbing the surrounding buildings. The sequence of the works for the construction phase of this project will, ultimately, be prepared by the contractor who will undertake the works but we expect, and will guide them towards a sequence similar to the following:

- Sequenced construction of the underpinning of the house starting from the middle and working down from existing footing level,
- Pins to start at four or five locations reducing to one at completion, following a traditional 1 3 5 2 4 sequence,
- Backfill each pins when complete,
- Piling to commence independently of the undedrpinning with capping beam cast before excavation commences
- Arisings removed by conveyor to skips or wagons. The contractor may opt to store arisings temporarily before removal from site,
- Installation of lateral props between the house walls just above existing undercroft ground level,
- Excavation down to slab formation level,
- Installation of new below ground drainage,
- Formation of reinforced concrete basement slab,
- Formation of reinforced concrete liner wall,
- Removal of temporary props.

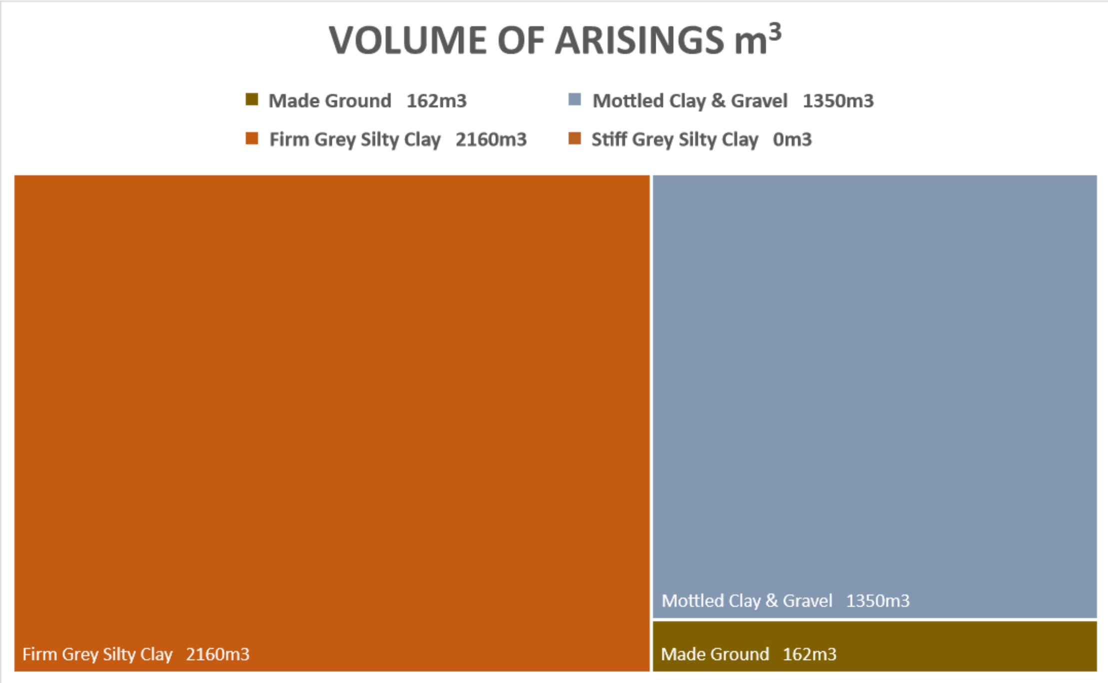
Underpinning is done following a hit-&-miss sequence; local props and sheeting will be required to support the excavations. With the conclusion of the perimeter underpins and commencement of excavation works, bracing props will be installed between the walls, and maintained in place until the new basement slab and part of liner wall are constructed. Continuity reinforcement between the pins will allow lateral props to be provided at 2-3m c/c rather than to each pin.

The programme of works will be confirmed once the contractor is appointed but it is expected that the subterranean construction will take approximately 6 months.

Elsworthy Road is a popular and busy residential road. Traffic is two-way, there are more than one route in and out of the road and the road is wide enough for traffic to pass in both directions with vehicles parked on either side. It is a road that will accommodate construction traffic although a traffic management plan will be necessary for the control of construction vehicles particularly during excavation.

Temporary storage of arisings

Shored Excavation for an underpin



9.0 NOISE & NUISANCE

Construction works generally are a source of noise and nuisance which can affect operatives within the site as well as neighbours and passing members of the public. Demolition and excavation works are particular sources of this potential harm so it will be necessary during these works, at 31, Elsworthy Road, for the contractor to mitigate the extent and impact of noise, dust, traffic and vibration.

Noise: Generated by the mechanical equipment used to excavate for the new basement;
Mitigated by using electrical equipment where possible and mufflers or attenuators on diesel engines or generators, by working only within agreed and designated hours;

Dust: Generated by excavation works and the transfer of arisings from the works area to the disposal skip or wagon;
Mitigated by damping conveyors when in operation, by installing a weatherproof cover over the site, by washing-down vehicle wheels before leaving site;

Traffic: Generated by delivery and removal vehicles travelling to and from site;
Mitigated by establishing a traffic management plan, by identifying and using routes appropriate to the vehicles, by scheduling Vehicle movements to avoid peak traffic periods, by ensuring vehicles are low-emission standard;

Vibration: Generated by use of heavy breakers for sustained periods and by heavy vehicles or plant
Mitigated by using light, hand-held and electrical breakers, by avoiding excessively heavy plant.

Protection: Robust hoarding will be erected around the site, front rear and sides, to secure the site from intrusion as well as provide protection to neighbours and passing public from noise, dust and material arisings.

The works will cover around 540m^2 and excavate to ~4.5m over the area, which will generate approximately 3,700m^3 of spoil as scheduled alongside. Removal of this volume will need around 180 vehicles.:

Covered Site

Small Excavator used near Boundaries

10.0 CONCLUSIONS

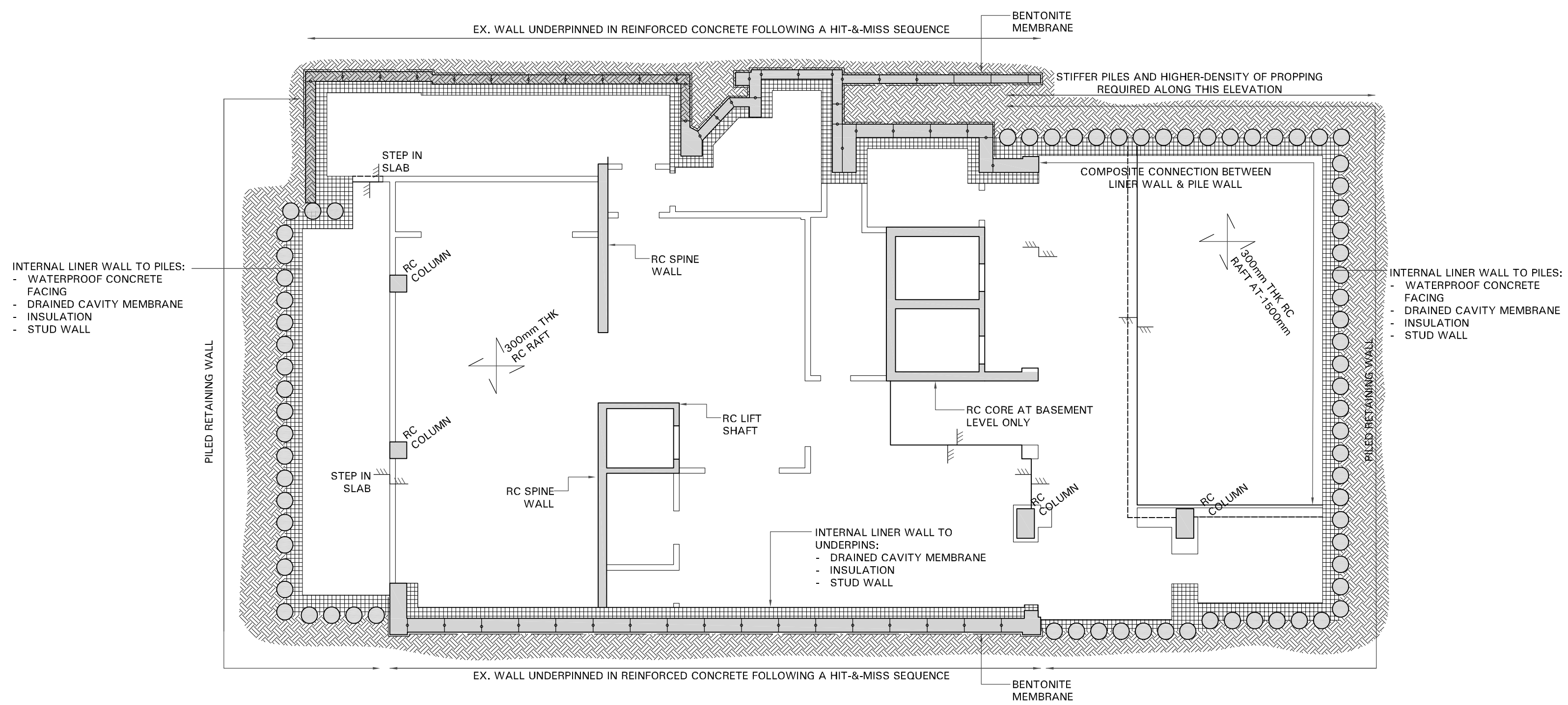
The proposed development of 31 Elsworthy Road can be achieved using standard construction techniques and materials. The new construction will not be beneath the prevailing groundwater level. The basement can be constructed using relatively light techniques, in controlled and pre-determined sequences and without the need for a large open excavation before construction can start and consequent extensive temporary works. Where mechanical means are necessary to construct permanent works these can be of a type that generates low vibrations to which the surrounding buildings have a form and construction that is robust and resistant to.

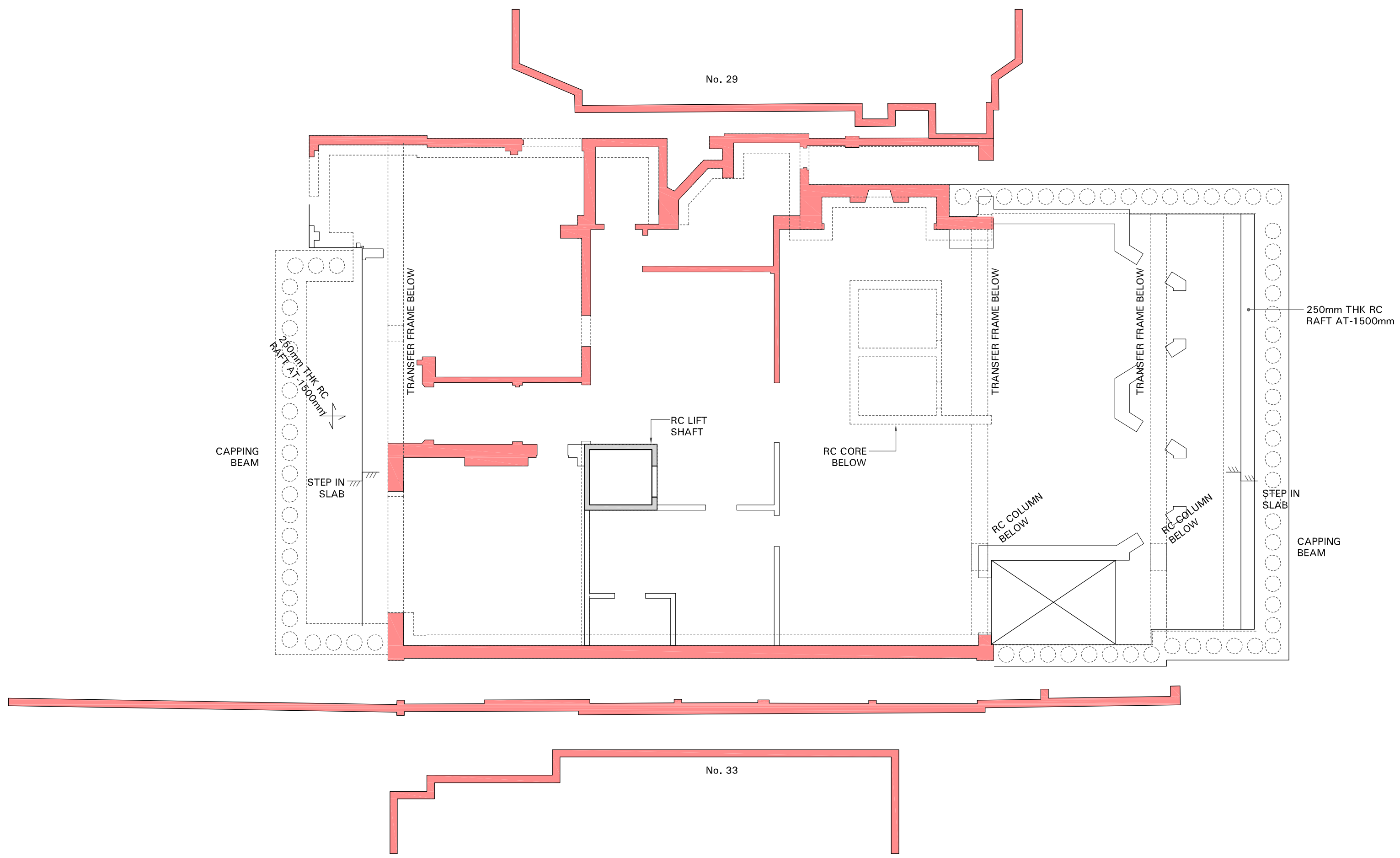
- The site specific site investigation has established the near-surface soil profile to be the London Clay Formation and the construction and loadpaths calculated to ensure that the building will be adequately supported by the existing geology.
- The site is over an unproductive strata in relation to the underlying aquifers.
- As outlined in Section 6 above, the construction of the subterranean basement will not affect the integrity of the surrounding building stock, will not disturb underlying hydrogeology or overload the near-surface geology.
- The site is on level ground in any case but, notwithstanding this, the construction techniques and sequences proposed minimises the risk of instability, ground slip and movement.
- There are no critical utilities or infrastructure beneath the site that cannot be relocated easily to accommodate the construction and, as there is no change in use or level of occupancy proposed there will be no significant increase in foul discharge to the public sewer.
- The proposed construction will not be beneath the prevailing groundwater level. The basement can be constructed using relatively light techniques, in controlled and pre-determined sequences and without the need for a large open excavation before construction can start and consequent extensive temporary works. Where mechanical means are necessary to construct permanent works these can be of a type that generates low vibrations to which the surrounding buildings have a form and construction that is robust and resistant to.
- The excavation for, and construction of the basement will need to be completed without involving or disturbing the existing ground and upper floors or the fabric of the retained walls. Underpinning will commence from the middle of the walls and will be cast in 1m-sections of mass concrete. The existing lower ground floor will, where possible, be left in place; where part or all is removed props will be installed between the party walls. Refer to sections 7 and 8 above.
- The subterranean works have been positioned to avoid any impact to nearby trees.
- By adopting an underpinning technique and following a hit-&-miss sequence, as described it will be possible to construct the basement without extensive temporary works.
- Any temporary works however required will be designed by the Contractor to current British Standards
- The proposed development is not above the Upper Aquifer, not within the catchment of The Hampstead Heath Pond Chains and not with a flood risk zone.
- The construction proposed within the rear garden and front drive will be set >1100 beneath the garden level which will be reinstated as a cultivated area so maintaining he current balance between hard and soft surface area and so maintaining the current regime for surface water run-off

Report Prepared By	Qualifications	Position	Signature	Date
Malcolm Brady	B.Eng C.Eng MIStructE	Principal		March 30th 2021

APPENDIX A SI REPORT BIA & GMA

APPENDIX B MBP DRAWING SET 8255





NOTES:

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Rev	Date	Description	By
P2	16/09/21	PRELIMINARY ISSUE	mb

Job
31 ELSWORTHY ROAD
PRIMROSE HILL
NW3 3BT

Drawing Status
PLANNING

Title
PROPOSED PLANS
BASEMENT AND GROUND LEVELS

Scale @ A1	Date	By	Checked
1:100	Mar '21	mb	mb

Drawing Number: MBP / 8255 / 100
Revision: P2

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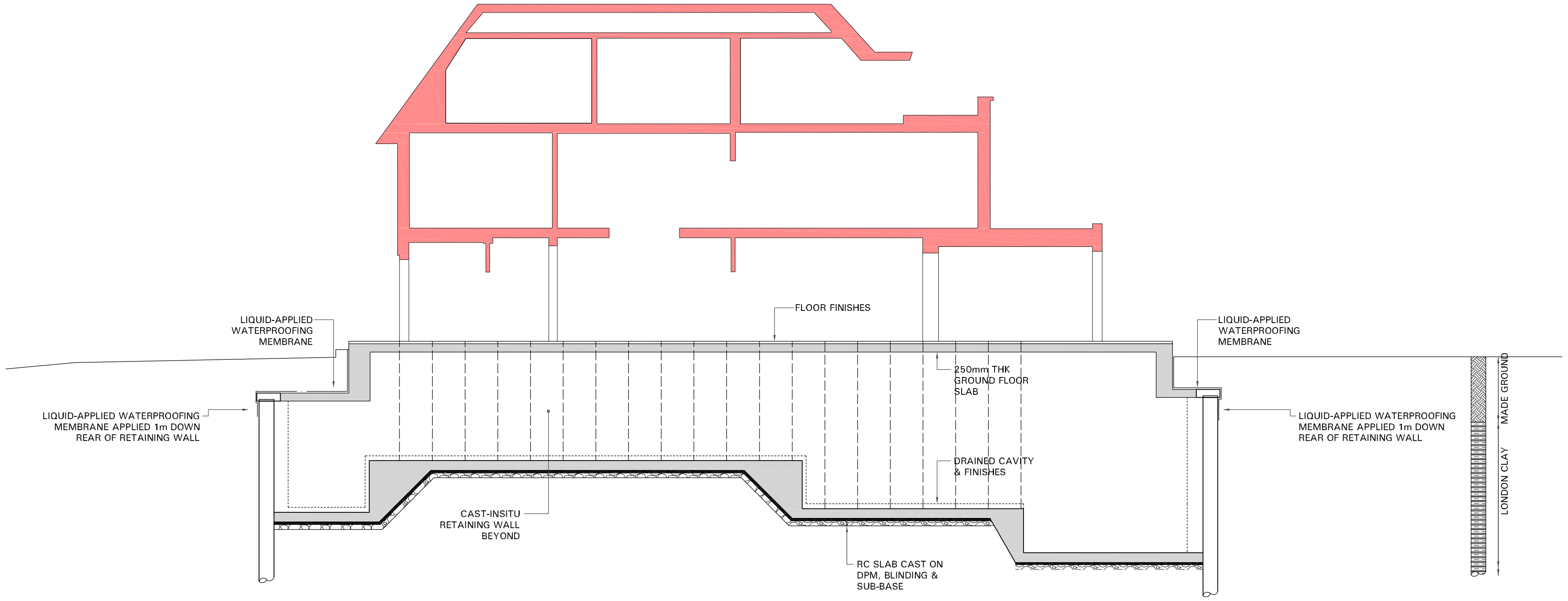
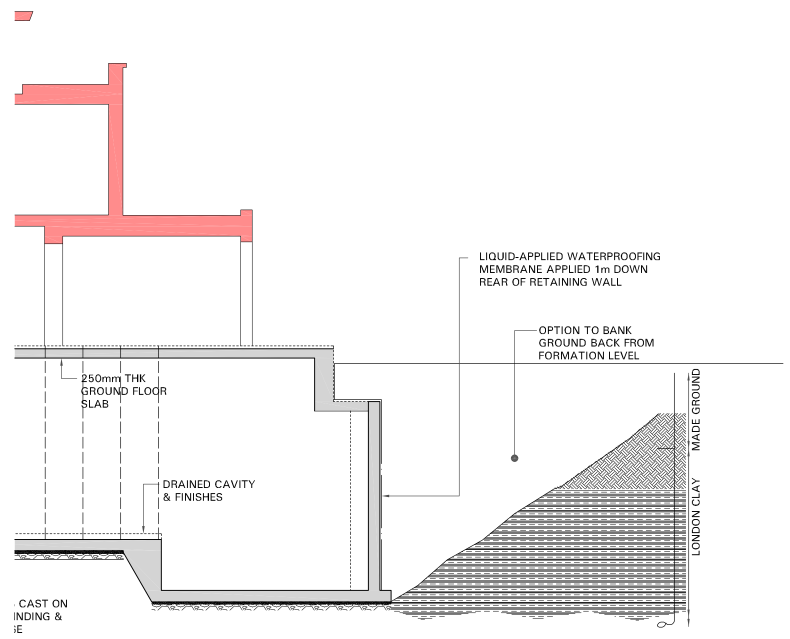




SPECIFICATION FOR UNDERPINNING WORKS TO BE USED IN LIEU OF NBS D50

110 The scope of the work is detailed on MBP Drawing set 8255 and all drawings referred to.
115 All materials and workmanship are to be in strict accordance with the Structural Engineer's Specification.
120 Works to be sequenced and completed as described in the Method Statement provided
125 Prior to commencing any excavation works the Contractor is advised to carry out a survey to locate the position of all buried services.
130 Openings at basement level may need to be suitably propped to restrict any cracking during the underpinning works.
135 Excavate accurately with vertical faces and to depths shown on drawings. The underpin blocks are to be excavated in lengths not exceeding the pin sizes indicated and leaving not less than either:
 i) 2.0 metres of undisturbed footing on either side of the open excavation or
 ii) At least one completed section of dry-packed underpinning on either side of the open excavation.
 ij) At no time should more than 30% of all other walls be left unsupported.
140 Test existing brick-lime footings for soundness by tapping with a hammer over the whole width. Break out and remove any loose or unsound material to a uniform level soffit.
145 Do not excavate beyond the inner face of the adjacent wall at the rear. Do not excavate more working space than necessary at the front.
150 Keep the excavations clean and dry. Remove all soil and loose concrete, etc from adjacent completed pins to form a good key.
155 Obtain approval of the Engineer or Building Control Inspector before concreting each section.
170 Raise RC Underpins as Detailed and Scheduled
172 Provide Ø12 dowels between adjacent pins at 600mm Vertical c/c
175 Except where indicated on the drawings, not less than 24 hours after completion of each pin, pack gap between underpinning concrete and soffit of footing / existing / stage I underpinning. Dry-pack to be 1:3 (cement : coarse sand) mortar gauged with only just sufficient water to moisten thoroughly.
180 Use a wooden ram to hammer mortar hard, in strips not exceeding 75mm deep into gap working symmetrically from the rear toward the face so as to completely fill all space between underpinning concrete and existing footing / underpinning with mortar.
185 Leave dry-pack not less than 72 hours before starting adjacent excavation.

OPERATIONS FOR TOP-DOWN CONSTRUCTION

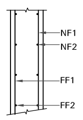
Excavation and construction will be completed to the sequence determined by the engineer. The walls will be cast in hit-and-miss sequence and in one or two vertical stages, from top to base, as detailed on Drawing Set MBP-7272: if top-down sequence is adopted the first, top stage to be completed around the plot before the lower stage is started.

Stage 1:
Excavate to 1/2-Depth below existing ground level over 1m-width
Place Reinforcement for top section with bars extending beyond lower edge for next stage
Place shuttering for exposed face, propped off the opposite face of the excavation
Cast top section of reinforced concrete retaining wall
Maintain prop to shuttering
Repeat for next section in sequence at same level

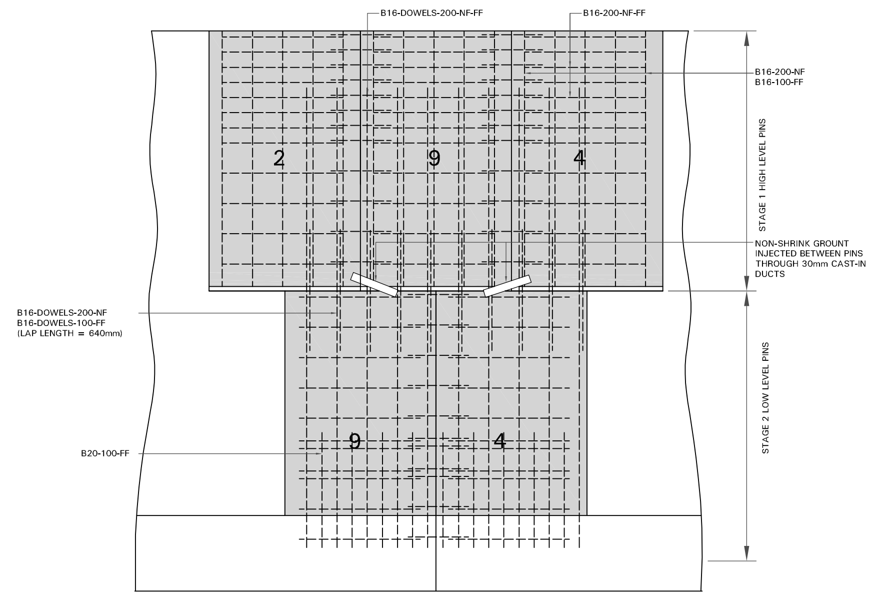
Stage 2:
Install sheeting to excavated face & install one central, adjustable prop between sheet and retaining wall
Excavate to basement slab level
Expose underside of top section, scabble surface and clean.
Install hydrophyllic waterstop & prepare exposed reinforcement
Place reinforcement for lower section and lap with bars from upper section
Position shutter with suitable birdsmouth to allow lower pin to be cast within 30mm of higher pin
Place shuttering for exposed face, propped off the opposite face of the excavation
Cast lower section of reinforced concrete retaining wall
Maintain prop to shuttering
When concrete is set remove formwork and install shutter across 30mm gap to prevent loss of grout when pouring in WEBER SBD 5 STAR GROUT through 30mm pipe
Por grout through pipe 1 until it spills from pipe 2 - rod through pipe 1 if grout does not exude pipe 1.
Proceed to next section on sequence at same level

Stage 3:
Install sheeting to excavated face & install one central, adjustable prop between sheet and retaining wall to full depth
Excavate to basement formation level
Expose underside of lower section & prepare exposed reinforcement
Construct section of basement slab
Proceed to next section on sequence at same level

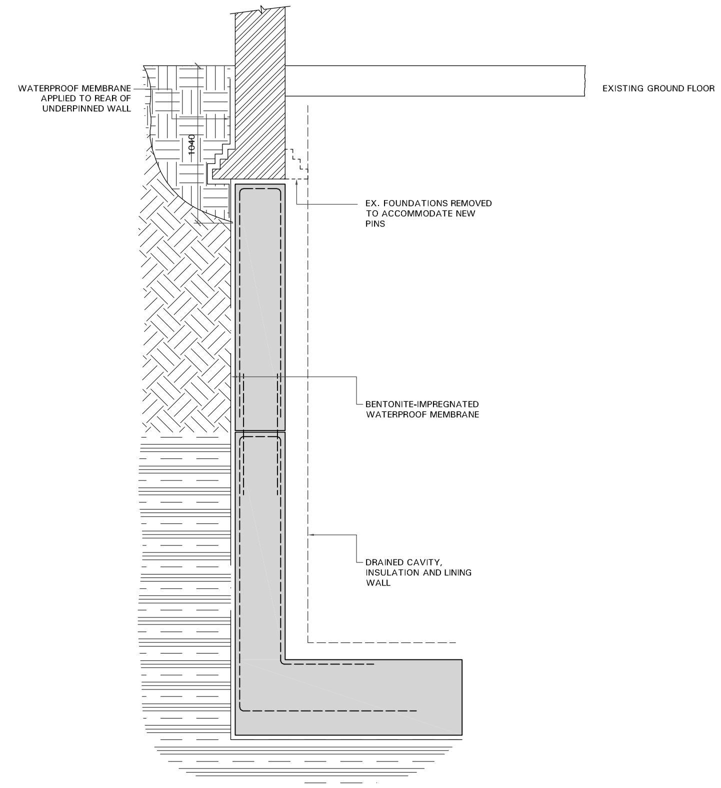
REINFORCEMENT NOTES:
REINFORCE RETAINING WALLS & BASE WITH B16 & B20
BARS AT 150mm VERTICAL & HORIZONTAL c/c
BASE OF WALL: B20-100- FF1
B16-200-NF1
WALLS: FRONT COVER = 25mm
REAR COVER =60mm
BASE COVER (CONCRETE CAST ON BLINDING) = 40mm
MAX AGGREGATE = 20mm



Indicative Concrete Mixes:
- RC 35 Concrete - 1:2:4 Cement:Sand: 20mm Aggregate
- ST 4 - 1:2:4 Cement: Grit Sand: 14mm Aggregate
- GEN 1 - 1:3:6 Cement: Grit Sand: 14mm Aggregate



ELEVATION ON STAGES FOR WALL



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Rev	Date	Description	By
P2	16/09/21	PRELIMINARY ISSUE	mb

Job
31 ELSWORTHY ROAD
PRIMROSE HILL
NW3 3BT

Drawing Status
PLANNING

Title
PROPOSED SECTIONS

Scale @ A1	Date	By	Checked
1:100	Mar '21	mb	mb

Drawing Number: MBP / 8255 / 101
Revision: P2

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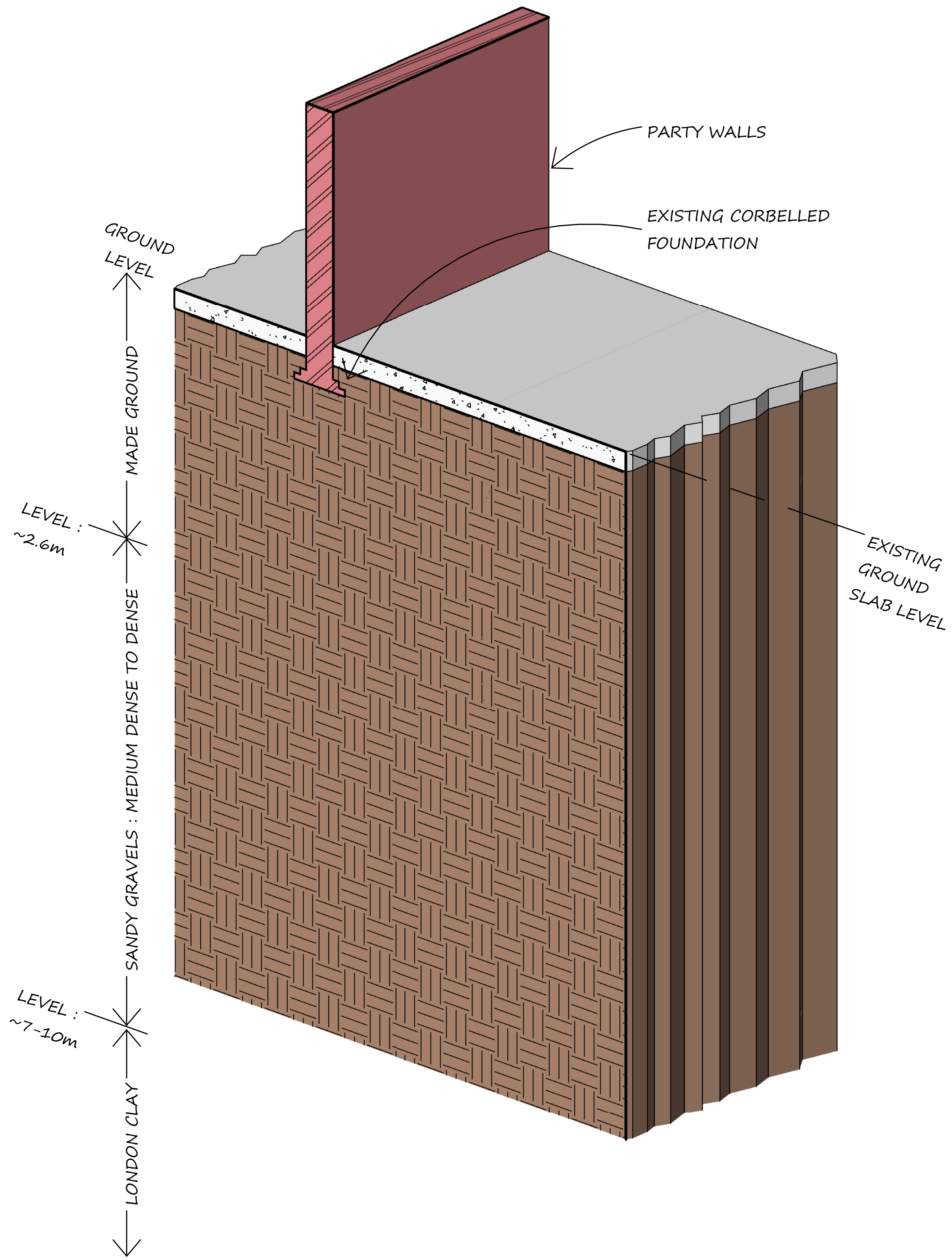
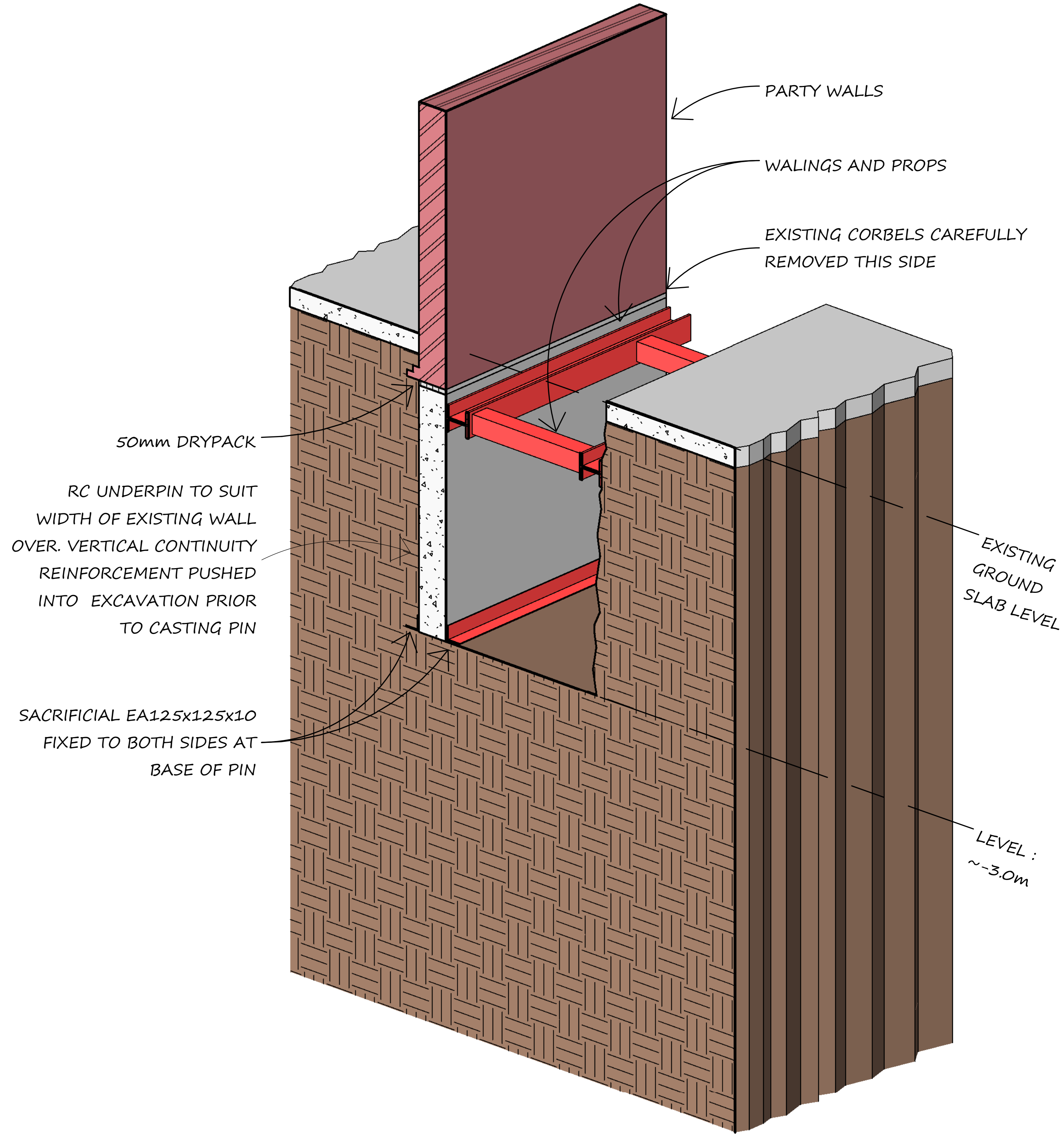


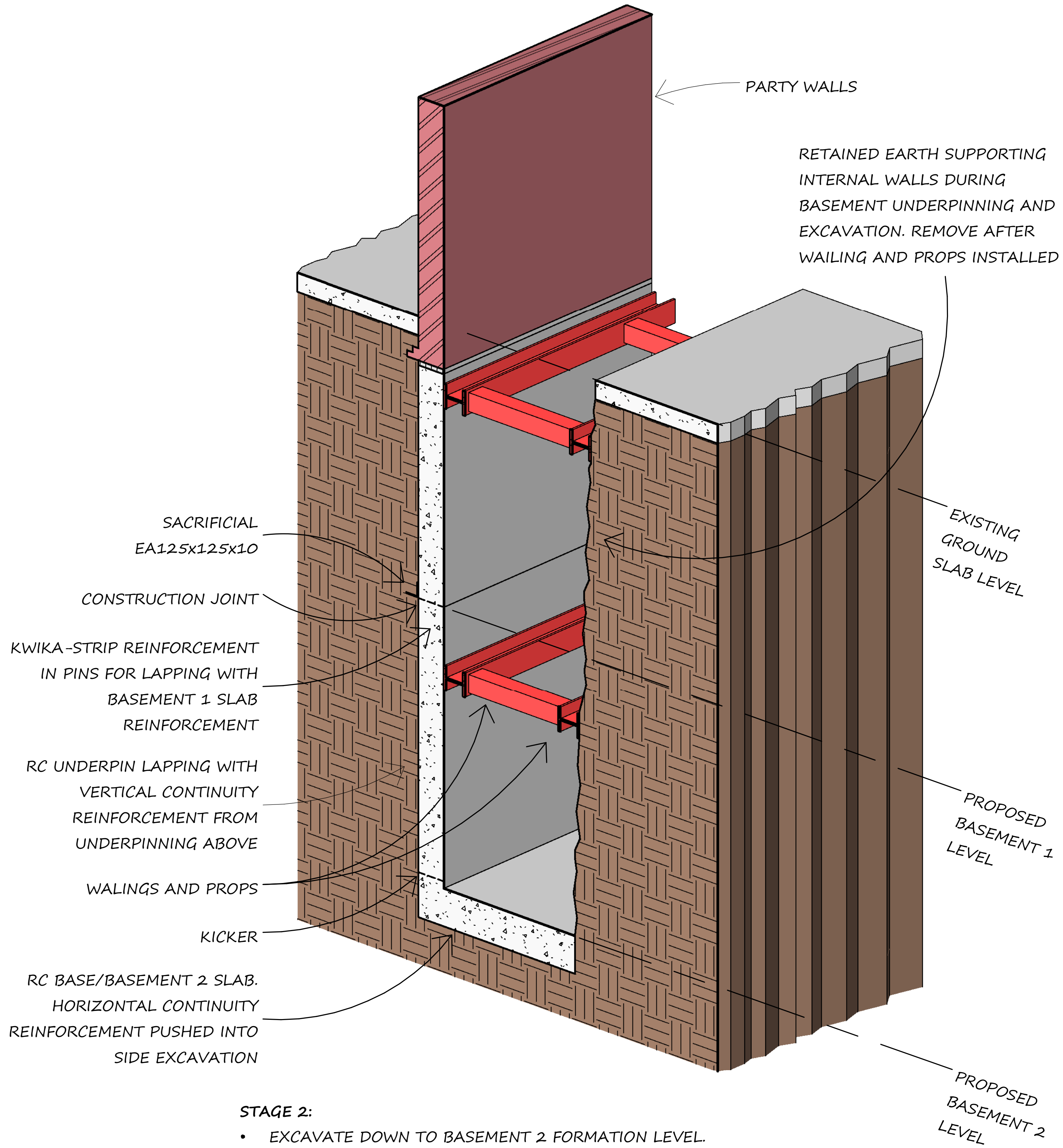
EXISTING FOUNDATION



STAGE 1:

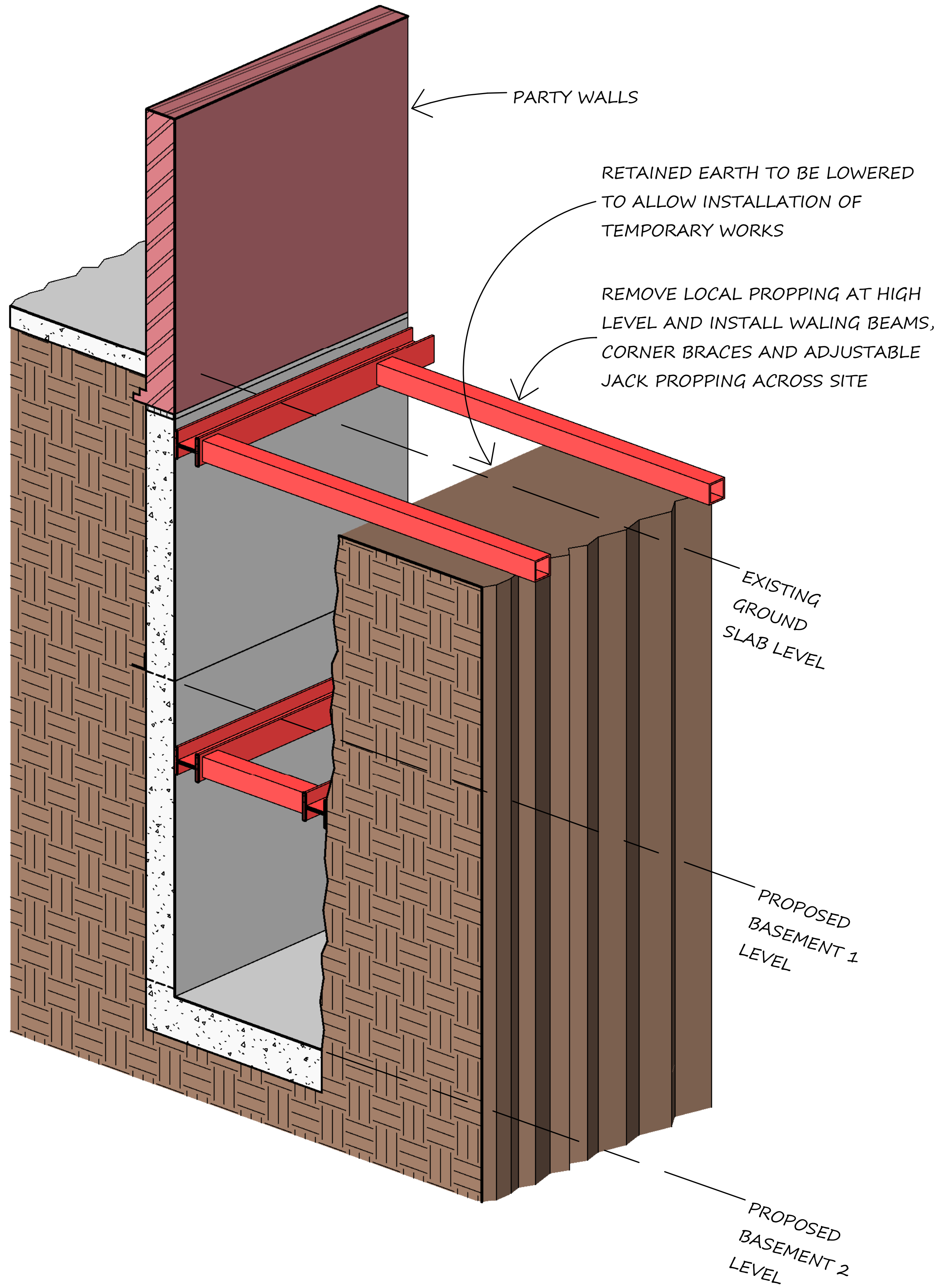
- UNDERPIN ALL ROUND TO A DEPTH OF -3.0m.
- INSTALL SACRAFICIAL BEARING STEEL ANGLES TO BASE OF PINS.
- PROVIDE PROPS BETWEEN PINS AT UNEXCAVATED EARTH BLOCK.
- FIX VERTICAL CONTINUITY REINFORCEMENT BARS INTO GROUND BEFORE CASTING PINS.

STAGE 1 BASEMENT CONSTRUCTION



STAGE 2:

- EXCAVATE DOWN TO BASEMENT 2 FORMATION LEVEL.
- CAST EDGE OF RC BASE/SLAB UP TO KICKER.
- CAST UNDERPIN, LAPPING REINFORCEMENT.
- INSTALL SECOND STAGE PROPS.
- HORIZONTAL CONTINUITY REINFORCEMENT BARS PUSHED INTO SIDE OF EXCAVATION.



STAGE 3:

- REDUCE LEVEL ACROSS SITE, INCLUDING EXISTING SLAB, BY 500mm.
- INSTALL TEMPORARY WORKS STRUCTURE, WALING BEAMS/CORNER BRACING/PROPS

<u>**STAGE 2 BASEMENT CONSTRUCTION**</u>

<u>**STAGE 3 BASEMENT CONSTRUCTION**</u>

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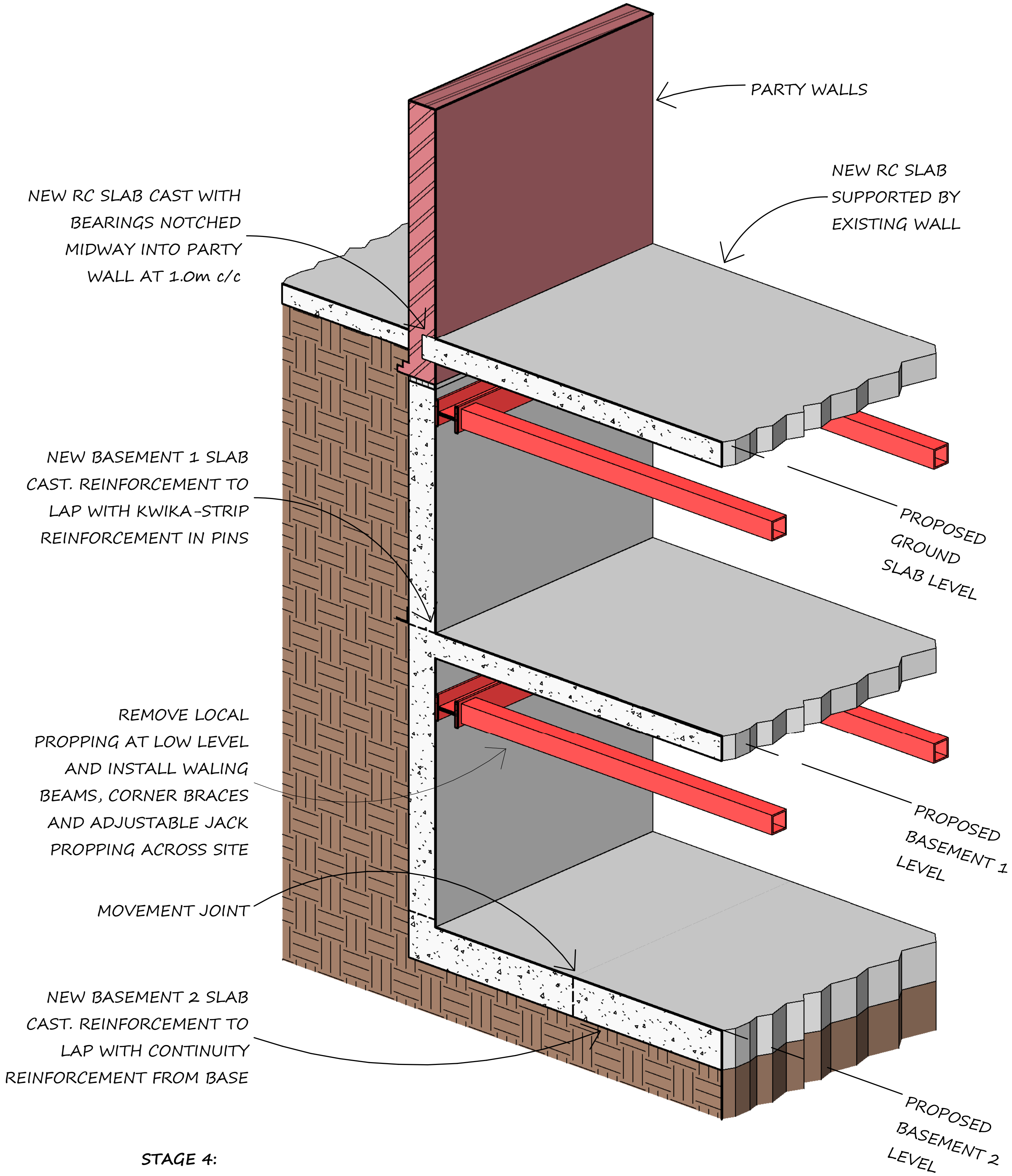
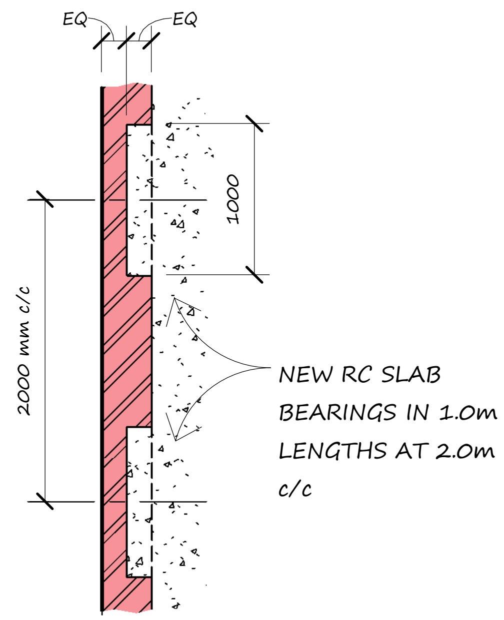




PLAN VIEW ON GROUND FLOOR SLAB BEARING

STAGE 4:

- EXCAVATE RETAINED EARTH DOWN TO BASEMENT 2 LEVEL FORMATION LEVEL.
- INSTALL SECOND STAGE TEMPORARY WORKS STRUCTURE, WALING BEAMS/CORNER BRACING/PROPS.

STAGE 5:

- CAST BASEMENT 2 RC SLAB.

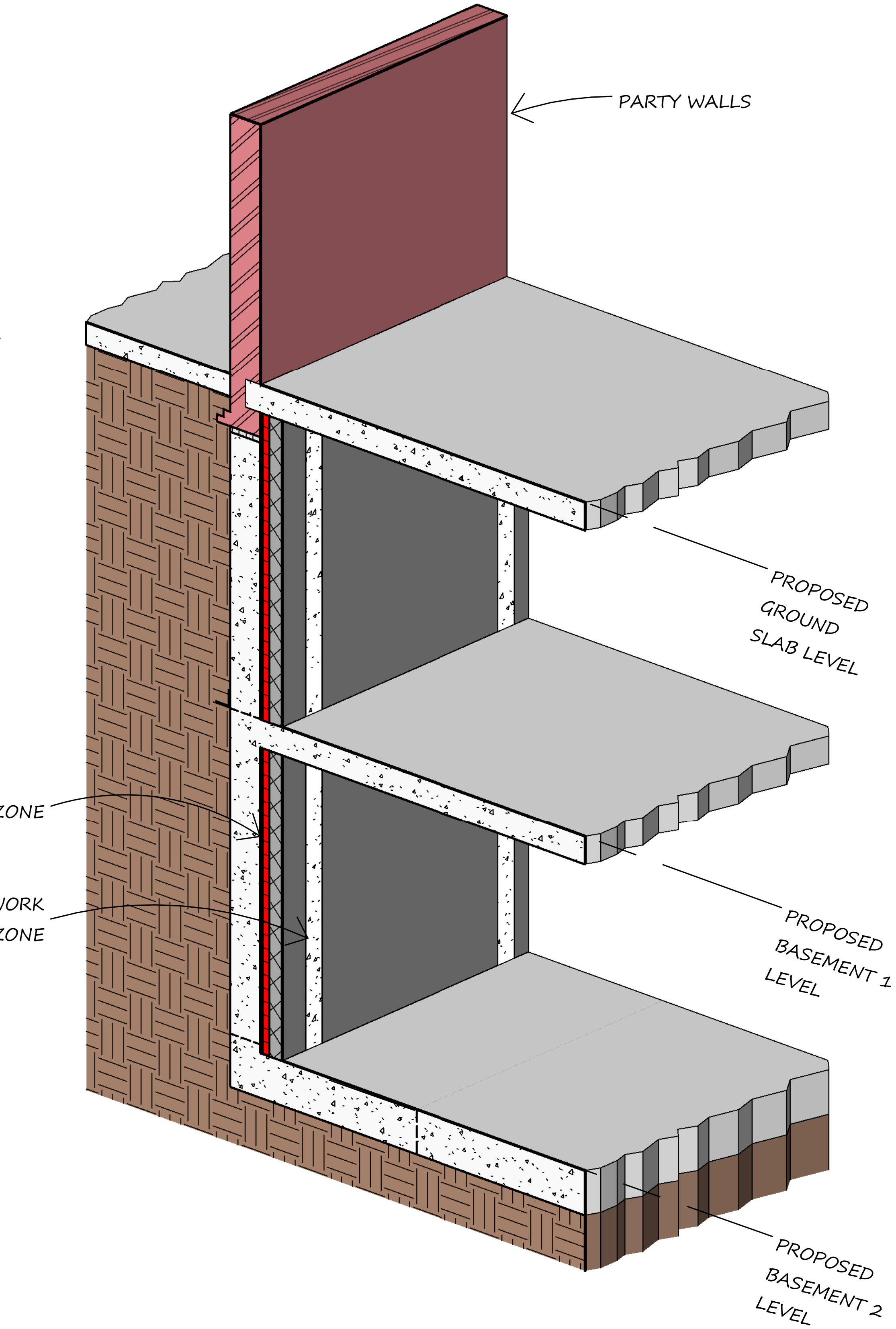
STAGE 6:

- CAST BASEMENT 1 RC SLAB.

STAGE 7:

- CAST GROUND FLOOR SLAB WITH HIT & MISS BEARING.

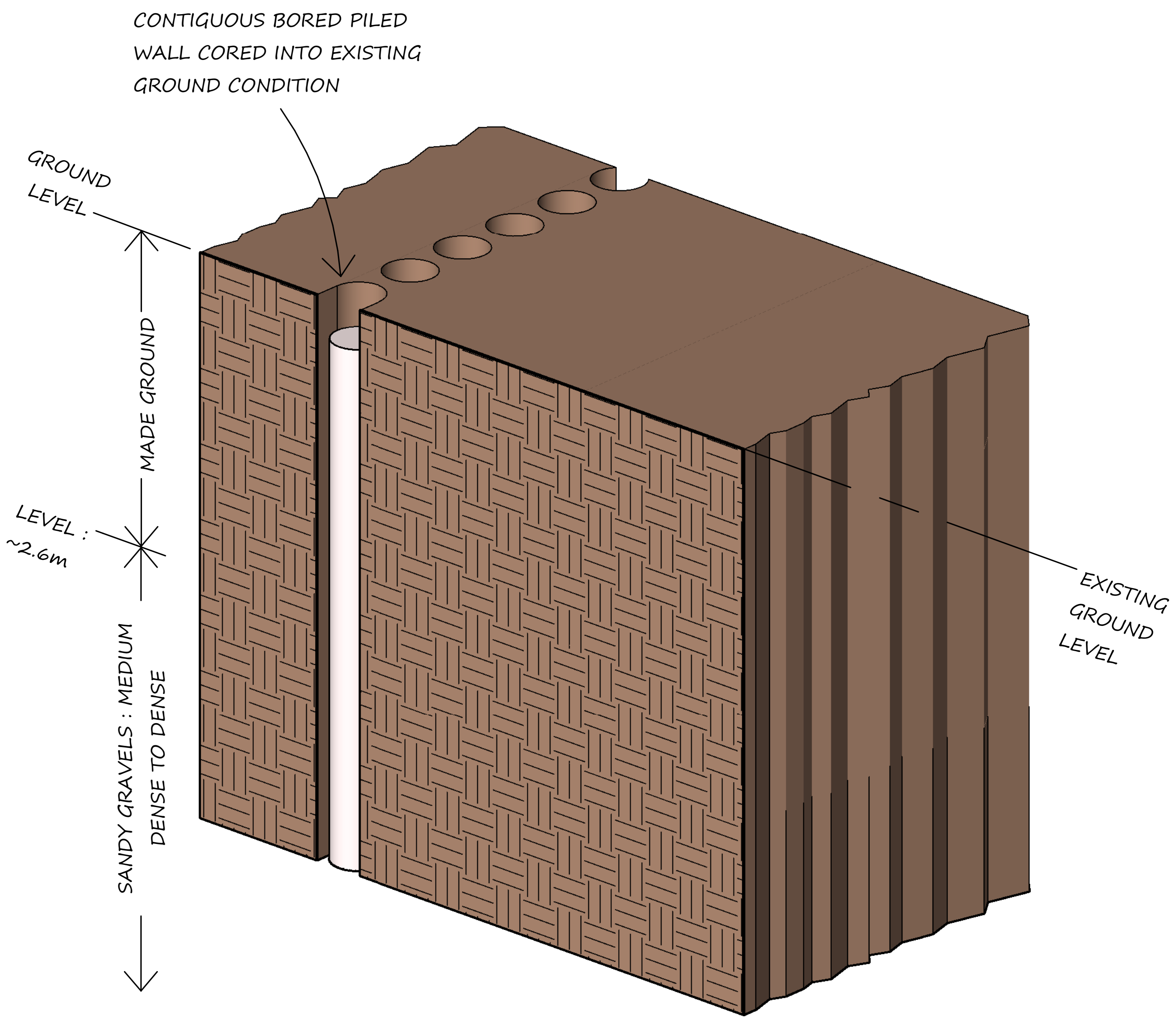
<u>STAGE 4 TO 7 BASEMENT CONSTRUCTION</u>



STAGE 8:

- REMOVE TEMPORARY WORKS STRUCTURE.
- CONSTRUCT INSULATED RC COLUMN + BLOCKWORK LINER WALL.

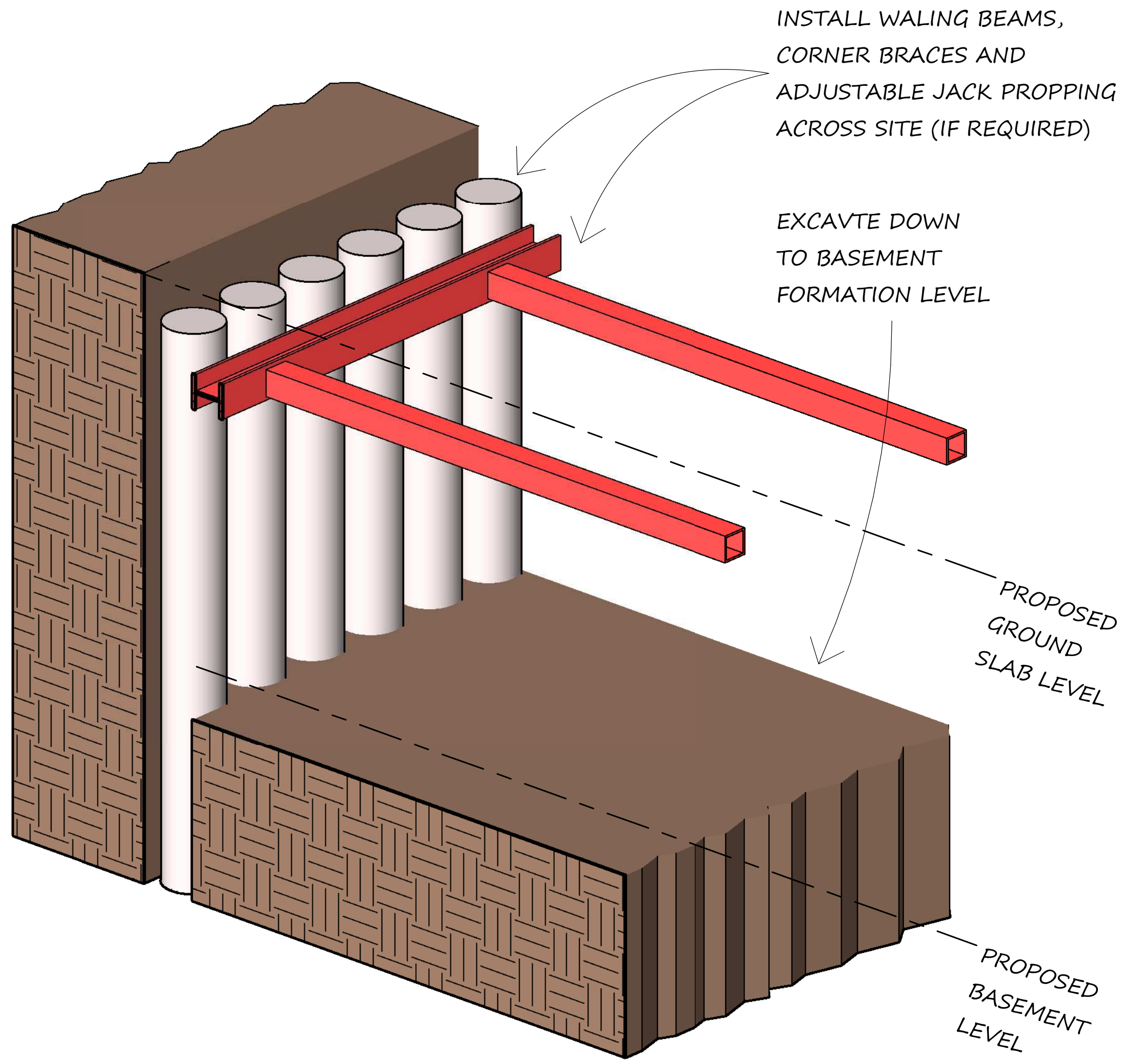
<u>STAGE 8 COMPLETED BASEMENT CONSTRUCTION</u>



STAGE 1:

- CORE INTO EXISTING GROUND USING AUGER TO REQUIRED PILE DEPTH
- INSERT REINFORCEMENT CAGE
- CAST PILED WALL ALL ROUND

STAGE 1 CONTIGUOUS PILED WALL CONSTRUCTED



STAGE 2:

- EXCAVATE DOWN TO BASEMENT FORMATION LEVEL.
- PROVIDE WALINGS AND PROPS IF PILED WALL IS NOT DESIGNED AS CANTILEVER.

STAGE 2 EXCAVATION

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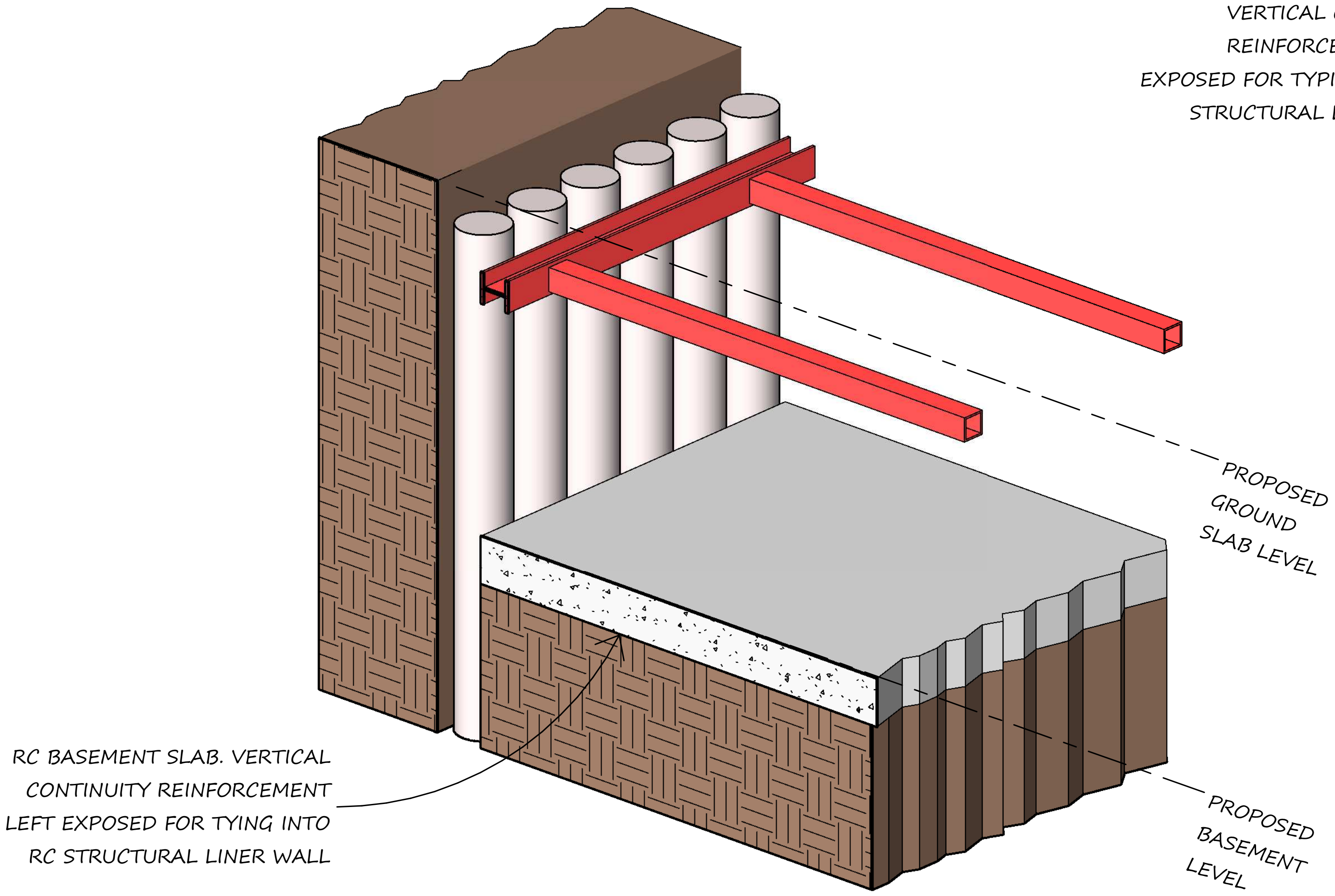
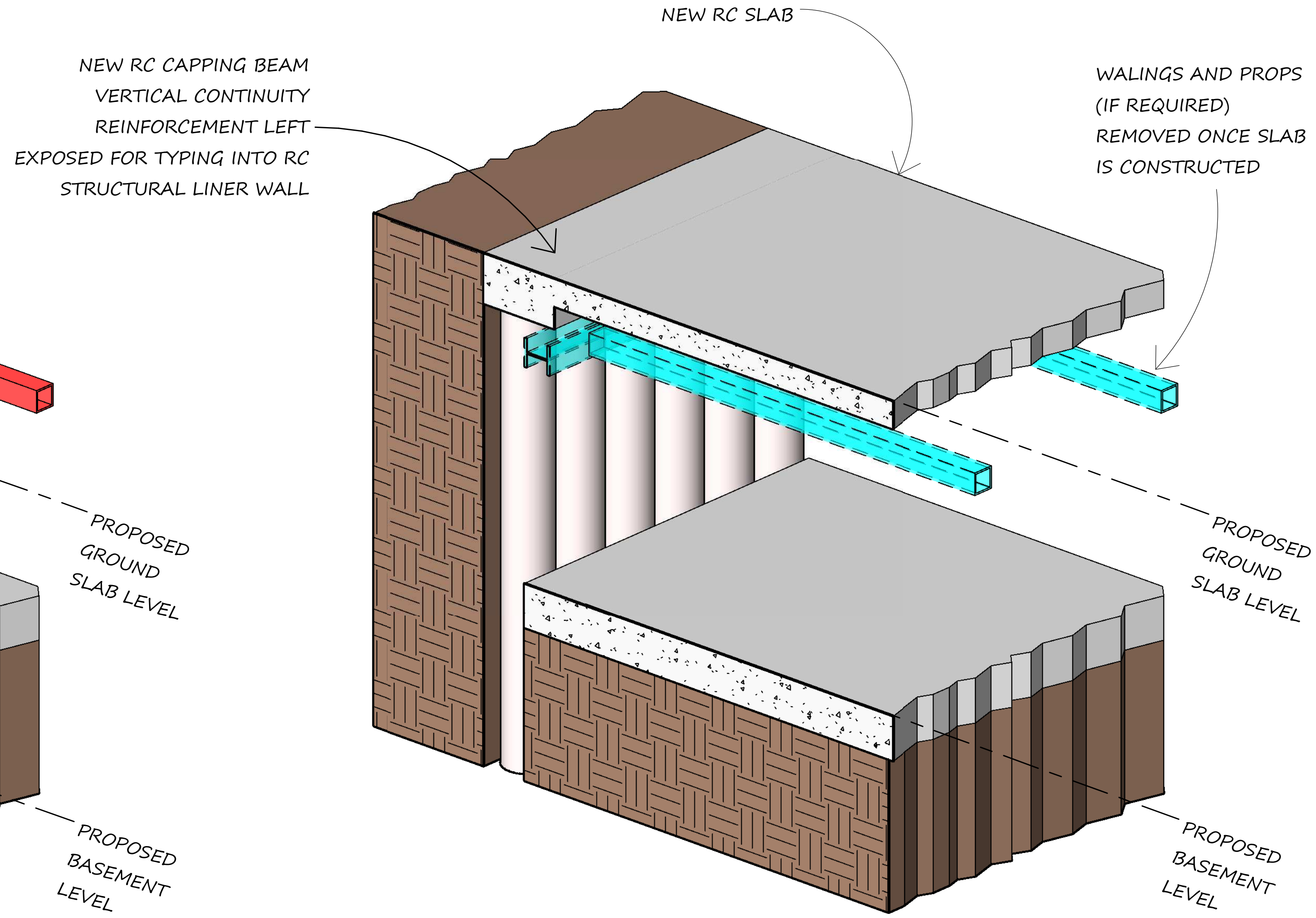


STAGE 3:

- CAST RC BASEMENT SLAB LEAVING EXPOSED REINFORCEMENT FOR TYING INTO WALL REINFORCEMENT.

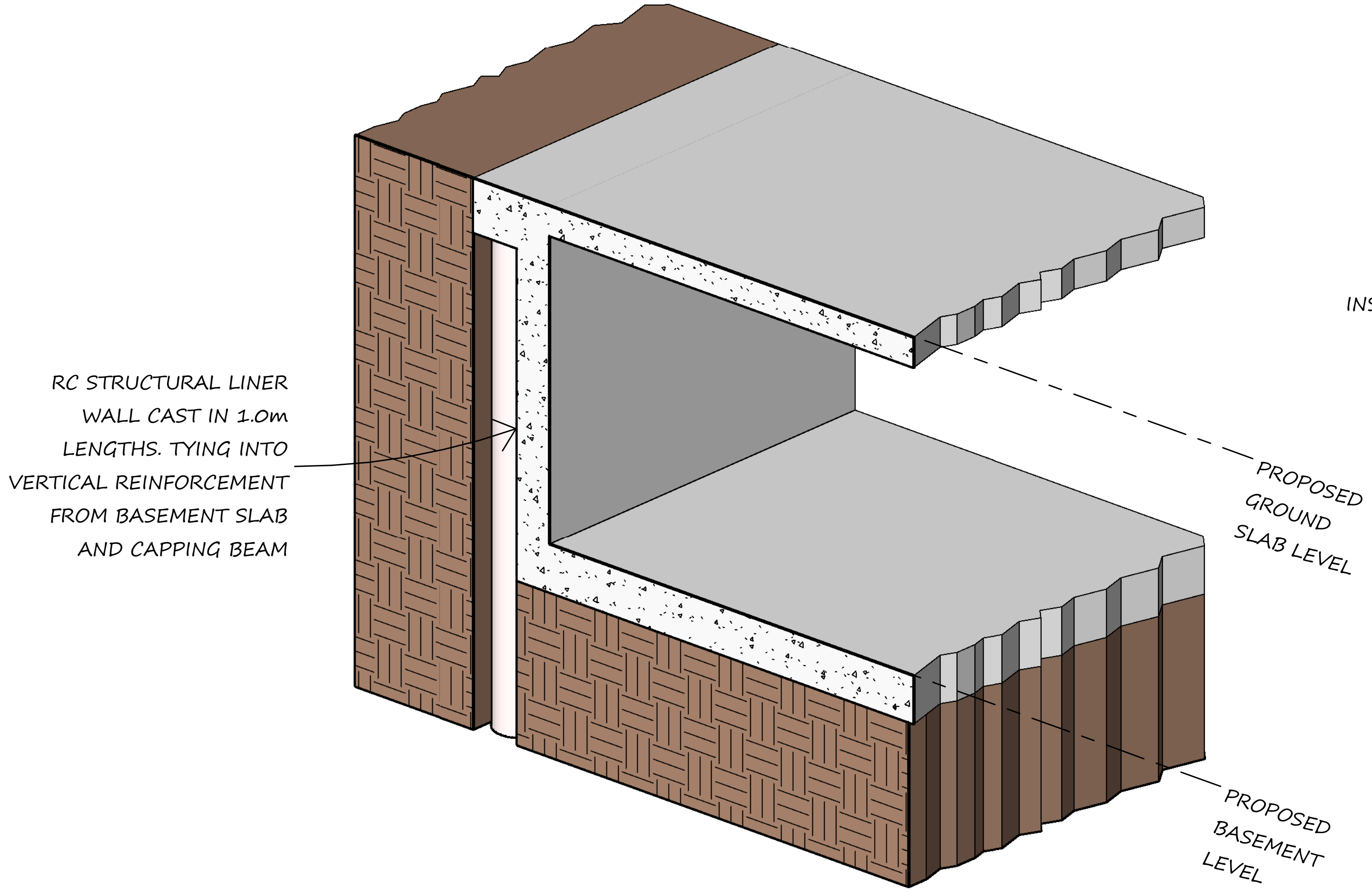


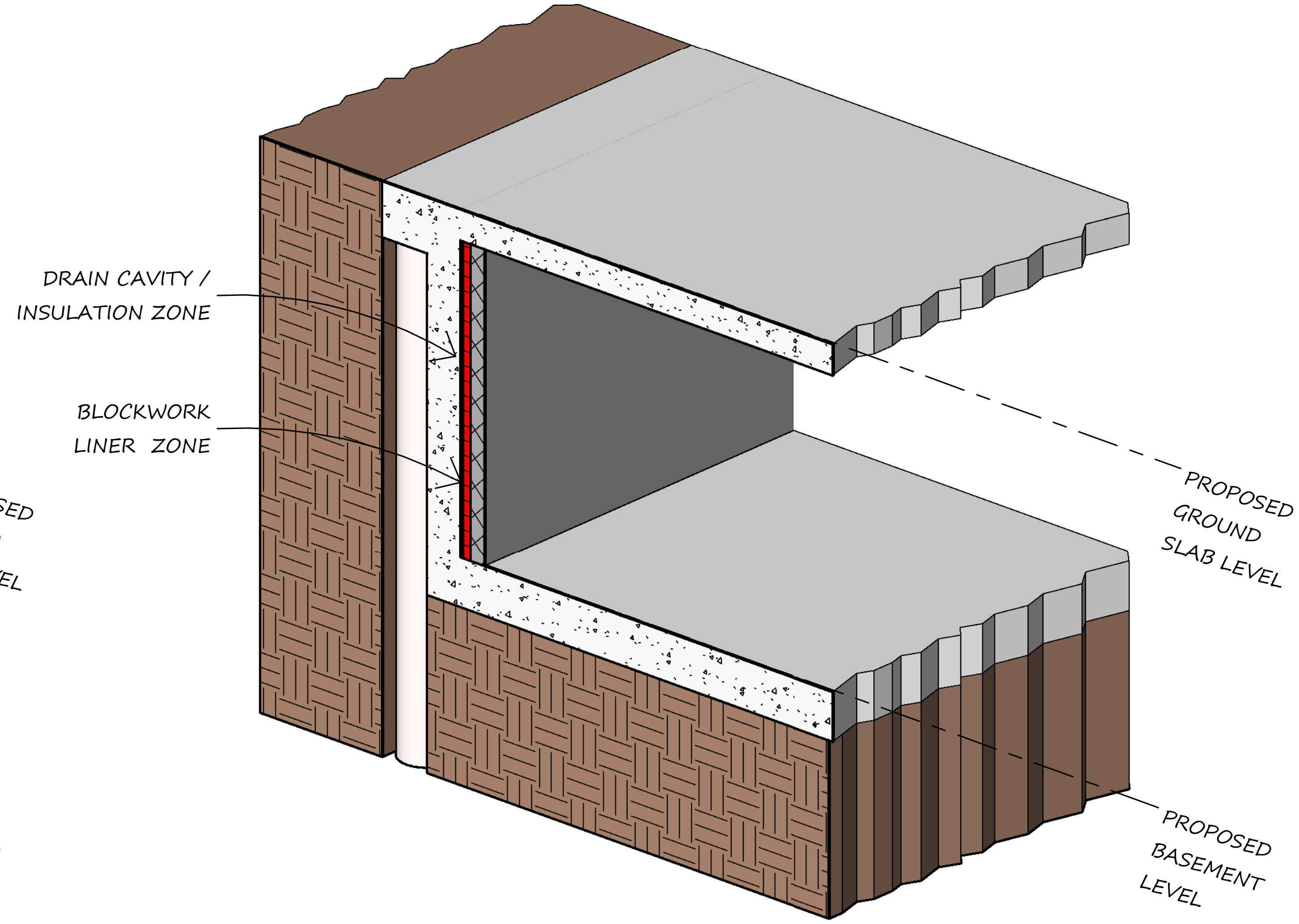
STAGE 4:

- CAST RC CAPPING BEAM AND SLAB TYING INTO PILE REINFORCEMENT, LEAVING EXPOSED REINFORCEMENT FOR TYING INTO WALL REINFORCEMENT.
- REMOVE WALINGS AND PROPS (IF REQUIRED) ONCE GROUND FLOOR IS CONSTRUCTED.

STAGE 3 BASEMENT CONSTRUCTION

STAGE 4 BASEMENT CONSTRUCTION





STAGE 5:

- CAST RC STRUCTURAL LINER WALL ALL ROUND IN 1.0m LENGTHS USING UNDERPIN SEQUENCE.

STAGE 6:

- CONSTRUCT INSULATED DRAIN CAVITY AND BLOCKWORK LINER WALL.

<u>STAGE 5 BASEMENT CONSTRUCTION</u>

<u>STAGE 6 COMPLETED BASEMENT CONSTRUCTION</u>

APPENDIX C MBP CALCULATION SET 8255

LOADING TO SIDE ELEVATION

The side walls will be underpinned along their length whereas the the front and rear elevations will be supported off transfer frames at ground level to accommodate the basement being longer than the original house.

Floor joists span front to rear so the side wall will take a small width of floor weigth and occupancy load as well as the roof construction.

Dead Load of Solid Brick Wall $G_{K1\_SolidBrickWall}$ = **6.98** kN/m²
Dead Load of Timber Floors $G_{K2\_TimberFLoors}$ = **0.85** kN/m²
Dead Load of Pitched Timber Roof $G_{K3\_PitchedTimberRoof}$ = **1.25** kN/m²

No-Access Roof Load $Q_{K1\_NoAccess}$ = **0.70** kN/m²
Cat A Occupancy Load Q_{K2_CatA} = **1.500** kN/m²

Height of Gable Wall $H_{\_GableWall}$ = **9.000** m
Loaded Width of Floors L_{W_Floors} = **0.60** m
Span of Roof Supported $L_{W\_SupportedRoof}$ = **3.25** m

Dead Load from Roof $N_{G\_Roof} = G_{K3\_PitchedTimberRoof} \times L_{W\_SupportedRoof}/2$ = **2.03** kN/m
Dead Load from Floors $N_{G\_Floors} = G_{K2\_TimberFLoors} \times L_{W\_Floors} \times 2$ = **1.02** kN/m
Dead Load from Gable Wall $N_{G\_GableWall} = G_{K1\_SolidBrickWall} \times H_{\_GableWall}$ = **62.820** kN/m
Total Dead Load $N_G = \text{sum}(N_{G\_Roof}, N_{G\_Floors}, N_{G\_GableWall})$ = **65.871** kN/m

Imp Load from Roof $N_{Q\_Roof} = Q_{K1\_NoAccess} \times L_{W\_SupportedRoof}/2$ = **1.14** kN/m
Imp Load from Floors $N_{Q\_Floors} = Q_{K2\_CatA} \times L_{W\_Floors} \times 2$ = **1.80** kN/m
Total Imp Load $N_Q = \text{sum}(N_{Q\_Roof}, N_{Q\_Floors})$ = **2.94** kN/m

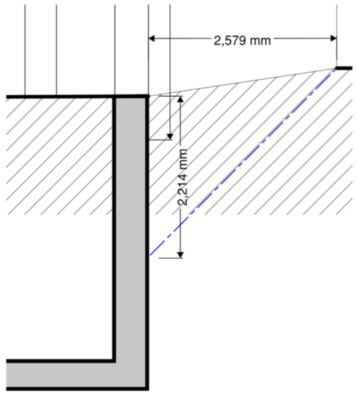
PROPOSED LOADING

The underpinning to the gable wall will support all the existing loads + the weight of and load from a solid concrete ground floor slab.

Dead Load of New Ground Slab $G_{K10\_NewGroundSlab}$ = **5.40** kN/m²
Width of Ground Slab Supported $L_{W\_GroundSlab}$ = **1.50** m

Dead Load from Ground Slab $N_{G\_GroundSlab} = G_{K10\_NewGroundSlab} \times L_{W\_GroundSlab}$ = **8.10** kN/m
Imp Load from Ground Slab $N_{Q\_GroundSlab} = Q_{K2\_CatA} \times L_{W\_GroundSlab}$ = **2.25** kN/m

UNDERPINNING RETAINING WALL



The house next door is of similar construction and configuration so existing gable wall loads can be adopted as the surcharge load for the design of the underpinning

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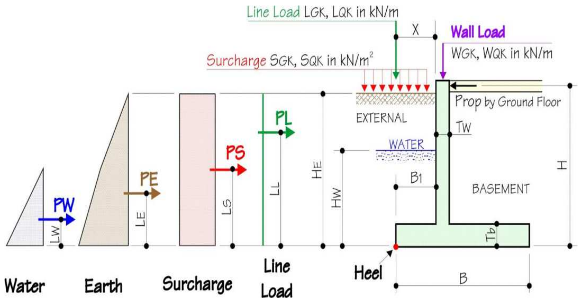
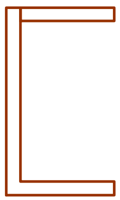
IDEALISED STRUCTURE and FORCE DIAGRAMS

DESIGN STATUS : NOT VALID



DIMENSION (mm)

H =	4000	B =	2500	Tw =	330
Hw =	2000	Bl =	0	Tb =	300
He =	4000				



Wall Geometry

MATERIAL PROPERTIES

		steel class	A		
fcu =	35 N/mm^2	γm =	1.50	concrete	
fy =	500 N/mm^2	γm =	1.15	steel	
Cover to tension reinforcement (co) =			40	mm	
Max. allowable design surface crack width (W) =			0.3	mm	(0.2 or 0.3 mm only)
Concrete density =			24.0	kN/m3	

SOIL PROPERTIES

Design angle of int'l friction of retained mat'l (Ø) =	30	degree	
Design cohesion of retained mat'l (C) =	0	kN/m2	(Only granular backfill considered, ie "C" = 0)
Density of retained mat'l (q) =	20	kN/m3	
Submerged Density of retained mat'l (qs) =	20.00	kN/m3	(default=2/3 of q), only apply when Hw >0
Design angle of int'l friction of base mat'l (Øb) =	20	degree	= 13.33
Design cohesion of base mat'l (Cb) =	0	kN/m2	ASSUMPTIONS
Density of base mat'l (qb) =	10	kN/m3	a) Wall friction is zero
Allowable gross ground bearing pressure (GBP) =	125	kN/m2	b) Minimum active earth pressure = 0.25qH

LOADINGS (unfactored)

			c) Granular backfill
Surcharge load -- live (SQK) =	10	kN/m2	h) Design not intended for walls over 3.5 m high
Surcharge load -- dead (SGK) =	0	kN/m2	i)Does **not** include check for temp or shrinkage
Line load -- live (LQK) =	3	kN/m	
Line load -- dead (LGK) =	66	kN/m	
Distance of line load from wall (X) =	2500	mm	
Wall load -- live (WQK) =	3	kN/m	
Wall load -- Dead (WGK) =	66	kN/m	

LATERAL FORCES

Ko = 0.50 default Ko = (1-SIN Ø) 0.50

Kac = 1.41 = 2Ko$^{0.5}$

Force (kN)		Lever arm (m)		γ_f	Ultimate Force (kN)
PE =	80.00	LE =	1.333	1.40	112.00
PS(GK) =	0.00	LS =	2.00	1.40	0.00
PS(QK) =	20.00	LS =	2.00	1.60	32.00
PL(GK) =	33.00	LL =	1.90	1.40	46.20
PL(QK) =	1.50	LL =	1.90	1.60	2.40
PW =	20.00	LW =	0.67	1.40	28.00
Total	154.50				220.60

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EXTERNAL STABILITY

STABILITY CHECK : OK

ANALYSIS - Assumptions & Notes

1) Wall idealised as a propped cantilever (i.e. pinned at top and fixed at base)
2) Wall is braced.
3) Maximum slenderness of wall is limited to 15, i.e [0.9*(He-Tb/2)/Tw < 15]
4) Maximum Ultimate axial load on wall is limited to 0.1fcu times the wall cross-sectional area
5) Design Span (Effective wall height) = He - (Tb/2)
6) -ve moment is hogging (i.e. tension at external face of wall)
+ve moment is sagging (i.e. tension at internal face of wall)
7) " Wall MT. " is maximum +ve moment on the wall.
8) Estimated lateral deflections are used for checking the **P∆** effect .

UNFACTORED LOADS AND FORCES

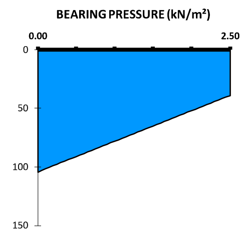
Lateral Force	Force (kN)	Lever arm to base (m)	Base MT. (kNm)	Wall MT. (kNm)	Reaction at Base (kN)	Reaction at Top (kN)	Estimated Elastic Deflection ∆ (mm)
PE =	74.11	1.28	-38.04	17.01	59.29	14.82	0.5
PS(GK) =	0.00	1.93	0.00	#DIV/0!	0.00	0.00	0.0
PS(QK) =	19.25	1.93	-9.26	5.21	12.03	7.22	0.1
PL(GK) =	33.00	1.75	-24.34	18.25	24.30	8.70	0.4
PL(QK) =	1.50	1.75	-1.11	0.83	1.10	0.40	0.0
PW =	17.11	0.62	-7.12	2.04	16.22	0.89	0.0
Total	144.97		-79.87	#DIV/0!	112.95	32.03	1.1

GROUND BEARING FAILURE

LOAD CASE: Wall Load MIN
Surcharge MIN

Taking moments about centre of base (anticlockwise "+")

Vertical FORCES (kN)		Lever arm (m)	Moment (kNm)
Wall load =	66	1.08	71.60999934
Wall (sw) =	29.30	1.08	31.79
Base =	18.00	0.00	0.00
Earth =	0.00	1.25	0.00
Water =	0.00	1.25	0.00
Surcharge =	0.00	1.25	0.00
Line load =	66.00	0.00	0.00
∑ V =	179.30	∑ Mv =	103.40



MOMENT due to LATERAL FORCES, Mo = -69.50 kNm

RESULTANT MOMENT, M = Mv + Mo = 33.91 kNm

ECCENTRICITY FROM BASE CENTRE, M / V = 0.19 m

MAXIMUM GROSS BEARING PRESSURE = 104.27 kN/m^2 < 125 OK

SLIDING AT BASE (using overall factor of safety instead of partial safety fac F.O.S = 1.50

SUM of LATERAL FORCES, **P** = 112.95 kN

BASE FRICTION, F_b = - (**V** TANØb + B.Cb) = -65.26 kN

Factor of Safety, F_b / P = 0.58 < 1.50 FAIL .. but

therefore, LATERAL RESISTANCE to be provided by BASEMENT SLAB = 104.16 kN

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STRUCTURAL DESIGNS (ultimate) DESIGN CHECKS : OK

BS8110 reference

WALL (per metre length)

AXIAL LOAD CAPACITY (Limited to 0.1fcu) = 1155.00 kN > 97.2 OK 3.4.4.1

Lateral Force	Force (kN)	γ_f	Ultimate Force (kN)	Ult. Moment at base (kNm)	Ult. Shear at base (kN)	Ult. Shear at top (kN)
PE =	74.11	1.40	103.76	-53.26	83.01	20.75
PS(GK) =	0.00	1.40	0.00	0.00	0.00	0.00
PS(QK) =	19.25	1.60	30.80	-14.82	19.25	11.55
PL(GK) =	33.00	1.40	46.20	-34.07	34.02	12.18
PL(QK) =	1.50	1.60	2.40	-1.77	1.77	0.63
PW =	17.11	1.40	23.96	-9.96	22.71	1.25
Total	144.97		207.11	-113.89	160.75	46.36

Design Bending Moments

On INTERNAL face due to lateral forces, M_{int} = 58.13 kNm

On EXTERNAL face due to lateral forces, M_{ext} = -113.89 kNm

Eccentricity of Axial Loads = 125 mm

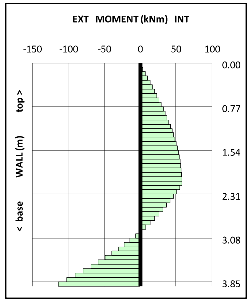
LATERAL DEFLECTION " Δ " = 1.1 mm

Due to eccentricity of axial loads, M_{ecc} = 12.2 kNm

Due to PΔ effect, M_p = 0.11 kNm

Total Mmt on INTERNAL face (M_{int}+0.5M_{ecc}+M_p) = 64.3 kNm

Total Mmt on EXTERNAL face (M_{ext}+0.5M_{ecc}) = -120.0 kNm



		EXTERNAL FACE		INTERNAL FACE				
WALL REINFORCEMENT :	Min. As =	429		429		mm^2		Table 3.25
	ϕ =	20		20		mm		
	centres =	200	< 389	200	< 555	mm	OK	3.12.11.2.7(b)
	As =	1571	> 429	1571	> 429	mm^2	OK	
MOMENT of RESISTANCE :	d =	280		280		mm		
	z =	258		258		mm		3.4.4.4
	As' =	0		0		mm^2		3.4.4.4
	M_{res} =	176.3	> 119.96	176.3	> 64.31	kNm	OK	

		BASE of WALL		TOP of WALL				
SHEAR RESISTANCE:	As =	1571	ϕ =	16	@200 mm 1005	mm^2/m		
	100As/bd =	0.56%	=	0.36%				
	vc =	0.64		0.55		N/mm^2		Table 3.8
	V_{res} =	178.5	> 160.75	153.8	> 46.36	kN	OK	3.5.5.2

ACK WIDTH to BS8100/8007 X = 93.84 mm εm = 0.00098 BS8007

Temp & shrinkage effects not included Acr = 101.80 mm **W =** 0.20 < 0.30 mm OK App. B.2

REINFORCEMENT SUMMARY for WALL

	Type	ϕ mm	centres mm	As mm^2	Min. As mm^2	
INTERNAL FACE	H	20	200	1571	429	OK
EXTERNAL FACE	H	20	200	1571	429	OK
TRANSVERSE	H	16	150	1340	429	OK

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OUTER BASE (per metre length) BS8110 reference

γ_f = 1.50 (ASSUMED)

Ult. Shear = 34.12 kN (AT d from FACE of WALL)

Ult. MT. = 0.00 kNm TENSION - TOP FACE

BOTTOM REINFORCEMENT :	Min. As =	390	mm^2			Table 3.25
	ϕ =	20	mm			
	centres =	200	mm	< 497	OK	
	As =	1571	mm^2	> 390	OK	
MOMENT of RESISTANCE :	d =	250	mm			
	Z =	228	mm			3.4.4.4
	As' =	0	mm^2			
	Mres =	155.82	kNm	> 0.00	OK	
SHEAR RESISTANCE:	100As/bd =	0.56%				
	vc =	0.68	N/mm^2			Table 3.8
	Vres =	170.26	kN	> 34.12	OK	3.5.5.2

CHECK CRACK WIDTH IN ACCORDANCE WITH BS8100/8007 Temp & shrinkage effects not included

X = 87.63 mm εm = -0.00029 BS8007

Acr = 101.80 mm W = -0.06 mm < 0.30 OK App. B.2

NO CRACKING

INNER BASE (per metre length)

Ult. Shear = -65.87 kN (AT d from FACE of WALL)

Ult. MT. = 119.80 kNm TENSION - BOTTOM FACE

BOTTOM REINFORCEMENT :	Min. As =	390	mm^2			Table 3.25
	ϕ =	20	mm			
	centres =	200	mm	< 312	OK	
	As =	1571	mm^2	> 390	OK	
MOMENT of RESISTANCE :	d =	250	mm			
	Z =	228	mm			
	As' =	0	mm^2			
	Mres =	155.82	kNm	> 119.80	OK	3.4.4.4
SHEAR RESISTANCE:	100As/bd =	0.63%				
	vc =	0.68	N/mm^2			Table 3.8
	Vres =	170.26	kN	> 65.87	OK	3.5.5.2

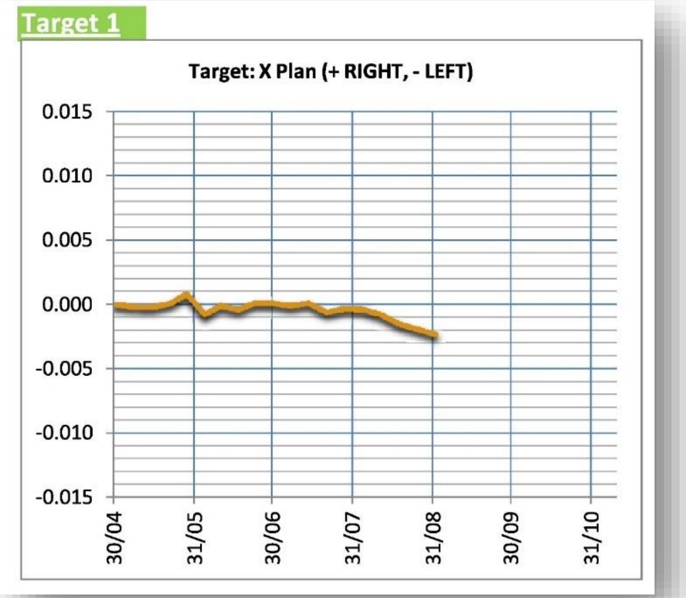
CHECK CRACK WIDTH IN ACCORDANCE WITH BS8100/8007 Temp & shrinkage effects not included

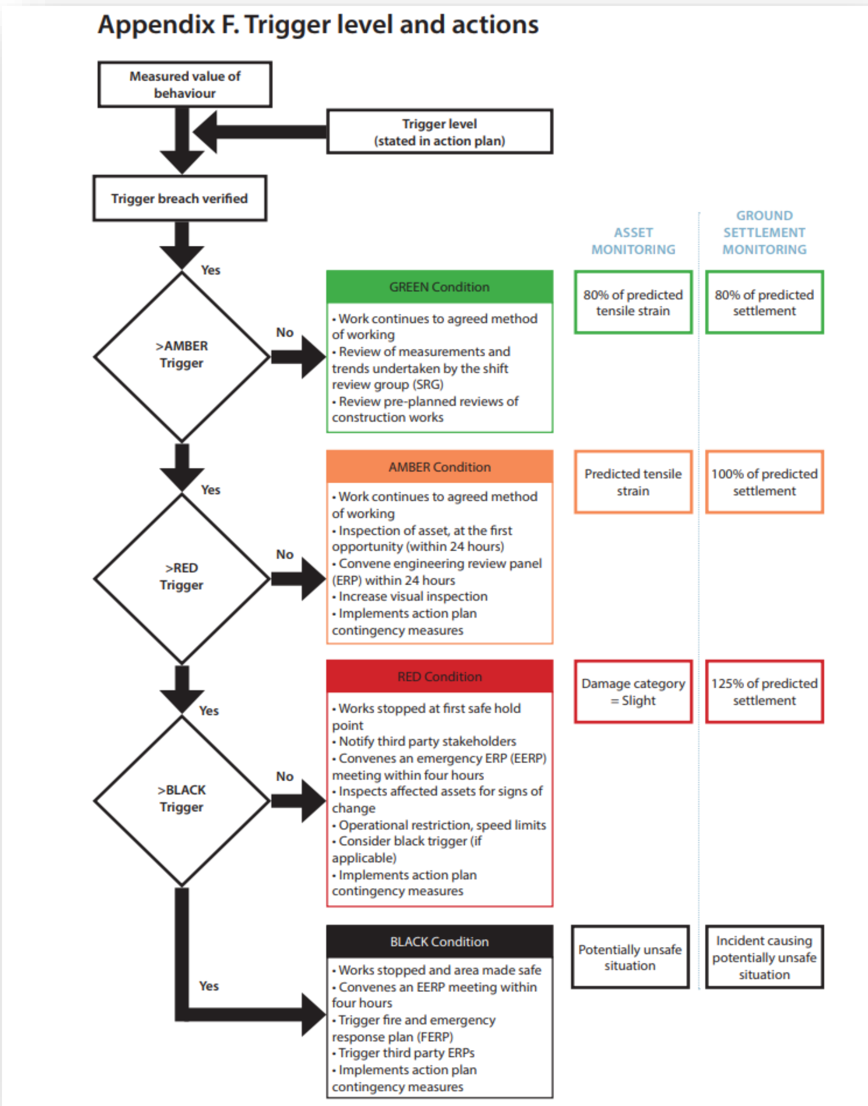
X = 87.63 mm εm = 0.001211 BS8007

Acr = 101.80 mm W = 0.23 mm < 0.30 OK App. B.2

REINFORCEMENT SUMMARY for BASE

	Type	ϕ mm	centres mm	As mm^2	Min. As mm^2	
TOP	H	20	200	1571	390	OK
BOTTOM	T	20	200	1571	390	OK
TRANSVERSE	T	20	200	1571	390	OK





APPENDIX D PROCEDURE FOR MONITORING ADJACENT STRUCTURES

An independent surveyor will monitor the adjacent structures and party walls for movements throughout the principal demonstration & construction works and, in the event of any movements exceeding the agreed target levels the method of works will be reviewed and altered as necessary.

- The proposed monitoring points will be agreed with the contractor
- The Green/Amber trigger level will be 5mm
- The Amber/Red trigger level will be 10mm

The monitoring regime and frequency proposed is:

Activity	Frequency of monitoring
Site set up	Bi-Weekly
Demolition & Excavation	Weekly
Underpinning & Ground Works	Weekly
Principal Construction Works	Bi-Weekly

Target monitoring will monitor the party walls and front and rear elevations with an accuracy of +/- 2mm. The results of the monitoring are to be recorded and issued by email to the project engineer, CA and engineers for the adjoining properties, on the day that the results are taken. The results are to be presented both in table and graphical form with the graphs for each point plotting the readings taken against time. The following actions will be taken if the trigger levels are exceeded:

Trigger Level	Action
Green/Amber	Immediately notify the engineers. Increase frequency of monitoring to a daily basis.
Amber/Red	Contractor to stop all works and immediately notify the engineers. Contractor and project engineer to put forward proposals, such as additional propping, to limit further movement to an acceptable level.

APPENDIX E PROCEDURE FOR CONTROL OF NOISE, DUST & NUISANCE

To control the disturbance due to noise and vibrations, all works on site will be restricted to the hours of Monday to Friday 8am to 6pm, Saturdays 8am to 1pm. Works that create excessive noise and/or vibration are prohibited, as are any works on Sundays and the bank holidays. The contractor employed to undertake the work will be a member of the Considerate Constructor Scheme.

Appropriate measures will be taken to keep dust pollution to a minimum. These measures are compliant with Camden Planning Guidance – Basements dated 2018. Such measures will include the use of water to suppress dust and soil being excavated from basement level, covers for conveyors and skips, and barriers installed around dusty activities that are undertaken externally.

All work will be carried out in accordance with BS 5228-1:2009 and BS 5228-2:2009. All works will employ Best Practicable Means as defined by section 72 of the Control of Pollution Act 1972 to minimise the effects of noise and vibration. All means of managing and reducing noise and vibration which can be practicably applied at reasonable cost will be implemented.

The following measures will be taken:

- Consultation/ communication with neighbours/affected others prior to the start of the works.
- Use only of modern, quiet and well-maintained equipment, all of which will comply with the EC Directives and UK regulations set out in BS 5228-1:2009
- Use of electrically powered hand tools rather than air powered tools and a compressor will be used for to the minimum extent practicable
- Avoidance of unnecessary noise (such as engines idling between operations or excessive engine revving, no radios, no shouting)
- Use of screws and drills rather than nails for fixing hoarding.
- Careful handling of materials, so no dropping off materials from an excessive height (no more than 2m) into skip etc.
- Ensuring that the conveyor is well maintained with rollers in good working order and well oiled.
- Collection /delivery times will be as given in the CTMP

Collection/delivery vehicles will not loiter/wait in the area before the allowed times

- No site run-off of water or mud until the water has been left to settle and is free from particles
- During Demolition:
- Special Care to ensure the site is closed-over
- Dust suppression with water if necessary if needed (recommended)
- Cutting equipment to use water suppressant or local extraction & ventilation

If measures to control dust are unsuccessful works will be stopped and alternative methods proposed and implemented

A detailed CTMP will be prepared by the contractor undertaking the works

APPENDIX F CMS CHECKLIST USING THE LONDON BOROUGH OF CAMDEN PLANNING GUIDANCE – BASEMENTS MARCH 2018 AS REFERENCE

Screening – the screening process is to determine whether there is any need for a full BIA	BIA included
Scoping – the identification of the potential impact of the proposed scheme this is done through the geological, hydrogeological and hydrological study	Included
Site investigation and study - ground movement potential impact on neighbouring properties, if there is a risk of subsidence this should be described using the Burland Scale	Included
Impact Assessment – evaluating the direct and indirect implications including Flood risk Assessment, Landscaping, watercourses, Historical Ground information through OS Maps, identification of Aquifers,	Included
Building Regulations – the submission of building regulations is required with the full details of works planned, full site investigation and Structural Engineers report on the investigation and development proposals	Next phase – detail design
Detailed site specific analysis of hydrological and geotechnical local ground conditions	Considered
Analysis of how the excavation of the basement may impact on the water table and any ground water flow, and whether perched water is present	Considered
Details of how flood risk, including risk from groundwater and surface water flooding has been addressed in the design, including details of any proposed mitigation measures	Considered
Details of measures proposed to mitigate any risks in relation to land instability	Considered
A comprehensive non- technical summary document of the assessments	Included
Identify the location of the development in relation to an aquifer or a water course	Included
Impact on flooding and drainage including measures to reduce the risk of flooding to the proposed basement and neighbouring properties	Considered
Appropriate basement construction methods to maintain structural stability of the statutory listed host building and neighbouring statutory listed properties	Considered
Details of noise, disruption and vibrations to neighbouring properties would be minimised during the construction process	Considered
Programme duration	Included
Construction vehicles' routing and movements, The number and types of construction vehicles, Site access and egress arrangements	Considered