14 Blackburn Road
Structural Statement

2110-EXP-S-RP-0010 Rev1.1

Contents

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Founded in 1999, the practice was born out of a desire to raise the quality of engineering involvement in projects beyond that of traditional engineering organisations. We enjoy open-minded collaboration with users, architects, designers, clients and contractors in the search for simple and beautiful solutions.

It should be noted that the design information presented herein has been prepared in support of the Planning Application. It is therefore preliminary and subject to further design development and coordination to be undertaken during subsequent design stages as more information, such as results of further ground investigation works, becomes available.

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1.1	04 April 2025	For Planning (with minor update)	HD	TH
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0.0 Executive summary

0.0 Executive Summary

This report is prepared by Expedition Engineering on behalf of Hampstead Asset Management Ltd ("the Applicant") and their delivery partner Fifth State to summarise the structural engineering concept design for the redevelopment of 14 Blackburn Road, West Hampstead, London (the Site).

The proposed development would deliver:

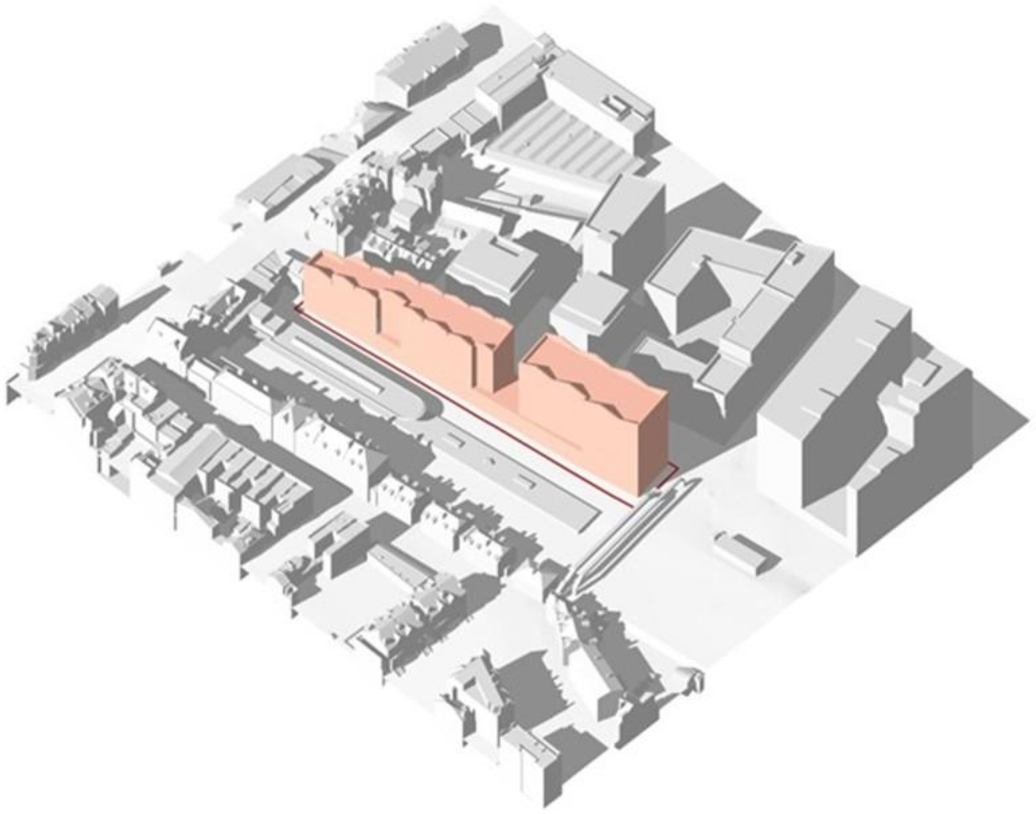
- 192 no. purpose-built student accommodation rooms (Sui Generis).
- 35 no. affordable homes (C3) and,
- 1,619 sqm of lower ground and ground floor commercial floorspace to include:
  - A new and enhanced flexible commercial/business space (Use Class E/Sui Generis) for the Builders Depot, comprising of show rooms, retail space and ancillary offices and an internal service yard accessed from Blackburn Road. This space is capable of being subdivided to allow for future flexibility.
  - A publicly accessible ground floor café at the base of the PBSA (Use Class E/Sui Generis).

This report covers the structural engineering work undertaken during the pre-planning stage of the project in support of the Planning Application, including a review of the site conditions and constraints. It describes the proposed structural engineering concept designs and confirms these are technically viable based on the information available. It also provides information for use in formulating a cost plan consistent with this stage.

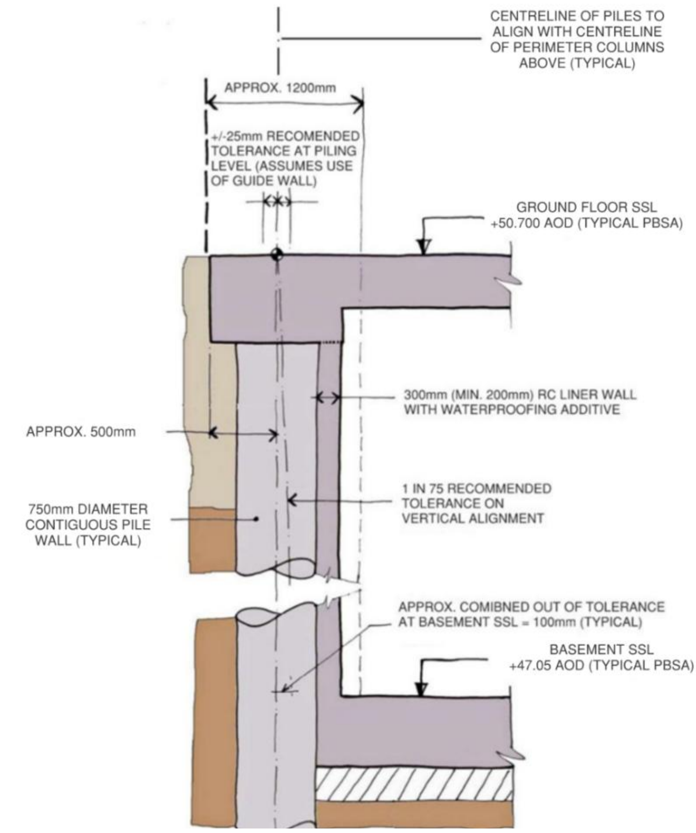
The key structural aspects for the building are as follows:

- For the residential (C3) block, 250 thick traditional in situ RC slab on RC columns, avoiding transfer structures.
- Cantilevers to support the external walkway at the northern face of the building and the internal apartment amenity spaces along the south of the building. For the northern cantilevers, thermal breaks will enable continuity of the slab while thermally isolating the portion beyond the main envelope of the building.
- For the PBSA (Sui generis) block, 225 thick traditional in situ RC slab on RC columns.
- Within the PBSA block above the service yard, RC transfer beams to enable vehicular access to the space.
- In other areas of the PBSA block, transfer structures have been avoided.
- In the basement, a contiguous pile wall of varying height to retain the ground in the temporary and permanent case. Some locations of this wall support columns from above.

It should be noted that the design information presented is preliminary and subject to further design development and coordination to be undertaken during subsequent design stages as more information, such as results of further ground investigation works, becomes available.



Site location in context of West Hampstead, London (Image from HTA)



Indicative section through perimeter contiguous pile retaining wall

Section of residential block indicating lateral stability structures in red

1.0 Introduction

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This report is prepared on behalf of Hampstead Asset Management Ltd ("the Applicant") and their delivery partner Fifth State to summarise the structural engineering concept design for the redevelopment of 14 Blackburn Road, West Hampstead, London (the Site).

Demolition and redevelopment of the Site for a mixed-use development comprising purpose-built student accommodation (Sui Generis), affordable housing (Use Class C3), lower ground and ground floor flexible commercial/business space comprising of showrooms, retail and ancillary offices (Use Class E/Sui Generis) and a café/PBSA amenity space (Use Class E/Sui Generis) and associated works including service yard, cycle parking, hard and soft landscaping, amenity spaces and plant." ('the proposed development').

The proposed development comprises of two distinct buildings that are linked at ground level. The C3 building will be 4-7 storeys including a taller ground floor and the PBSA building will be 10 storeys including a ground floor and amenity mezzanine level. There is a double height space spanning these lower two floors in the café at the base of the PBSA.

The proposed development would deliver:

- 192 no. purpose-built student accommodation rooms (Sui Generis).
- 35 no. affordable homes (C3) and,
- 1,619 sqm of lower ground and ground floor commercial floorspace to include:
  - A new and enhanced flexible commercial/business space (Use Class E/Sui Generis) for the Builders Depot, comprising of show rooms, retail space and ancillary offices and an internal service yard accessed from Blackburn Road. This space is capable of being subdivided to allow for future flexibility.
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It should be noted that the design information presented is preliminary and subject to further design development and coordination to be undertaken during subsequent design stages as more information, such as results of further ground investigation works, becomes available.

View of proposed development, with residential portion to the right and the PBSA block to the left (HTA image)

2.0 Site Conditions

2.0 Site Conditions

2.1 Site location and description

The site is in the London Borough of Camden (LBC), south-east of West Hamstead overground station and directly north of West Hampstead tube station. It is located along the southern side of Blackburn Road, next to the B510 to the west.

The site is currently occupied by a builders' merchants, with single- or double-height warehouses taking up most of the space and an outdoor storage yard situated in approximately the easternmost third of the site. The southern perimeter of the site is bounded by the train line, with a footbridge and services overpass bridging over the line to the south-west of the site. A series of small single-story commercial units lies to the west of the site.

The site measures 0.24 ha, and is a long tapering rectangular plot, measuring approximately 135 m long by 12 m to 22 m wide.

2.2 Site topology

The site lies adjacent to Blackburn Road, which slopes in elevation next to the site. The pavement elevations along the northern edge of the site range from approximately +54 m AOD. at the western end of the site to +51m AOD. at the eastern end. The existing ground level over the majority of the site surface is at the lower level of +51m AOD, enabled by a retaining wall of increasing height along the northern site boundary.

2.3 Existing structures

The existing structures on site include the following:

- 1 to 2-storey masonry warehouse buildings that front on to Blackburn Road.
- Metal-framed portal warehouse sheds that cover most of the site and wrap around the masonry buildings. The roofs comprise asbestos containing materials that will require specialist removal as part of the redevelopment works.
- The existing retaining wall along the northern boundary that retains the increasing ground levels along Blackburn Road.

2.4 Geological conditions

The following document summarises the ground conditions at the Site:

- Phase 1 Desk Study (3749-A2S-XX-XX-RP-Y-0001-00) prepared by A-squared Studio and dated March 2025.

The above document indicates that the following ground model stratigraphy can be assumed, based on information published by the BGS and available nearby borehole logs:

Strata	Elevation of top of stratum (mAOD)	Thickness (m)
Made Ground	+54.0 to +51.0m	1.9m
London Clay Formation	+52.1m to +49.1m	>72.0m

The site is assumed to directly overly the bedrock geology of the London Clay Formation, with Made Ground assumed to be present on site due to historical demolition and construction works. The London Clay Formation is underlain by the Lambeth Group, Thanet Formation and the White Chalk Subgroup at depth.

It is anticipated that further ground investigation works will be undertaken on site to inform the detailed design of proposed substructures and foundations in due course.

2.5 Groundwater

The report notes that the groundwater is likely to comprise a perched water table, with previous ground investigations encountering groundwater seepages at 1.20m bgl to 1.30m bgl. Other than these groundwater seepages, the groundwater level is likely to lie beneath the London Clay Formation Unproductive Strata. Since foundations for the proposed development will not penetrate the base of the London Clay Formation, no sensitive groundwater receptors have been identified at the site.

It is anticipated that further groundwater monitoring will be undertaken as part of the further ground investigation works to be undertaken on Site in due course.

2.6 Contamination

Reference should be made to the Phase 1 Desk Study for details of contamination. This report notes that there are likely to be elevated concentrations of arsenic, lead, PAHs and TPHs present on site with reference to a previous site report. The desk study also highlights potential contamination risks associated with the Site and recommended mitigation measures proposed for the development.

Further environmental testing will be undertaken as part of the further ground investigation works to be undertaken on Site once planning permission has been granted.

2.7 Ground gas

Reference should be made to the Phase 1 Desk Study noted above for a details of potential contamination risks associated with the Site and recommended mitigation measures proposed for the development.

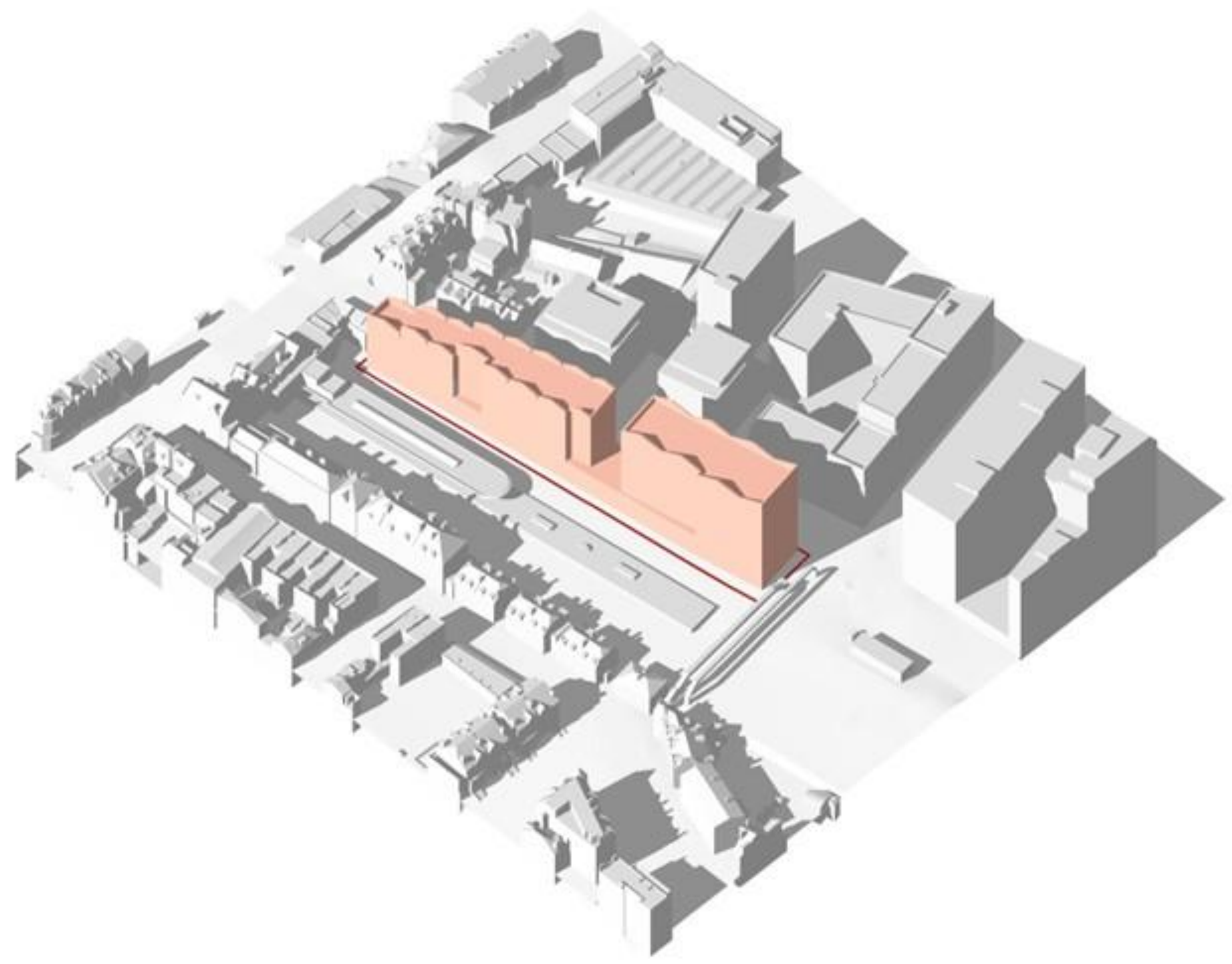
It is anticipated that further environmental testing will be undertaken as part of the further ground investigation works to be undertaken on Site in due course.

2.8 Potential In-ground obstructions

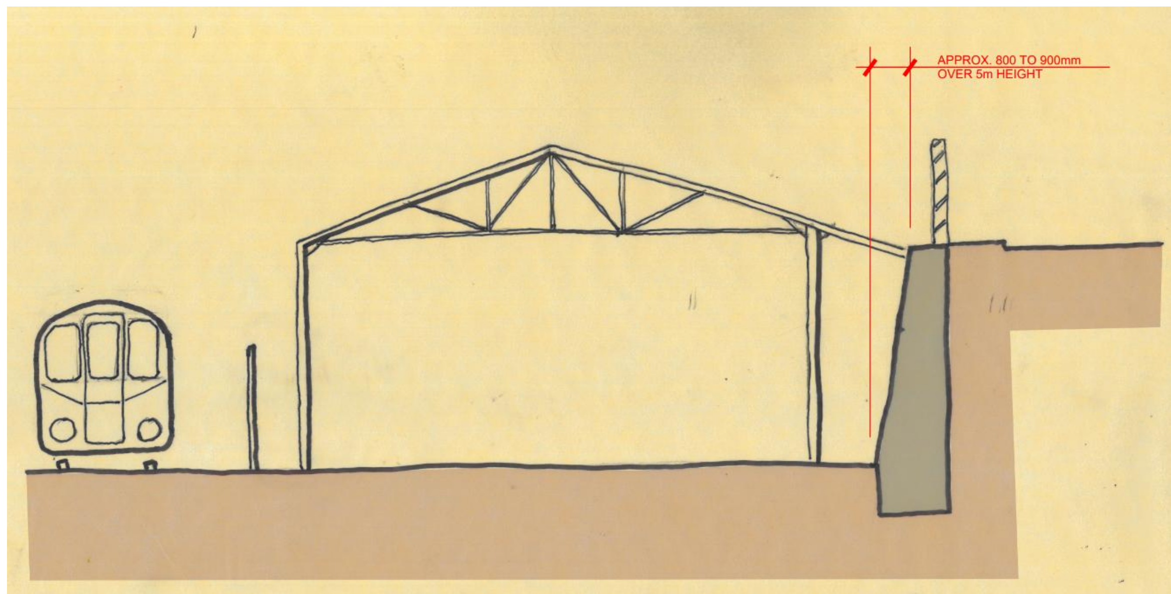
Historical maps indicate that the site and its vicinity was greenfield land until the 1890s, when railway lines were built within 120m of the site, with urbanisation near the site quickly following course. Maps dated to 1915 show that a single terminus track associated with the extension of the Metropolitan Railway line ran across the middle of the site.

By 1935 the warehouse buildings were constructed, which appear to be the same brick buildings now present on the Site. Further warehouses, garages and depots were added by 1974, and conversion into the existing builders' merchants since at least 2008.

Electrical substations are also present on the site, notably in the north-north-east corner.



Site location in context of West Hampstead, London (Image from HTA)



Sketch section through western end of existing site indicating maximum height of retaining wall

It is unknown of any remnants of the original railway track still exists within the ground. It is anticipated that additional trial pits and/or probing will be undertaken as part of the further ground investigation works to be undertaken on Site in due course.

A report from the site dated 2008 undertook a ground investigation. This ground investigation encountered Made Ground between 0.6 m to 1.9 m thick, underlain by the London Clay Formation. The Made Ground comprised dark grey, clayey, silty gravel of concrete, brick and ashes.

2.9 In-ground infrastructure

No industrial infrastructure such as storage tanks or pipework were identified during the site walkover conducted by A-squared, although machinery was noted in the brick building which consisted of an automated paint mixer and a vertical baler. An electric switch room was identified in the north-eastern corner of the site and housed multiple switchboards and fuseboards.

It is currently unclear if there are any existing in-ground services that remain within the Site footprint. If present, it is likely that existing in-ground services within the Site footprint are redundant and can be removed as part of the redevelopment works.

It is anticipated that further investigation of shallow in-ground services across the Site will be undertaken as part of the further ground investigation works to be undertaken on Site in due course.

2.10 Neighbouring Transport for London (TfL) infrastructure

The railway line is located to the south of the site, at a level approximately the same as the eastern level of the site. The railway track itself is approx. 2m from the site boundary.

There is an existing footbridge over the adjacent railway next to the east of the site. This appears to be a steel truss footbridge, with an adjacent services steel gantry bridging structure.

The B510 road bridges over the railway approximately 20m from the western edge of the site.

An initial consultation has been undertaken with TfL, including the infrastructure protection team. The Basement Impact Assessment (BIA) and Ground Movement Assessment (GMA) submitted as part of the planning application documents include the preliminary assessment of potential impact on the railway. It is anticipated that there will be a planning condition that formalises the need for further consultation with and approval from TfL for the detailed development proposals.

It is anticipated that condition surveys and movement monitoring associated with the proposed development will be required as part of the TfL asset protection and approval process.

Aerial view of the site (Aerial view from Google Maps)

2.11 Other neighbouring properties

A series of small single-story commercial units lies to the west of the site, including a flooring merchant, hair stylists and gift shop. These typically include lower ground floor levels and it is considered likely that these are founded on shallow spread foundations.

The preliminary impact assessments prepared in support of the planning application demonstrate that the proposed redevelopment will not have significant adverse impact on the neighbouring properties identified above, or any others. This will be reviewed and revalidated as the design and construction proceeds.

2.12 Unexploded Ordnance (UXO)

There is a Preliminary UXO Risk Assessment prepared by RMS UXO Ltd for the site, dated January 2025. This concludes that Borough of Hampstead overall was subjected to a very-high level of bombing and that a preliminary search of local records & mapping suggests that the site in question sustained damage from bombing. There is therefore a potential risk posed by UXO, the extent of which needs clarification.

The desk study recommends advancing to a detailed UXO risk assessment per CIRIA C681 guidelines for a thorough examination of wartime conditions in the anticipated work area. This will be undertaken in advance of any intrusive ground works (including investigations).

2.13 Trees and Invasive Species

The Arboricultural Impact Assessment for the Site was prepared by SJ Stephens Associates, dated March 2025. This assessment highlights 4 no Category C trees in the vicinity of the substation at the north-eastern corner of the site. All of the trees are recorded as having heights 3 m or less. Removal of all of these trees is recommended as a management strategy. Subsequently, no tree protection fencing is required.

3.13 Archaeology

The site is not located within the Camden Archaeological Priority Area.

It is anticipated that if any archaeological evaluation works are planned, these will be undertaken and coordinated with the further ground investigation works to be undertaken on Site in due course.

View of site boundary from the north-west

View of site boundary from the north-east

3.0 Structural Overview

3.0 Structural Overview

The development comprises two visually distinct blocks with a lower level amenity terrace between the two. A 4-to-7-storey residential block features to the west, and a 10-storey Purpose-Built Student Accommodation (PBSA) block to the east, with commercial, service yard and amenity space extending across the street level. The residential block features a cantilevered access walkway along the northern face of the block, and internal unit amenity space cantilevers along the southern face.

The eastern side of the building is the purpose-built student accommodation (PBSA) block, featuring a mezzanine PBSA amenity and PBSA-accessible external terrace amenity space. The ground floor contains a café, bin stores for both PBSA and the café, and the service yard area for the commercial space at the lower levels of the residential block.

The ground floor is mostly occupied by the street-level commercial showroom, its accompanying service yard, core zones & bin stores, and a PBSA café amenity space at the eastern extent. Two substation areas also feature in the south-eastern corner of the building.

An approximately rectangular common single storey basement area lies beneath both the PBSA and residential blocks, partitioned to provide separated cycle store space and individual building plant rooms. Much of the western portion of the separated basement is made up of an extension of the street-level commercial showroom space.

Storey-high plant enclosures are included at the roof levels of the PBSA and residential blocks where terraces are not present – these are typically on the top-most roof level of each respective block.

A number of alternative structural framing solutions and configurations were considered for the PBSA and residential buildings at the pre-planning stage. A brief list of those considered is as follows:

- Traditional in situ reinforced concrete (RC) flat slabs – proposed solution (see below)
- Traditional in situ RC band beams and slabs – increases maximum structural depth, requires additional coordination with services and increases construction time.
- Post-tensioned (PT) flat slabs – does not appear suitable for limited floor spans or thermally isolated cantilevers, therefore likely to increase embodied carbon and introduces potential procurement constraints.
- Steel frame with precast concrete – increases overall structural depth and requires additional coordination with services.
- Steel frame with slabs on metal deck – increase overall structural depth, requires additional coordination with services and potential acoustic issues.

The proposed structural option for the PBSA and residential buildings is based on traditional in situ RC frame construction with flat slabs at this stage. It is considered that this solution provides maximum flexibility for further development of internal apartment layouts and allows for alternative/modern methods of concrete construction to be incorporated as the design develops, e.g. precast columns, slabs or twin wall core construction.

The proposed structural solutions for substructures and superstructures are summarised in sections 4.0 and 5.0 respectively below.

The key design criteria to be adopted for the structural engineering design are also summarised in Appendix A.

Northern (roadside) elevation of the development, from HTA drawing pack.

4.0 Primary Substructures and Foundations

4.0 Primary Substructures and foundations

4.1 General description

The proposed basement under building is single storey, approx. 3.5 m deep on average, and extends over an area of approx. 1,500m². The basement level steps with the road elevation, such that the extreme west basement level is 2.225m higher than the eastern edge of the basement. While the under the PBSA block the basement is full depth, under the C3 block only partial excavation is required due to the lower ground levels to the south.

Although not directly under the footprint of the residential block, the western side of the basement is mostly occupied by the lower level of the commercial showroom & accompanying offices. Also present is the C3 core and accompanying cycle store, LTHW and MCW and residential sprinkler tank room.

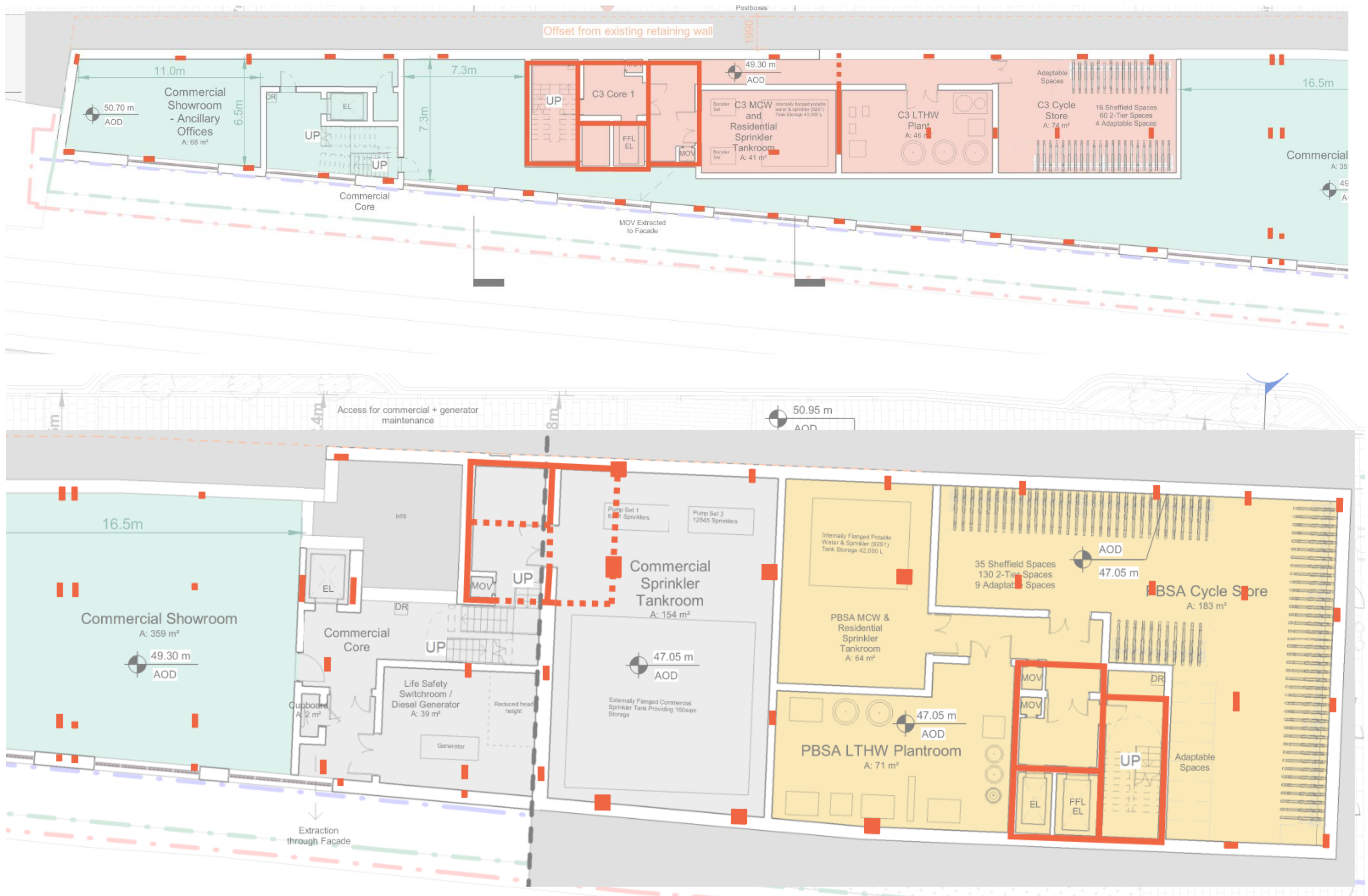
Beneath the PBSA block, the west side contains plant, sprinkler tanks and the commercial core. The eastern side, which is separated from the western side by a wall, contains the PBSA sprinkler tank room, plant, and a large PBSA cycle store.

For both blocks, the stability structure extends down to the basement level. The central core of the 3 stability cores partially transfers to a series of columns at the eastern side between the ground and basement levels.

The proposed basement is set in 3m from the boundary with TfL infrastructure on the south side. The extent of the basement is brought in 2m from the existing retaining wall at the western portion of the northern site boundary, where the existing retaining wall supporting Blackburn Road lies. This is to accommodate the inclination of the existing wall, the potential for existing toe support (to be confirmed by site investigation) and suitable offset for piling operations. Where there is no existing retaining wall or the level difference is small, the new basement wall will replace the retaining wall and push out to the site boundary.

The eastern edge of the basement is brought in 5 m from the site boundary. This avoids any potential clash with the Thames Water sewer and keeps away from the foundations of the Granny Dripping Steps footbridge.

The substructure and foundation proposals are further summarised in the sections below. The Basement Impact Assessment (BIA) for the Site goes into more detail on many of the substructure aspects referred to in this statement. Note the lateral stability and primary vertical structures that extend through the basement to foundation level are summarised in section 5.0 below.



Marked-up extract from HTA Basement GA Plan

4.2 Retaining walls

The basement retaining walls are proposed to comprise embedded contiguous pile walls, formed using closely spaced piles (e.g. 600mm to 900mm diameter) founded within the London Clay Formation strata, and finished with a reinforced concrete lining wall.

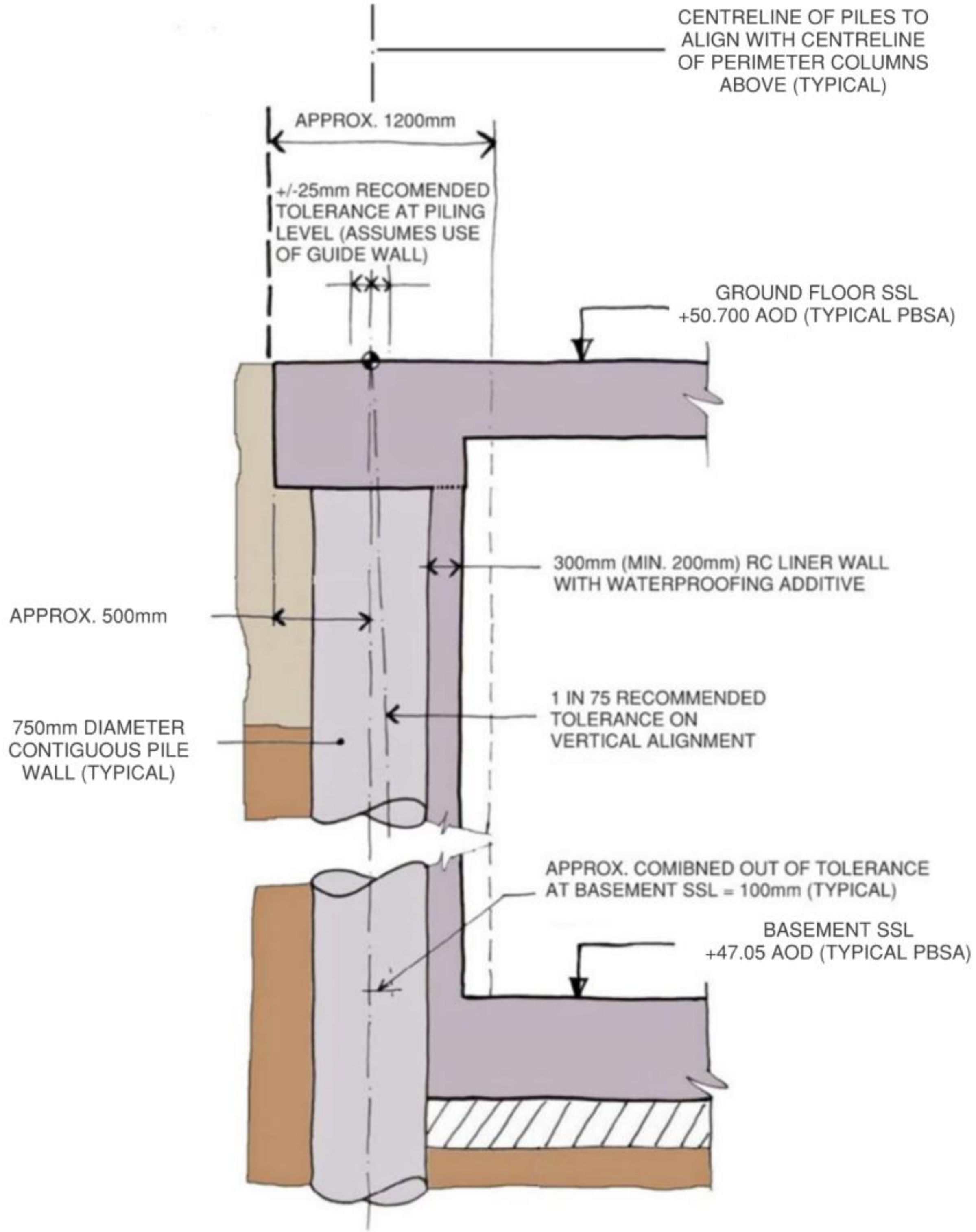
The contiguous pile walls will be installed in advance of the basement excavations and used to retain the adjacent ground in both temporary and permanent conditions. It is anticipated the temporary propping across the basement will be used to help minimise ground movements in the temporary condition, before the basement and ground level slabs are constructed to prop the retaining walls in the permanent condition.

As noted in section 2.0 above, there is a low risk of encountering the groundwater table due to the relatively impermeable clay strata. It is likely that there will be perched water upon the London Clay Formations, and some level of management of rainwater and basement seepage will be required. High groundwater mitigation measures such as constant de-watering operations during excavation are not expected.

The basements shall be designed for a minimum of structural waterproofing Grade 2 to BS 8102, with the option to enhance this to Grade 3 to BS 8102 with the implementation of additional measures.

Where the lower ground floor is to be up against the existing retaining wall, it is anticipated that there will need to be a cavity drainage waterproofing system or similar to manage groundwater seepage through the existing wall.

Where the contiguous pile wall is aligned with building columns above, it will be designed to accommodate the associated vertical building loads, which is expected to result in longer piles in the relevant locations.



Indicative section through perimeter contiguous pile retaining wall

4.3 Foundations

At this stage it is assumed that the load bearing foundations for the basements and buildings above will comprise reinforced concrete (RC) pile groups and RC pile caps.

Pile foundations offer a reliable and relatively stiff foundation solution that can be efficiently designed to respond to the variations in the proposed building loads across the site.

It is anticipated that continuous flight auger (CFA) piling methods and a combination of pile diameters will be adopted (e.g. 450mm to 900mm), dependant on confirmation of site ground conditions, level of load taken by each pile dependant on number of storeys above and the proposed piling rig/sequence strategy.

The feasibility of piled raft foundations, which may provide material and construction programme savings, can be considered in more detail as the detailed design progresses and once the results of further ground investigation works are available.

4.4 Basement and ground floor structures

The basement and ground floor slabs in the PBSA/residential blocks are proposed as in situ RC construction for its adaptability to alternative column grids and floor levels, and for its inherent durability, robustness and fire resistance properties.

In the permanent condition, the basement and ground level slabs will act as rigid diaphragms to laterally prop the basement retaining walls.

The design of basement and ground floor slabs, including the interfaces with the retaining walls, will be integrated and coordinated with the structural waterproofing strategy.

5.0 Primary Superstructures

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5.1 General description

The proposed structural solution for the PBSA and residential block superstructure comprises traditional in situ reinforced concrete (RC) frames with concrete cores for stability.

In the PBSA building, 2.925 m floor-to-floor dimension has been adopted at PBSA levels to help ensure an efficient design and limit overall height impact. Taller storeys with a 4.05 m floor-to-floor dimension are incorporated at the amenity mezzanine level and the ground floor.

In the residential building, 3.150 m floor-to-floor dimension has been adopted for levels 2 to 4, with a larger 3.65 m floor-to-floor for level 05 to the roof. The ground floor space has a floor-to-floor height ranging from 3.885m to 6.30m, dependent on the presence of the mezzanine floor above or not as well as the stepping level of the ground floor.

The PBSA superstructure block reaches a height of approx. 32 m above ground level. The residential superstructure tower block reaches a height of approx. 24.9 m above ground level. The PBSA amenity terrace between the two has a height of approx. 6.3 m above ground level.

The superstructure proposals are further summarised in the sections below.

Section of residential block indicating lateral stability structures in red

Section of PBSA block indicating lateral stability structures in red

5.2 Lateral stability structure

Lateral stability will principally be provided by the full height reinforced concrete core walls located around the main lifts, stairs, and service risers within the residential and PBSA buildings.

The residential and PBSA blocks are structurally independent buildings above street level, with a doubled line of columns at the interface between the two.

The stability cores within the PBSA building are approximately square in profile and sit close to the western and eastern sides of the block. The additional stair means that an additional smaller core is situated in the south of the tower's floorplate.

The stability core within the residential building is rectangular in profile with an approximate aspect ratio of 1.6:1. This contains two sets of stairs and while the core is situated approximately centrally in the plan shape of the residential block from ground to level 5, the western face of the core forms the external envelope of the block from level 6 up to the roof. An additional shear wall is located to the east of the core, which aligns with the bin store wall at ground level.

At each level, floor slabs will be designed to act as diaphragms to transfer wind and other horizontal forces to the laterally stiff stability walls. The stability walls will be designed to cantilever from foundation level.

Plan on typical upper floor of PBSA block indicating lateral stability structures

Plan on typical upper floor of residential block indicating lateral stability structures

5.3 Floor structures

Residential (C3) block typical floors are proposed to be 250 mm thick traditional in situ RC flat slabs, without drop heads at columns, at this stage. PBSA block typical floors follow a similar approach, but with a 225 mm thick RC flat slab. Roof slabs or slabs under amenity spaces are proposed to be 250 mm thick traditional in situ RC flat slabs, again without drop heads at columns, at this stage. The final slab thickness will be determined once the slab spans are confirmed, following detailed coordination of internal columns within some of the larger apartments.

The residential building includes projecting access walkways on the northern face from Levels 02 to 06. It is proposed that these will comprise traditional RC in situ concrete flat slab cantilevers with thermally isolated connections back to the main RC frame. Similarly, the residential building's cantilevering internal amenity spaces can be achieved with the same continuous traditional RC in situ concrete flat slab.

Alternative and modern methods of concrete floor construction (e.g. partially precast slabs) will be further considered during the detailed design stage, where potential material, carbon and/or construction programme savings may be achievable.

5.4 Vertical structures

Columns and walls in the PBSA and residential buildings are proposed to be constructed in traditional RC at this stage. Columns at the northern and southern perimeters of the residential block are relatively closely spaced to minimise column locations within units, and limit deflections of the relatively large cantilevers of the northern walkways and southern internal unit amenity spaces. The option to increase the slab thickness to achieve largely column free apartments may be considered if the proposed internal column locations are found to be too disruptive during the detailed design and coordination of the layouts.

In addition to the stability walls described above, there are internal columns, typically located on the lines of party walls between dwellings to minimise the impact on the internal layouts.

For the PBSA block, column locations align with partitions between units to avoid any column locations within units. The proposed width of PBSA units aligns well with the column grid and slab thickness.

The option to adopt precast columns to reduce construction time will be considered further as the design develops.

Mark-up of typical residential upper floor plan (marked-up extract of HTA drawing)

Mark-up of typical PBSA upper floor plan (marked-up extract of HTA drawing)

5.5 Transfer Structures

For the student block, a transfer structure is required above the service yard & loading area to enable a change in the apartment column layout and the column layout required for vehicular access beneath. This will be achieved with downstand RC band beams at Level 01 supporting the transfer slab, approximately 1200 mm wide by 1500 mm deep. These transfer beams will land on larger columns that extend from L01 down to the basement level.

In the commercial core to the west of the service yard, a lift shaft is currently shown at ground and basement levels, which coincides with a key column location defined by the upper floors above. Similarly to the service yard, it is proposed that this column is transferred onto the walls of the commercial core by means of a modest transfer beam.

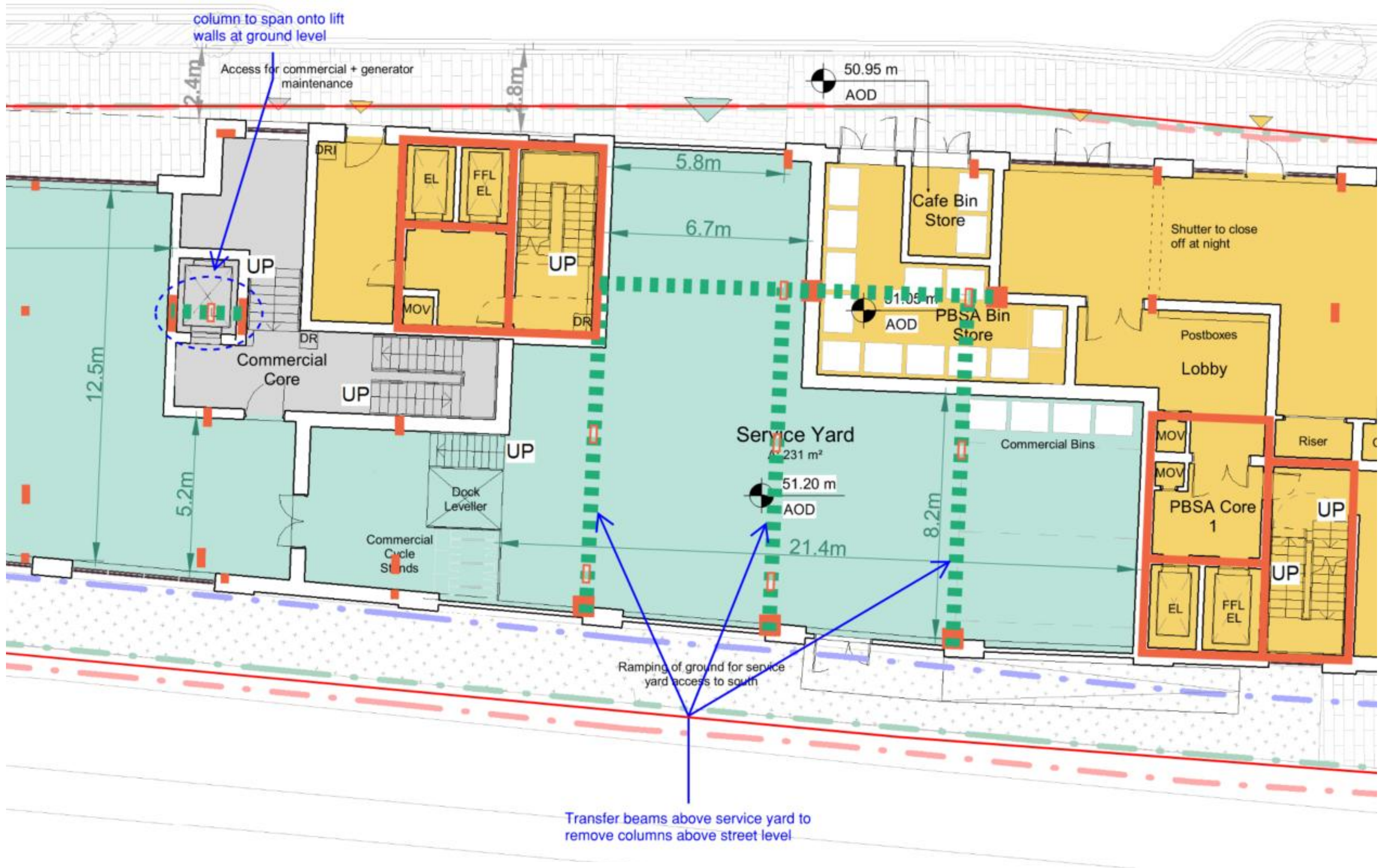
Elsewhere in the PBSA building and within the residential building, the primary structure column locations are coordinated to be consistent for the full height of the buildings and hence no further transfer structures are required.

In the residential building, it is proposed to coordinate some internal columns within the larger affordable dwellings to limit slab spans and allow deflections in the substantial northern and southern cantilevers to be limited. The columns will be coordinated with internal partitions and/ or located to avoid disruption to the use of the apartment. The option to increase the slab thickness to achieve largely column free apartments may be considered if the proposed internal column locations are found to be too disruptive during the detailed design and coordination of the layouts.

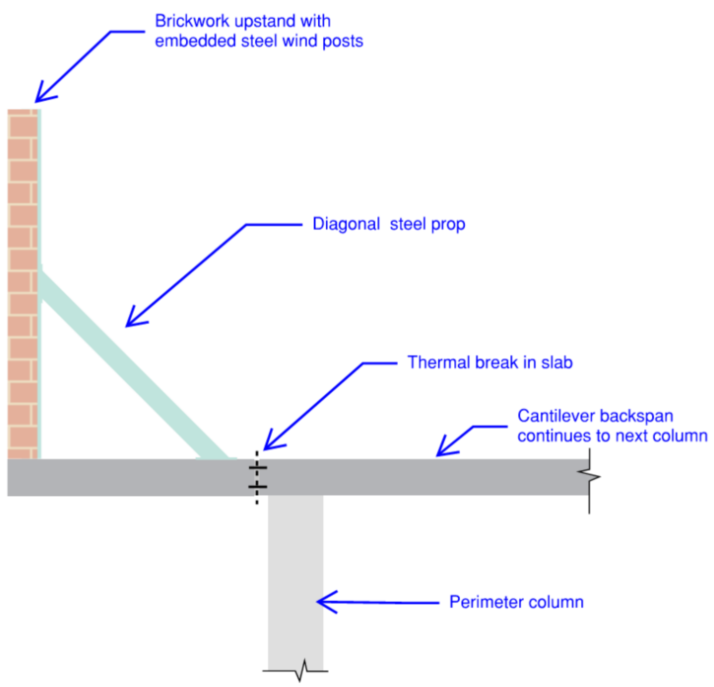
The option to adopt precast columns to reduce construction time will be considered further as the design develops.

5.6 Roof parapet restraint

To support the relatively tall brick parapets along the northern elevation of the roof, diagonal steel props are proposed to provide adequate restraint and robustness to resist horizontal loads resulting from wind acting in either direction. In the areas where the parapet rests on the tip of a cantilevering slab e.g. the northern perimeter of the residential block, this raking prop will connect back to the supporting slab on the 'cold side' of the thermal break so that the prop does not act as a thermal bridging element.



Mark-up of typical PBSA upper floor plan (marked-up extract of HTA drawing)



Sketch of roof upstand prop at a cantilevering location.

Appendix A - Outline Design Criteria

Appendix A - Outline Design Criteria

Structural Engineering Design Criteria

A1 Minimum Loading Allowances

The following minimum loads have been allowed for to date.

Table 1: Imposed Load Allowances

Location	Load
Car parking (ground) / cycle storage (ground and basement)	2.5 kN/m²
Apartments & PBSA[1]	1.5 kN/m² + 1.0 kN/m² = 2.5 kN/m²
Walkways/Terraces	2.5 kN/m²
Circulation Areas (Stairs and Corridors)	3.0 kN/m²
Retail[1]	4.0 kN/m² + 1.0 kN/m² = 5.0 kN/m²
Class E unit[1]	2.5 kN/m² + 1.0 kN/m² = 3.5 kN/m²
Plant rooms (basement)	To suit specific plant room use, otherwise 7.5 kN/m²

1. Includes allowance for lightweight stud partitions throughout (1.0 kN/m²) ie no heavy weight / blockwork partitions

Table 2: Superimposed Dead Load Allowances

Location	Allowance	Load
Cycle/car parking areas	Suspended services (high level basement)	0.5 kN/m²
Apartments and PBSA	Floor finishes, services and ceilings (max. 45mm screed)	1.5 kN/m²
High level Landscaped Areas	General allowance for mixed landscaping (to be developed with Landscape Architect)	7.5 kN/m²
Green roofs	Lightweight system	1.5 kN/m²
Retail / Restaurants / Leisure	Floor finishes, services, etc.	3.0 kN/m²
Offices	Floor finishes, ceiling and services	0.85 kN/m²
Façades (typical)	General allowance for single skin brickwork with metal restraints system	2.5 kN/m² on elevation

Other building allowances - Including wind and snow actions derived in accordance with Eurocode 1 and relevant UK National Annexes

A2 Deflection Limits

The table below sets out the preliminary deflection limits adopted for the design of the structure. These will be expanded on further at a later stage in the project through a movement and tolerances study and report. These limits assume a reinforced concrete structure and are in accordance with EN1992.

Table 3: Assumed Deflection Limits

Area	Maximum Relative Deflection
Vertical imposed load deflection	Span/360 generally, Span/500 where sensitive finishes are present
Vertical total load deflection	Span/250
Slab edge deflections for façade	Span/500 or 15mm MAX Cantilever/250 or 15mm MAX
Horizontal sway of structure	Height/300 per storey or Total Height/500

A3 Structural Tolerances

The building tolerances specified for concrete and steel structural elements will generally be as per the standard tolerances set out in the National Structural Concrete Specification (NSCS) and the National Structural Steelwork Specification (NSSS) respectively.

A4 Design Life

The primary structure is to be designed for design life of 60 years.

A5 Structural Fire Resistance

Based on advice from Orion Fire Engineering, the Fire Safety Consultant, the minimum fire rating of primary structural elements is as follows:

- 60 minutes Fire Rating for apartments, ancillary rooms and amenity spaces;
- 120 minutes Fire Rating for electrical supply plant rooms and firefighting cores across the whole building; and
- 240 minutes Fire Rating to electrical substations.

The reinforced concrete frame primary structure will be specified with minimum dimensions and concrete cover to reinforcement to achieve the required Fire Rating. Other structural materials, e.g. steelwork and timber, may require applied fire protection if used.

Structural Engineering Design Criteria continued

A6 Robustness and Disproportionate Collapse

In accordance with the UK Building Regulations Part A, each building is required to be designed and constructed so that in the event of an accident the building will not suffer disproportionate collapse. Robustness requirements will be met for each building to suit its consequence class as defined in Table II of Building Regulations Part A3. Typically, robustness requirements will primarily be met by providing effective horizontal ties, as described in the Eurocodes for framed construction, together with effective vertical ties in all supporting columns and walls.

The structure shall be designed to ensure that there is no disproportionate collapse under foreseeable accidental actions. This does not mean that no collapse will occur due to an accidental action, but rather that the collapse that occurs will not be disproportionate to the degree of damage done to the structure. How much damage is allowed to occur to a building following an accidental action is determined by the consequence class of the structure, in accordance with The UK Building Regulations Part A3 Table 11 and BS EN 1991-1-7:2006+A1:2014 (Eurocode 1-7) Table A.1
The consequence class of the various blocks are as follow:

- PBSA block – CC2b
- Residential block – CC2b

For a building of Consequence Class 1 no special robustness measures are required.

For a building of Consequence Class 2b effective horizontal ties or effective anchorage between suspended floors and walls as defined in BS EN 1991-1-7:2006+A1:2014 A.5.1 and A.5.2 respectively for framed and load-bearing wall construction shall be provided. Vertical ties shall be provided in all supporting columns and walls in accordance with BS EN 1991-1-7:2006+A1:2014 A.6.

As an alternative to simply providing the ties specified above the structure may be checked to ensure that upon the notional removal of each supporting column and each beam supporting a column, or any nominal section of load-bearing wall as defined in BS EN 1991-1-7:2006+A1:2014 A.7 (one at a time in each storey of the building) the building remains stable and that any resulting collapse does not exceed 15% of the floor area of that storey or 70 m^2, whichever is smaller, and does not extend further than the immediately adjacent storeys. Any elements the removal of which results in a greater collapse are to be designed as a key element in accordance with BS EN 1991-1-7:2006+A1:2014 A.8.

For Consequence Class 3 structures, under the Eurocode EN1991-1-7 a systematic risk assessment must be carried out.

Table A.1 - Categorisation of consequences classes.

Consequence class	Example of categorisation of building type and occupancy
1	Single occupancy houses not exceeding 4 storeys. Agricultural buildings. Buildings into which people rarely go, provided no part of the building is closer to another building, or area where people do go, than a distance of $1^1/_2$ times the building height.
2a Lower Risk Group	5 storey single occupancy houses. Hotels not exceeding 4 storeys. Flats, apartments and other residential buildings not exceeding 4 storeys. Offices not exceeding 4 storeys. Industrial buildings not exceeding 3 storeys. Retailing premises not exceeding 3 storeys of less than 1 000 m^2 floor area in each storey. Single storey educational buildings All buildings not exceeding two storeys to which the public are admitted and which contain floor areas not exceeding 2000 m^2 at each storey.
2b Upper Risk Group	Hotels, flats, apartments and other residential buildings greater than 4 storeys but not exceeding 15 storeys. Educational buildings greater than single storey but not exceeding 15 storeys. Retailing premises greater than 3 storeys but not exceeding 15 storeys. Hospitals not exceeding 3 storeys. Offices greater than 4 storeys but not exceeding 15 storeys. All buildings to which the public are admitted and which contain floor areas exceeding 2000 m^2 but not exceeding 5000 m^2 at each storey. Car parking not exceeding 6 storeys.
3	All buildings defined above as Class 2 Lower and Upper Consequences Class that exceed the limits on area and number of storeys. All buildings to which members of the public are admitted in significant numbers. Stadia accommodating more than 5 000 spectators Buildings containing hazardous substances and /or processes

NOTE 1 For buildings intended for more than one type of use the "consequences class" should be that relating to the most onerous type.

NOTE 2 In determining the number of storeys basement storeys may be excluded provided such basement storeys fulfil the requirements of "Consequences Class 2b Upper Risk Group".

NOTE 3 Table A.1 is not exhaustive and can be adjusted

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