Grand Union House, London NW1

Structural Report

December 2018

Camden Mixed Developments Ltd

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Confidential

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1 INTRODUCTION

1.1 BACKGROUND

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1.2 PURPOSE OF REPORT

The purpose of this report is to record the development of the design through to the end of Stage 2 and to support the planning application, identifying assumptions, recording key design decisions and providing a platform for the on-going development of the design.

2 EXECUTIVE SUMMARY

2.1 BACKGROUND

The proposals are for a mixed-use redevelopment of a 1980s reinforced concrete building along Kentish Town Road in Camden.

The existing office building is principally a three storey reinforced concrete frame with a steel roof and a separate single storey construction at 16 Kentish Town Road. The basement of the building is used as a car park for Sainsburys' and is to be retained and kept operational with minimal disruption during the construction of the proposed scheme. The twelve car parking spaces at gorund floor level which belong to the residents of Grand Union Walk are also to be retained.

The structural strategy therefore is to where ever possible maintain existing foundations and columns and minimise disruption to Sainsbury's operations; this has driven the decision making process when considering structural materials and form.

The proposed scheme consists of two buildings. A commercial building utilising as much of the existing concrete frame as possible while increasing the number of stories and a residential building to the South which is a new construction as it is not limited by the Sainsbury car park below. Flexible retail and leisure uses (class A1, A3 and/or D2) are proposed at ground floor level with the commercial and residential buildings.

The scheme requires the demolition of the roof, mezzanine and part of the level 1 slab to the South of the site that does not sit above the Sainsburys' car park.

The new structure above level 1/above ground level South of the core is to be constructed as a steel moment frame with 160mm thick CLT panels for the typical office levels and 220mm thick CLT panels at the roof levels. A new mezzanine level is inserted between ground and level 1 and consists of shallow UC sections supporting a 60mm thick SPS floor for plant areas and a semi-open steel grille for pedestrian and bicycle storage areas and associated facilities.

Strengthening works to the columns between the ground floor and level 1 are required to support the new taller structure above and to allow for fixing in the new mezzanine level. Based on the record information, strengthening works are not required to the columns between ground level and the basement.

The existing structural concrete columns are generally supported on RC pad footings. The proposed structure primarily has the same column grid as per the existing building.

In any location where a new column does not sit over an existing footing then a new foundation will be constructed below the existing basement slab to a depth equivalent but not more that the existing foundation depth to ensure that no existing foundations are undermined.

The residential building consists of 200mm and 250mm RC flat slabs supported on blade columns. A concrete core provides lateral stability. Walking columns and an RC upstand western elevation and downstand on the eastern elevation allow for set-backs at roof level and a large column-free span for the retail frontage.

3 THE SITE

3.1 LOCATION AND BOUNDARIES

The existing building was designed and constructed in the late 1980s as part of a large campus development that consists of:

a) A Sainsbury's supermarket and atrium fronting Camden Road

b) The existing office building and gym (previously workshops and crèche) alongside Kentish Town Road.

c) A residential terrace beside the Grand Union Canal (Grand Union Walk).

d) A basement car park under most of the site.

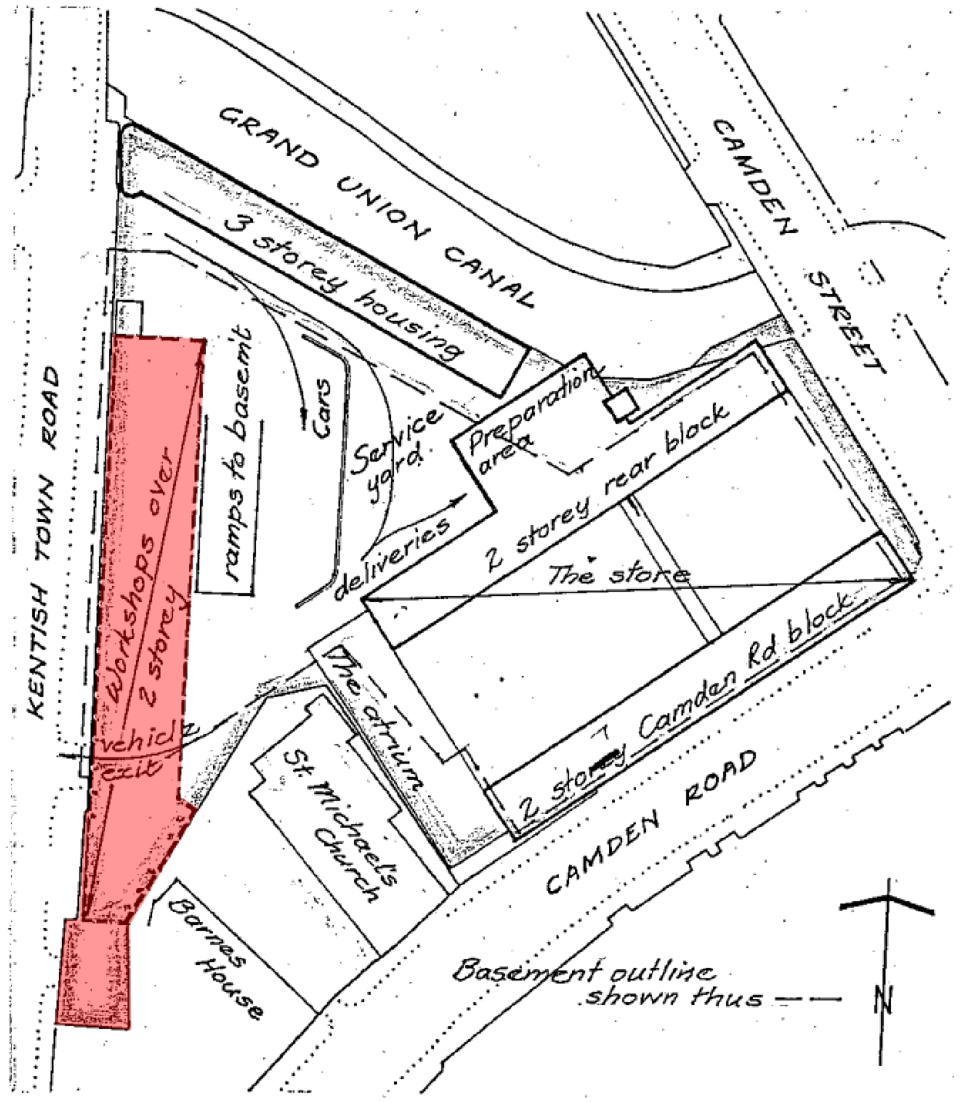

Figure 1: The existing building highlighted on the site campus

3.2 SITE SURVEY

A survey of the existing building was undertaken by Plowman Cravan in May 2017. The survey did not include the UKPN room.

A condition survey was undertaken by Watkinson + Cosgrave in May 2015. Key notes are as follows:

CONCRETE STRUCTURE GENERALLY

"…our visual inspection revealed no evidence of significant cracking, deflection or other distress to the superstructure that would indicate failure of the foundation…"

and

"…there were no signs of cracking or deformation of the frameworks within the building…the exposed concrete is...in generally sound condition but no cover meter testing or testing for carbonation of the concrete was undertaken and in consideration of its age, it is recommended that such further investigation should be made in order to ascertain the exact condition of the concrete."

COLUMNS

"…structural columns adjacent to the service road have evidence of localised vehicle impact and it should be confirmed that this has not affected the structural integrity. Consideration should also be given to providing local means of protection to the affected columns."

ASBESTOS

"Given the dates of construction it is possible that asbestos containing materials are present."

No asbestos documentation was forthcoming on site and it was recommended that the client's solicitors ascertain whether it exists and "…if not that a specialist be commissioned to undertake a detailed asbestos survey and to prepare an asbestos register."

3.3 KEY DEVELOPMENT CONSTRAINTS

The new development is to minimise any impact to Sainsbury's store operations. This means minimising any works in the basement car park and to allow deliveries in and out of the service yard. The design of the proposed scheme achieves this as follows:

- The lightweight structure above Sainsbury's car park ensures that no strengthening works are required to the columns between basement and ground level (subject to a structural investigation). In addition, the foundations supporting these columns do not require any enhancement.

- The CLT floor panels allow the frame to be constructed more quickly than traditional methods to minimise construction time.

- Retaining the level 1 structure may allow the bridge structure over the delivery yard exit to act as a crash deck.

3.4 EXISTING STRUCTURES / DEMOLITION

The existing roof, mezzanine and part of the level 1 structure south of the core is to be demolished. These areas are highlighted on WSP drawings GUH-WSP-DE-0M-DR-S-200101, GUH-WSP-DE-01-DR-S-200101 and GUH-WSP-DE-04-DR-S-200101.

One column to the north requires demolishing and replacing with a steel encased section to load the basement column concentrically. This is shown on GUH-WSP-00-0M-DR-S-200101 P02.

A column on the eastern elevation may need to be demolished replaced depending on what the structural investigation works (see section 3.6) reveals the corbel/transfer detail to be. The column in question is highlighted on GUH-WSP-00-ZZ-DR-S-200303 P01.

Demolition/excavations to create the foundations to the residential block and the office areas south of the core are TBC pending the Geotechnical Site Investigation Specification survey (see section 3.5) and the Structural Investigation Specification (see section 3.6).

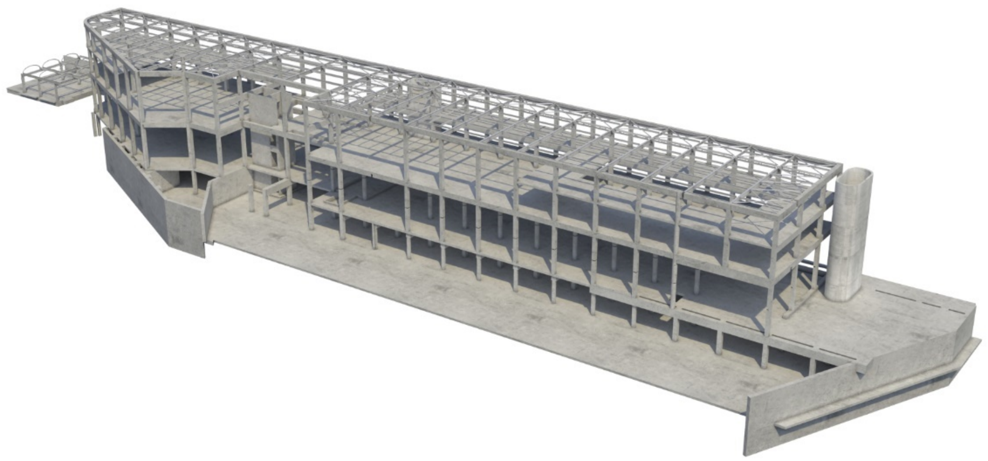

Figure 2: A 3D model of the existing building constructed from the record and survey information.

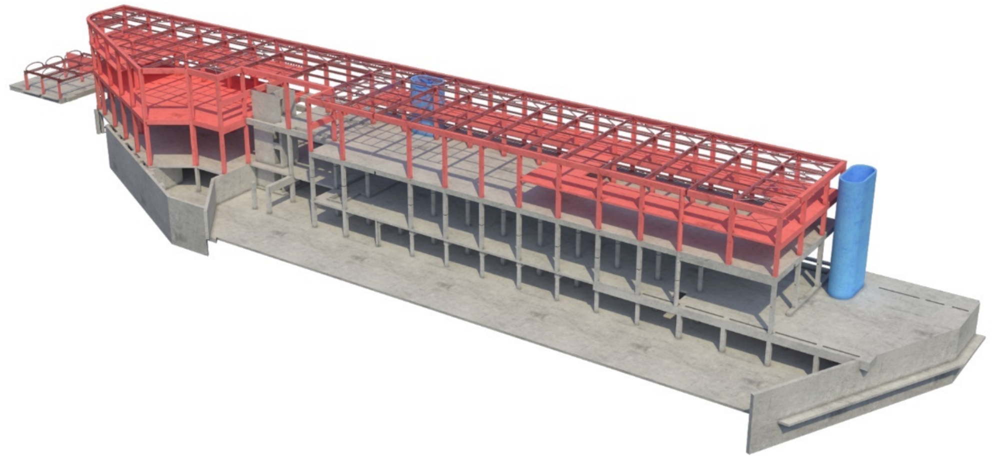

Figure 3: A 3D model of the existing building highlighting the structure to be demolished in red. The lift cores in blue are to be retained if possible subject to the findings of a structural investigation (see section 3.6).

3.5 STRUCTURAL INVESTIGATION WORKS – GEOTECHNICAL CONSIDERATIONS

A preliminary geo-environmental risk assessment (desk-study) has been produced by WSP (ref: WSP, "Grand Union House – Preliminary Geo-Environmental Risk Assessment (Desk Study)", First Issue, June 2018. This document highlights environmental and geotechnical risks and considerations, predominantly with respect to ground conditions.

A site specific investigation is required to confirm the ground profile, engineering parameters, contamination levels in the south of the site, and groundwater regime beneath the site. WSP have prepared the Site Investigation Specification (ref: WSP, "Grand Union House – Site Investigation Specification", Revision 1, June 2018) and the Client has procured it.

The strategy is to reuse the current foundations beneath the main building and no new supplementary foundations will be required for the new development in this area. The geotechnical engineer will need review the short and long term settlements from the demolition and construction works from the change in loads and check the foundations have an appropriate allowable bearing pressure and factor of safety for the new development. The structural engineer will need to assess the current columns at ground level and beneath within the basement, have the appropriate capacity to support the new structure.

The client will need to obtain the relevant insurance for the new building to be supported on the historical foundations.

The new building proposed in the south will require new foundations. A site investigation will be required so these can be appropriately designed. The differential settlements between the old and the new structure will need to be assessed to ensure they are within the structures tolerable limits.

The following further works will be required:

- A enabling works package should be allowed to remove all obstructions. This is likely to only be relevant in the southern area of the site where new foundation will be required;
- A site investigation will be required to confirm the ground and groundwater regime beneath the site;
- A Ground Investigation Report (GIR) will be required in accordance with the Eurocodes;
- A Geotechnical Design Report (GDR) will be required in accordance with the Eurocodes for the foundation design;
- A risk assessment will need to be completed to confirm the structures / assets at risk from ground movements and which assets will require a Ground Movement Assessment (GMA) to be completed. Liaison with the adjacent asset holders will be required to discuss ground movements, monitoring strategy, and any remedial measures required or Monitoring Action Plans (MAP) which will be required to be implemented during the works. The listed buildings on site will also need to be accounted. The critical structures are likely to be:
    (i) LUL assets
    (ii) Party Wall Structures – The Mango Room Hotel to the south of the site is likely to be a party wall and the requirements of the party wall act will need to be implemented if this is the case.
- Early liaison with Thames Water is recommended. Particularly associated with the unknown sewer present on the historical foundation drawing.
- Early liaison with the party wall engineer is recommended to determine their ground movement assessment, monitoring and condition survey requirements.
- Early liaison with TFL is recommended to determine their correlation survey, ground movement assessment, monitoring and condition survey requirements.

Based on the information contained within this report, and with due regard to the geotechnical aspects of the proposed development, it is the opinion of WSP that the site represents a **LOW / MEDIUM** risk with respect to development issues.

3.6 STRUCTURAL INVESTIGATION WORKS – STRUCTURAL ENGINEERING CONSIDERATIONS

A Structural Investigation Specification is to be produced between the end of Stage 2 and the start of Stage 3. It is necessary to carry out intrusive and non-instructive investigations of the structural frame and foundations for the following reasons:

TO PROVE THE ACCURACY OF THE RECORD INFORMATION

The current assessment of the structural capacity of the existing frame is based a set of record drawings and a report. During this design stage it has been discovered that even Construction Issue record drawings do not always reflect what has actually been constructed on site. In addition, the record information is incomplete and an educated guess has had to be made when producing existing structure GAs for this design stage. Any missing/incomplete information has generally been highlighted on the Structural Stage 2 set of drawings and include the following:

- The central half of the building's foundation plans are missing. We have interpolated what the likely size of the pad footings are based on the column and pad sizes from the plans we do have either side of the area of missing information. To the South, the drawings show conflicting information on the position of a pad foundation.
- Only the Northern third of the ground floor structural plan is available. We have interpolated what the remaining two thirds are based on an existing column schedule and the Plowman Craven survey. To the South, the drawings show conflicting information on the position of two columns. A corbel detail or transfer is implied on the Eastern elevation but no details on it are available.
- The 1st floor bridge structure has clearly changed since the construction issue drawings or has been modified afterward. A column position to the North has also changed.
- Column reinforcement information is incomplete.

A structural survey is therefore required to prove that the record information is generally correct where there are no differences between them and what has been built and to investigate the differences and confirm that our assumptions of the missing information was correct.

TO ASSESS THE CURRENT CONDITION OF THE CONCRETE FRAME

The condition of the concrete frame and its suitability for increased service life needs to be assessed considering the investment that is to be made into redeveloping the building. The majority of the concrete frame to be re-used is generally exposed and is in an environment with a BE EN ISO 12944: Part 2 and SIO 9223 corrosivity risk category of **C3 – MEDIUM.**

The durability and condition of the current concrete and its ability to continue to provide protection to the internal reinforcement steel as well as the condition of said reinforcement is critical to ensuring that the existing structure is suitable for an increased service life.

TO ASSESS THE CAPACITY OF THE EXISTING ELEMENTS OF THE PROPOSED SCHEME

Clarifying what has been built and the differences to the record information, and identifying the current condition of the concrete frame enables the Structural Engineering team to more accurately assess what the structural and life-time capacity of the existing frame is.

3.7 RETAINED INFRASTRUCTURE AND SERVICES

The Northern Line runs below Kentish Town Road, and the Fleet Storm Relief Sewer runs below Camden Street but remote from the site. An oval brick sewer crosses the side to the south, passing below existing foundations.

3.8 HISTORIC USE OF THE SITE

The site has been developed for various uses over the years and from 1924 to 1984 was a major bakery. Demolition of the bakery buildings was completed during the winter of 1986/7.

4 SUBSTRUCTURE

4.1 RETAINED BASEMENT WALLS

The existing basement wall is likely to be reinforced concrete but its thickness, reinforcement and concrete specification and grade are unknown.

The record information suggests that the majority of the walls along Kentish Town Road pre-date the current building and were originally constructed for the bakery. A visual inspection reveals these walls to be in poor aesthetic condition and that parts of the wall have water ingress.

A new wall was constructed along the rear of the UKPN room on gridline W07 and sits on a two metre wide strip footing. It is possible that this wall is retaining soil and/or backfill to the south.

4.2 BASEMENT SLAB

An existing reinforced concrete raft approximately 1200mm-750mm thick formed the foundations to the old bakery. The record information suggests that 'infill concrete' was cast over the full plan area of the raft, however its thickness is unknown and will be confirmed by the Geotechnical Site Investigation Specification survey (section 3.5) and the Structural Investigation Specification (section 3.6).

4.3 SUBSTRUCTURE FRAMING AND FLOORS – GROUND FLOOR

The existing ground floor structure is generally a 250mm thick reinforced concrete slab spanning between downstand beams. The record information suggests that the road slab leading in/out of the service yard is 300mm thick. This is to be confirmed by the Structural Investigation Specification (section 3.6) to assess the capacity of these slabs considering that the office and residential building may be serviced by waste and delivery vehicles.

4.4 BASEMENT WATERPROOFING

WATERPROOFING GRADE

British Standard BS8102 (Protection of structures against water from the ground), defines three grades of basement waterproofing depending on use:

Table 1

Use	BS 8102 Grade	Performance level
Car Parking and plant rooms areas (excluding electrical rooms)	1	Some seepage and damp areas tolerable, dependent on the intended use. Local drainage might be necessary to deal with seepage
Plant rooms requiring a dryer environment and storage area	2	No water penetration acceptable Damp areas tolerable; ventilation might be required
Ventilated residential and commercial areas (habitable space)	3	No water penetration acceptable Ventilation, dehumidification or air conditioning necessary, appropriate to the intended use

In general given that the basement and its use is to be retained the existing waterproofing should achieve a Grade 1 suitable for car parking.

The UKPN room in the basement should achieve a Grade 3 considering the electrical nature of the plant within. The room is ventilated but the extent of the room's waterproofing performance level is currently unknown.

5 FOUNDATIONS

5.1 FOUNDATION DESIGN PRINCIPLES

The existing structural concrete framed columns are supported on RC pad footings. The record information indicates that the footings sit either on top of an older raft foundation or are cut into it. The exact scenario is to be confirmed by the Geotechnical Site Investigation Specification survey (section 3.5) and the Structural Investigation Specification (section 3.6).

The proposed commercial building primarily has the same column grid as per the existing building. South of the core however there are locations where the proposed columns are not on the same grid as those of the existing structure and hence cannot load the existing footings concentrically.

The record information has been used to estimate the capacity of the existing foundations. However since it is incomplete and conflicting in parts, radar and intrusive surveys will be required to determine what has been constructed on site. The record information at southern end of the existing office building is particularly unclear as to what the formation levels are of the foundations and whether they have been back-filled to ground level.

In any location where a new column does not sit over an existing footing then a new footing will be constructed to a depth equivalent but not more that the existing footing depth to ensure that no existing footings are undermined. All new footings will be designed as RC spread footings, subject to the ground investigations.

5.2 PRELIMINARY ASSESSMENT OF ALLOWABLE BEARING PRESSURES

A site investigation report conducted at the time of the design of the existing building recommended a safe bearing pressure of 200 kN/m². The record information states that taking into account both loading and settlement criteria into account an allowable soil bearing pressure of 150 kN/m² was adopted for design of the pad and strip footings.

The footings were designed to disperse the loads through 45º through the existing raft to ensure that the soil bearing pressure is not greater than 150 kN/m².

Since the record information is not clear on the depth of the raft below these footings or the formation levels of these footings the investigations mentioned in sections 3.5 and 3.6 are crucial to developing and checking the assumptions of the scheme.

For the Stage 2 design an allowable bearing pressure of 150 kN/m² was adopted. This figure is to be revised going forward based on the outcome of the Geotechnical Site Investigation Specification survey.

5.3 EXISTING FOUNDATIONS

RE-USE OF EXISTING PAD FOUNDATIONS AND STRIP FOOTINGS

The foundation strategy for the new building is to reuse the existing pad and strip footings within the bounds of the Sainsbury's car park and UKPN room without modification.

BENEFITS OF FOUNDATION RE-USE

There are considerable economic, programming and sustainability benefits to be gained by reusing the existing foundations. Benefits that will arise are listed below:

- Reduction in the construction programme;
- Less demolition required to columns supporting superstructure over;
- Less risk arising from obstructions in the ground;
- Lower foundation costs;
- Ground congestion would be minimised. This is important for the very long term future and value of the site;
- Preservation of archaeology. Clearly by minimising new ground works the risk to any existing archaeology is reduced;
- Reduction of new foundation works and therefore of embodied energy.

BRE CONSIDERATIONS FOR THE RE-USE OF FOUNDATIONS

Considerations for the reuse of foundations will need to include the following items;

- Quality of design information on the existing foundations;
- Integrity of the existing foundations;
- Design responsibility and insurances;
- Impact of demolition of the existing building on the existing foundations;
- The new column grid location in relation to the existing footings;
- Load carrying capacity of the existing footings.

The potential risks and programme and cost benefits need to be addressed at an early stage of the project for these issues to be addressed and the foundation strategy to be considered.

RISKS AND RISK MITIGATION

A number of measures should be put in place to mitigate the risks associated with this approach:

- Involvement and acceptance of the client and the client's insurers
- Involvement and acceptance of the approach by the District Surveyor
- A site investigation should be carried out to verify soil design parameters and hence confirm the geotechnical capacity of the existing footings.

It is considered that the above items can be addressed through well established procedures. The record information is comprehensive and there is no requirement for additional basement area. It would therefore be cost effective to re-use the existing basement walls and existing footings for the new development. During the feasibility stage the following strategy has been developed to maximise re-use of existing foundations:

- The inherent bearing capacity of the strata below the existing basement level will be incorporated into the analysis for the new foundations and will be combined with the capacity of the existing footings. A spring stiffness soil-structure interaction model will be used to enable the combined capacities to be used for the new development

- Any existing footing that is to be reused or strengthened is to have its dimensions and depth established.
- Where and if required, new footings will be added to supplement the existing to suit the new loads and building arrangements.

6 SUPERSTRUCTURE

6.1 SUPERSTRUCTURE FRAMING AND FLOOR – COMMERCIAL 1ST FLOOR

The existing 1st floor structure is generally a 200mm-250mm thick reinforced concrete slab spanning between downstand beams. This is to be confirmed by the Structural Investigation Specification survey (section 3.6).

The existing structure is to be retained up to gridline W07. This includes the existing bridge structure which is to be maintained subject to the survey. The bridge structure contains a movement joint and appears to have been modified or changed since it was construction-issue record drawing. The effect of this modification and the movement joint on the stability of the frame is to be investigated further in Stage 3.

Where the existing frame is retained, the columns between ground and level 1 are to be strengthened by scabbling away the concrete cover to the reinforcement, introducing an additional reinforcement cage flush to the scabbled surface and the new concrete is cast. The resulting section is likely to be 50-100mm larger on each face depending on the reinforcement cage required and the initial size of the column. This method of strengthening is necessary to accommodate the mezzanine level (see section 6.2 below).

An existing column (EX23) is to be demolished replaced by a concrete encased steel column nearby on gridline WC/22. This is necessary to load the column below concentrically since the transfer beam supporting the existing column above does not have sufficient capacity to support the new structure.

A new concrete encased steel column is also to be introduced on gridline WD/21 to reduce steel tonnage by eliminating the need for a transfer beam and to maintain the 5mm edge beam deflection necessary to accommodate the façade's movement tolerance (see section 9.5).

New concrete encased steel columns are also to be introduced on gridline WD/12 and WC/12 for similar reasons as above. These new columns do not have any impact on the vehicle parking or paths.

The core area and the office space to the South of gridline W07 is to be a steel moment frame with 160mm CLT panels spanning between. The connection between the existing and new frame is to be developed in Stage 3.

6.2 SUPERSTRUCTURE FRAMING AND FLOOR – COMMERCIAL MEZZANINE

A new mezzanine level is inserted between ground and level 1 and consists of shallow UC sections supporting a 60mm thick SPS floor for plant areas and a semi-open steel grille for bicycle storage areas. The beams are to be connected via fin-plates to embedment plates resin-anchored into the existing columns.

6.3 SUPERSTRUCTURE FRAMING AND FLOOR – COMMERCIAL GENERALLY

Above level 1, the structure is a steel moment frame steel moment frame with 160mm thick CLT panels for the typical office levels and 220mm thick CLT panels at the roof levels. The beams and the soffit of the CLT is to be exposed.

A transfer beam is required at level 2 that mirrors the exiting transfer on level 1 below it due to there being no pad foundation or column below ground level on gridline WC/21.

The existing stair cores are to be retained and extended up the new taller structure. There is limited record information on these cores; an assessment of their capacity to be extended is to be carried out in Stage 3 using the information from the structural survey (section 3.6).

6.4 SUPERSTRUCTURE FRAMING AND FLOOR – RESIDENTIAL GENERALLY

The reinforced concrete residential building is formed using flat slabs and blade columns hidden within the walls and partitions. The thickness of the slabs has been optimised to achieve the clear spans required and to control deflections. The thinner 200mm slabs are generally located above the kitchen and more heavily serviced areas so as not to increase the floor build-up while the thicker 250mm slabs are generally located where the spans are greater and cantilever action is required.

Walking columns and an RC upstand western elevation and downstand on the eastern elevation allow for set-backs at roof level and a large column-free span for the retail frontage.

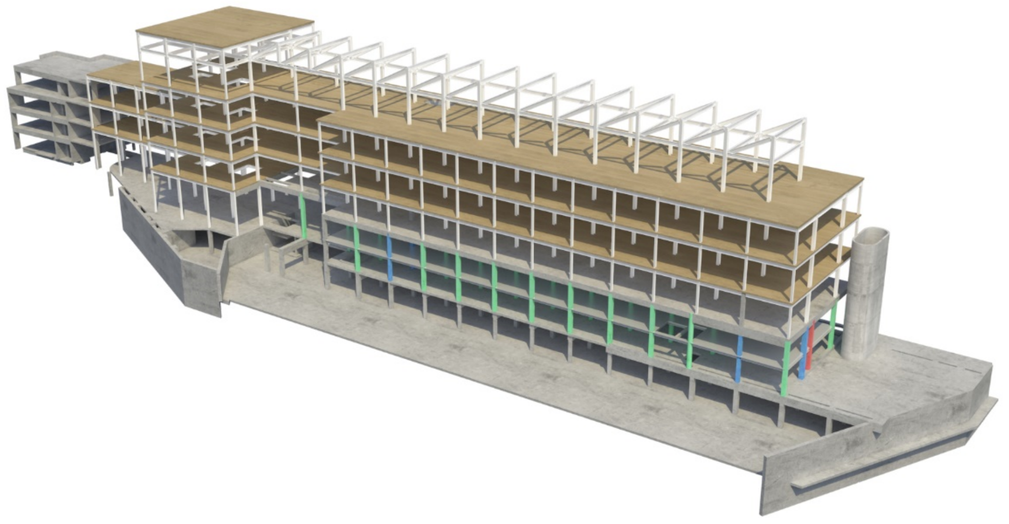

Figure 4: A 3D model of the retained concrete frame with the new CLT and steel frame on-top and the residential building to the left. The columns between ground and level 1 highlighted in green are to be strengthened. The columns in blue are new columns positioned where a column exists on grid in the basement to avoid expensive transfers and to avoid concentrating load.

6.5 MEP INTEGRATION

The steel beams have been designed to accommodate 290mm diameter holes at 600mm centres plus two 290x500mm rectangular openings in the middle third of the beam span. This is to be developed, confirmed and noted our the Structural drawings in Stage 3.

Plant areas on the roof are supported on the 220mm thick CLT panels. A load allowance has been made for a screed or additional spreader frame for the Plant. Plant areas on the mezzanine has been allowed for in the design of the beams and thickness specified of the open steel grille floor.

6.6 STABILITY

The stability of the building has been considered for wind loads and code defined notional loads.

Wind loads acting on the building are transferred to the floor panels/slabs from the facade via the cladding brackets. The concrete floor slabs/CLT panels act as stiff diaphragms to transfer the in-plane wind loads to the core (residential building) and frame (commercial building).

The stair and lift towers and portal action of the concrete frame provide stability for existing office building. The new structure above and south of the core (starting from ground level) is to be a pinned-based moment frame so as not to transfer any moments into the existing frame – only shear and axial loads.

6.7 ROBUSTNESS

The overriding principle of the building regulations is the concept of robustness. This is defined in EN 1991-1-7 as "the ability of a structure to withstand events like fire, explosions, impact or the consequences of human error without being damaged to an extent disproportionate to the original cause".

The building classification to Approved Document A of the Building Regulations is defined as a Class 2B for the commercial building, and for this classification effective robustness will be developed by providing effective horizontal ties together with effective vertical ties in the structural system.

The provision of vertical and horizontal ties will ensure that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause.

To satisfy the requirements for a Consequence Class 2B building, structural ties will be provided. These will include:

- Horizontal ties at each level to secure both internal and perimeter elements into the floor and roof level structures: beam-column and beam-beam connections will be detailed for the appropriate tensile forces and a suitable detail will be provided around the perimeter of the building to ensure that beams are tied into the floorplates.
- Vertical ties to ensure that columns are continuous from foundation to roof level: stanchions will be continuous through all beam-stanchion connections and splices will be checked to ensure that they have sufficient tensile capacity.

For the residential building, the building classification to Approved Document A of the Building Regulations is defined as a Class 2A. For this classification effective robustness will be developed by providing effective horizontal ties in the structural system.

The provision of horizontal ties will ensure that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause.

To satisfy the requirements for a Consequence Class 2A building, structural ties will be provided. These will include:

- Horizontal ties at each level to secure both internal and perimeter elements into the floor and roof level structures: beam-column and beam-beam connections will be detailed for the appropriate tensile forces and a suitable detail will be provided around the perimeter of the building to ensure that beams are tied into the floorplates.

6.8 EXECUTION CLASS

BS EN 1090-2 gives the technical requirements for the fabrication and erection of steel structure. The selection of the appropriate execution class provides a level of reliability against failure of the structure or a component within it that is matched to the consequence of its failure.

It sets the principle that a structure, or a part of it, can contain components with different consequence classes and hence different execution classes can be applied to different components.

In the UK, structures which fall under Building Regulations Class 3 for disproportionate collapse, generally fall into Consequence Class 3 (CC3) and hence Execution Class 3 (EXC3).

For EXC3, BS EN 1090 Annex A.3 distinguishes between some requirements to be applied to the structure as a whole – these mainly apply to QA systems and procedures - and others which can be selected on a component-by-component or a connection detail-by-detail basis.

The reality of a multi-storey building which falls into CC3 is that the general floor beams do not need to be fabricated to a higher standard but the columns, lateral load resisting systems and any transfer structures should be i.e. the vertical and lateral load carrying elements are more critical than the typical floor beams.

To this end the following approach will be adopted for this project:

1. All quality documentation, inspection documents, traceability and marking must follow the requirements of EXC3.
2. All columns, transfer beams, spreader beams and any members forming part of the lateral load resisting system and any welded attachments to these elements must follow the requirements of EXC3.
3. All other primary structural members can follow the requirements of EXC2.
4. All secondary structures such as staircases, plant support gantries etc should be fabricated to EXC2.

6.9 CLADDING SUPPORT

Perimeter/edge beams supporting cladding for the commercial building will be designed to ensure that the mid-span deflection due to live load does not exceed the values given in Section 9.5, typically 5mm. This will ensure that rotation of the cladding panels is limited and the width of the joint between the cladding panels is not excessive.

A stick curtain wall system will be adopted which transfers only vertical and horizontal loads at each floor level. The perimeter beams have not been designed for any torsional loads from the cladding system.

Cladding will be supported on a plate bolted or screwed into the CLT floor panels. Cladding shall not be connected to bottom flanges of perimeter beams.

7 CONSTRUCTION AND MAINTENANCE ISSUES

7.1 NOTIONAL SITE WIDE CONSTRUCTION SEQUENCE

To be developed during the next stage of design.

7.2 CRANEAGE

The contractor's craneage proposals must consider the proximity of the surrounding buildings, public footpaths and roads.

7.3 BUILDABILITY ISSUES

The site is constrained by the Sainsbury's service yard to the East, Kentish Town Road to the West.

Site access and the works are to limit any disruption to Sainsbury's operations.

7.4 KEY HEALTH AND SAFETY RESIDUAL RISKS

GENERAL

Throughout the design process, a risk assessment process has been undertaken to ensure that the health and safety of the works can be appropriately managed.

Where possible risks have been eliminated during the design; in other instances where the elimination of the risk was not possible, it has been reduced as far as is practicable.

Risks which remain in the design are the residual risks. These will need to be addressed later in the detailed design and/or managed during the execution of the works.

Residual risks relating to the structural engineering aspects of the project are, for ease of reference on site, shown on the structural drawings and are presented according to the nature of the action required. The categories into which risks are placed are as follows.

COMPULSORY ACTION RISKS

These are those risks which require a particular action to be undertaken by the Designer/Contractor. The identifying symbol for these risks on the drawings is a solid blue circle:

Risks identified as belonging in this category include:

- Temporary stability of the structure: the buildings have been designed based on the permanent condition only; the Contractor will have to make an assessment of the temporary stability of the buildings based on their specialist construction knowledge and intended construction sequence.
- The record information on which the design is based is incomplete. Based on the differences between a recent survey and the record information, it is clear that the structure changed during construction or has been modified after completion. Before proceeding with the work the contractor is to verify the information by undertaking additional investigations as required and is to notify the design team of any differences.
- The design assumes simple connections in some locations in the core area and part of the saw-tooth roof. The steelwork fabricator is therefore required to detail the fin-plate in the connection in such a way as to ensure the beam is able to rotate without the development of adverse load conditions in the detail; the detail developed must allow the beam to rotate, whilst allowing the full design loads to be realised.

WARNING ACTION RISKS

These are those risks which the Designer/Contractor is warned of and which require them to make an assessment of the action to be undertaken The identifying symbol for these risks on the drawings is a black exclamation mark in a yellow warning triangle:

Risks identified as belonging in this category include:

- Stability of excavations. According to record information, groundwater is relatively high across the site. This poses a significant risk to the stability of any open excavations.

PROHIBITIVE ACTION RISKS

These are risk items which lead to a particular site activity being prohibited. The identifying symbol for these risks on the drawings is a red circle with a red line through it:

Risks identified as belonging in this category include:

- The use of manual equipment to break down any existing foundations required. This activity has a number of implications for operatives who undertake this work on a regular basis, therefore to safeguard the health of site operatives, the use of manual breaking equipment is prohibited.
- The suspended ground floor and first floor slab and retaining structures have been designed for the permanent load criteria. During the execution of the works, the Contractor must not overload the slab by using it as a working platform or storage area and must plan the works accordingly.

INFORMATIVE ACTION RISKS

Key items of (design) information of which the Designer/Contractor needs to be aware but do not necessarily require an action. The identifying symbol for these risks on the drawings is a blue ‘i’ in a white circle:

8 SUSTAINABILITY

8.1 SITE OPPORTUNITIES

REUSE OF EXISTING BUILDING

The re-use of as much of the existing structure as possible has been considered during the design phase.

REUSE OF FOUNDATIONS

The design of the new structural elements has been undertaken with a view to re-use existing foundations wherever possible.

8.2 DESIGN OPPORTUNITIES

The design of the structural systems has been developed embracing the following principles:

- Develop the concept to provide flexible space that can extend the life of the building and enhance the building users' experience.
- Design structures economically to minimise embodied carbon
- Optimise loading criteria - no overdesign
- Specify high levels of recycled material content (structural steelwork, reinforcement, recycled aggregates, cement replacement) and low impact materials
- Consider future demolition and recycling opportunities.

8.3 MATERIAL SELECTION AND SPECIFICATION

Material has been selected and will be specified with a focus on the following:

- Economic use of material - no over specification of applicable loads or structural material grades
- Use of recycled materials
- Use of locally sourced material
- Minimised site waste

STEELWORK

Although steel production uses a large amount of energy and structural steelwork contains significant embodied carbon, it is also highly recyclable and it is possible to design very efficiently in steelwork to minimise the quantity of material specified and minimise waste generated.

Structural steel frames are also relatively lightweight in comparison to concrete frames and consequently lead to less heavy foundation solutions.

RECYCLING & RE-USE

Structural steelwork in the UK typically contains 40-45% recycled material however enhancing specifications to improve the recycled content of steelwork has questionable environmental benefits.

Global consumption of steel continues to rise, mainly as a consequence of industrialisation in the developing world and demand for new steel exceeds the supply of scrap steel by a factor of around two therefore it is not currently possible for all new steel to be produced entirely from scrap. While this remains the case, there is no net environmental benefit in specifying recycled steel in preference to primary steel with a lower recycled content.

Instead, we consider that a more sustainable approach is to specify steel products that are readily recoverable and recyclable. Structural steelwork used in buildings is typically over 94 per cent recoverable and 99 per cent recyclable.

Table 2 outlines typical recycling/recovery rates (2006)

	Structural Sections	Purlins and Rails	Cladding	Composite Floor Decking	Reinforcement	Internal Non-Structural Steel
Recycling %	86	89	79	79	91	85
Re-use %	13	10	15	6	1	2
Total %	99	99	94	85	92	87

Table 2 Re-Use and Recycling of Steel (from SCI)

Responsible sourcing- There are currently only 2 accredited fabricators.

Steelwork will be specified to be sourced in accordance with BES 6001 level "Pass" or equivalent.

LOCAL SOURCING

Local sourcing of steelwork will be investigated.

CONCRETE

Cement replacement

Portland cement is the most energy intensive component of concrete (accounting for ~7% of global CO_2 emissions

Cementitious waste products (produced as by-products of the steel and energy industries) such as Pulverised Fuel Ash (PFA) and Ground Granulated Blasftfurnace Slag (GGBS) provide less energy intensive products that can be used to replace up to 80% of the Portland cement content of concrete (depending on the application) and increased use of these products will reduce the embodied energy of the concrete.

GGBS is produced as a by-product during the manufacturing of steel in a blast furnace and is readily available throughout the UK. PFA is a fine ash precipitated from the exhaust gases produced at power stations by the combustion of pulverised coal. It is also readily available throughout the UK.

The use of cement replacement has been investigated and the findings can be summarised as follow:

- 50% Ground granulated blast furnace slag (GGBS) can reduce Embodied CO2 by over 40%
- 30% fly ash (FA) can reduce Embodied CO2 by over 20%
- Limestone fines can reduce Embodied CO2 by 15%
- Achievable % cement replacement linked to striking times and impact on programme
- Typically achievable % cement replacement in the UK at this time 50% (predominantly GGBS) but can be increased in some applications
- There are many positives and negatives associated with the use of GGBS and PFA, these are listed in the table below and are compared to Portland cement (OPC):

Table 3

Property	GGBS	PFA
Water Content	Slight reduction, 0.5-1.0% per 10%of ggbs	Considerable reduction, 3% per 10% of pfa
Workability	Improved	Improved
Setting Time	Slightly increased	Slightly increased
Strength	Lower early age and 28 day strength for a given cement content. Higher final strength	Lower early age and 28 day strength for a given cement content. Higher final strength. Advisable to increase PFA content (mass) by 10%
Appearance	Lighter in colour. Good finish	Inconsistent dark patches. Not good for high specification exposed finishes
Heat of Hydration	Considerably reduced. 50% min ggbs for large pours	Considerably reduced. 35% min (50% max) pfa for large pours
Chloride ion ingress	Very good resistance generally. For severe cases (marine or de-icing salts) 50% min ggbs recommended	Better than OPC but not as good as ggbs. 30% min pfa.
Creep	Lower creep values if cured well.	Lower creep values if cured well.

In terms of cement replacement that should be specified we would recommend 50% as a minimum and we would seek to explore the potential to increase this proportion as the design is developed.

Looking into the different elements, and weighing up the pros and cons of the use of GGBS versus PFA it was possible to establish that GGBS is an improved replacement and the table below states which elements GGBS is going to be specified for use with:

Table 4

Element	Using GGBS?
Foundations	Yes
Slabs	Yes
Walls	Yes
Columns	Yes
Beams	Yes

Aggregates

Concrete aggregates in the UK are commonly obtained by quarrying and marine dredging and at the same time much demolition waste can end up in landfill. The environmental impact of these processes can be reduced by substituting recycled or secondary aggregates as part of the concrete mix.

The use of Recycled Concrete Aggregate (RCA), Recycled Masonry (RA) and industrial by–products such as China Clay Waste has been investigated and the findings can be summarised as follow:

- 15% of UK aggregates are transported by rail and ship/barge
- Average road delivery distance is 38km
- Recycled aggregates can be a lower carbon option if sourced less than 15km (10 miles) from site
- Recycled and secondary aggregates comprise 25 % total UK market (highest in Europe)
- British Standards recommend 20% without need for testing
- Use of 25% recycled aggregates attains 1 BREEAM point (BREEAM 2008)

- More potential for use in non-structural elements, piling mat, sub-base, foundations and elements where large deflections are not anticipated.
- The lightweight aggregates used in the superstructure metal deck slabs are produced from industrial by-products hence are considered entirely recycled.
- Testing and certification of aggregates for high grade uses is not widely practiced and can result in procurement issues.

In the context of this development the opportunity to recycle demolition material on site will be modest due the limited amount of demolition required.

In terms of % recycled aggregate that should be specified we would recommend 25% as a minimum and we would seek to explore the potential to increase this proportion as the design is developed.

Responsible sourcing

Concrete will be specified to be sourced in accordance with BES 6001 level “Good” or equivalent.

Reinforcing steel

Reinforcing steel in UK typically contains 90-95% recycled material. Enhancing specifications to improve the recycled content of steelwork has questionable environmental benefits.

Global consumption of steel continues to rise, mainly as a consequence of industrialisation in the developing world and demand for new steel exceeds the supply of scrap steel by a factor of around two therefore it is not currently possible for all new steel to be produced entirely from scrap. While this remains the case, there is no net environmental benefit in specifying recycled steel in preference to primary steel with a lower recycled content.

Reinforcing steel in UK typically contains 90-95% recycled material. As discussed in the above section on steelwork enhancing specifications to improve the % recycled content of steel has questionable environmental benefits and consequently we would not recommend special provision for this is made in the specification.

Responsible sourcing

Reinforcement will be specified to be sourced in accordance with BES 6001 level “Good”, Eco-reinforcement or equivalent.

Local sourcing

Local sourcing of reinforcement will be investigated.

TIMBER

Recycled & low impact materials

Responsible sourcing

Timber will be specified to be Forest Stewardship Council (FSC) Certified or equivalent.

Local sourcing

Local sourcing of timber will be investigated.

9 DESIGN CRITERIA

9.1 DESIGN LIFE

The 'design working life' for the 'structure' (structural frame and main structural elements) is 50 years. This is in accordance with Eurocode 'Category 4' buildings – as recommended in Table NA.2.1 of the UK National Annex to BS EN 1990:2002.

'Design working life' is the notional figure for the statistical determination of applied loadings. The expected real life of a Category 4 building would be well in excess of 50 years, particularly if it is maintained and protected from the weather. The only higher Eurocode design life category is 'Category 5' – which is for 'monumental building structures' (eg, civic buildings and museums), highway & railway bridges and 'other civil engineering structures' (eg, underground stations and docks).

Some specified structural elements, such as exposed steelwork and concrete wearing surfaces, will require periodic inspection and maintenance in order to ensure serviceable life for at least 50 years. Superstructure elements which are not easily accessible, such as steelwork in external cavity walls, will be designed with generous corrosion protection - to provide in excess of 50 year life for the predicted environmental conditions.

Substructures will be designed for the 'Intended working life at least 50 years' designation in the requisite substructure Eurocodes. This is likely to provide well in excess of 50 years' real life for the predicted environmental conditions. However, where the consequence of deterioration of structural elements is deemed to be very significant, such as for perimeter retaining walls which support superstructure, those elements will be designed for the 'Intended working life at least 100 years' designation in the requisite substructure Eurocodes.

Some structural elements, such as those with concrete wearing surfaces and corrosion protection will require periodic inspection and maintenance. Steelwork members that are inaccessible and not easily maintained will be designed for the loss of steel section over the 50 year life of the building.

Steelwork members that are inaccessible and not easily maintained will be designed for the loss of steel section over the 50 year life of the building.

The substructure perimeter retaining walls will be checked for design life in accordance with BS 8500-1: 2002, and satisfy this standard for the most onerous structural performance level, being a structure of long service life (more than 100 years).

9.2 DESIGN LOADS

PERMANENT LOADS

Permanent loads (dead loads) are calculated from the known self-weight of the materials used for the construction of the frame.

SUPERIMPOSED PERMANENT LOADS

The following superimposed permanent loads have been adopted in the design:

Typical office (raised floor, fire protection, services and soundproofing)	1.40 kN/m²
Office flat roofs (fire protection, services, insulation, waterproofing and 25mm paving slabs)	2.43 kN/m²
Office 'saw-tooth' roof (insulation and waterproofing)	0.65 kN/m²
Residential 1st floor (services, ceiling, finishes and soundproofing)	2.55 kN/m²
Residential typical floor (services, ceiling, finishes)	0.70 kN/m²
Residential roof (services, ceiling, insulation, waterproofing and 25mm paving slabs)	1.68 kN/m²

VARIABLE LOADS

The following variable loads have been adopted in the design:

Typical office (2.5 kN/m² for the imposed floor load and 1.0 kN/m² for partitions)	3.50 kN/m²
Office flat roofs (non-plant areas)	4.00 kN/m²
Office flat roofs (plant areas)	5.00 kN/m²
Office 'saw-tooth' roof (access for maintenance only)	1.5 kN/m²
Residential floors	1.5 kN/m²
Residential roof (plant areas)	4.00 kN/m²

The record information indicates that the existing structure has been designed to the following variable loads. This is to be confirmed via a structural analysis and appraisal of the existing structure in Stage 3 taking into account the condition of the structure as part of the results of Structural Investigation Specification (section 3.6).

Workshop floor (level 1)	7.50 kN/m²
Mezzanine	7.50 kN/m²
Roof	0.75 kN/m²
Service yard (300mm thick slabs)	14.5 kN/m²
Car park	2.50 kN/m²
Basement slab (non-plant areas)	2.50 kN/m²

FACADE ACCESS EQUIPMENT LOADS

The roof will be designed to support the window cleaning equipment loads as required and provided by the façade access consultant.

CONSTRUCTION LOADS

General construction activities i.e. loading out floors, use of scaffold towers and MEWPs etc. is to be undertaken in such a manner as not to exceed the imposed loadings.

If higher loads are required options such as back propping should be discussed with WSP.

ABNORMAL LOADS

LIFT LOADS

All lift shaft walls and lift motor room beams will be designed for lift loadings provided by the lift consultant.

Loading from lift car assemblies are to be confirmed by the vertical access consultant.

PLANT REPLACEMENT AND MAINTENANCE LOADS

All plant replacement in and around the building is to be undertaken in such a manner as not to exceed the imposed loadings.

CLADDING LOADS

Loading due to cladding has been assumed as follows and is to be confirmed in Stage 3:

Office Stick curtain walling – East and West facades	1.2kN/m^2
Residential cavity wall	4.0kN/m^2

WIND LOADS

Wind loads acting on the main building frame and the various elements of cladding will be determined in accordance with the requirements of BS EN 1991-1-4 assuming the following:

Basic wind velocity	V_b	= 21.4m/s
Altitude factor	C_{alt}	= 1.0
Direction factor	C_{dir}	= 1.0
Seasonal factor	C_{season}	= 1.0
Probability factor	S_p	= 1.0

Building acceleration will be limited to 25mg for a 10 year return for the commercial occupancy.

Building acceleration will be limited to 12mg for a 10 year return for the residential occupancy.

SEISMIC LOADS

Based on PD 6698:2009 there are no requirements in the UK to consider seismic loading.

NOTIONAL HORIZONTAL LOADS

The building will be designed to resist notional lateral loads applied at each floor simultaneously as stipulated in BS EN 1991-1. This load is applied in addition to wind loads.

LATERAL EARTH PRESSURES

Earth pressures will result from active pressures on the back face of any retaining structures. These will be assessed based on the parameters of the retained material.

Hydrostatic pressure against the on the rear face of any retaining structures will be relieved by providing weepholes and/or suitable drainage. A hydrostatic head of 1 m will however be designed for in case the weepholes or drainage become blocked.

An imposed surcharge of 10 kN/m2 will be applied behind to the retained fill. This will represent the loads applied during executions (such as roller compaction) and will be greater than the loads applied post-completion when the site is in use.

9.3 FIRE RESISTANCE

FIRE RESISTANCE PERIODS

Considering that the commercial building is sprinklered and the residential building is not more than 18m above ground level, the following BS 476 fire resistance periods are adopted in the design of the building:

- Office superstructure CLT floor panels — 1 hour
- Superstructure beams and columns — 1 hour
- Substructure and existing structure generally — 2 hours
- Residential columns, floor slabs, beams and walls — 1 hour

All required periods of fire resistance for structural elements are to be confirmed by the Fire Engineering consultants.

METHOD OF FIRE PROTECTION

Fire protection will be achieved in insitu concrete construction by the specification of member size and concrete cover to the main reinforcement to achieve compliance with BS EN 1992-1-2.

All applied fire protection measures to structural steelwork elements are to be specified by the Architect.

9.4 LIGHTNING PROTECTION

The main column reinforcement or structural steel columns will be used as part of the down conductor in the lightning protection system. Testing points will need to be cast into the structure at appropriate locations.

9.5 SERVICEABILITY

DEFLECTION

Slab edge deflections

For the commercial building, deflection of the edge beams (due to variable loads) is generally limited to 5mm due to the stringent deflection requirement of the cladding.

For the residential building, deflection of the slab edge/edge beams is limited to span/500 based on a load history analysis differential case.

Internal deflections

Deflection of the internal floor beams is considered in three stages:

- Permanent load deflection due to self-weight of structure
- Superimposed permanent loads due to permanent dead load (ceiling, floor and services)
- Variable load deflections due to live loads which may be transient.

Where the steel floor beams deflect more than 10mm due to the design permanent loads, they will be pre-cambered to remove approximately 85% of the design permanent load deflection.

The space available for building services will only be affected by the deflections which have taken place prior and during the installation of the ceiling and the raised floor. This is conservatively taken as the combined deflection due to permanent loads and superimposed permanent loads. Thereafter the ceiling and raised floor will deflect with the structure as the variable loads are applied.

The variable load deflection criterion for all internal beams not supporting cladding is span/360.

The total deflection criterion for all internal beams not supporting cladding is span/250.

CRACK WIDTHS

- Superstructure & substructure crack width limit generally: 0.4mm
- Basement watertight wall and slab crack width limit: 0.1mm

EARLY AGE CRACKING

The residential concrete structure, particularly the slabs, will be subject to relatively large forces due to the expansion of the fresh concrete caused by the exothermic reaction of the cement hydration and then by the shrinkage as it cools and hardens. The amount of shrinkage is determined by the temperature drop which in turn is influenced by the cement content and type. The temperature drop is multiplied by the coefficient of thermal expansion of concrete (12 x 10-6) and the length of the element from the restraint to ascertain the contraction. This can be exacerbated by "locking" areas of slab between points of restraint and is mitigated by careful planning of the pour sequencing and the provision of additional reinforcement to control cracking where necessary.

FOUNDATION MOVEMENT

Differential settlement

A settlement assessment will be undertaken during the detailed design phase to establish the differential movements beneath the foundations.

SWAY

Overall sway

The deflection of the building due to design wind load is limited to H/500, where H is the building height.

Sway deflection of any one storey

The deflection of each storey, to be accommodated by the perimeter cladding, is limited to h/400 where h is the storey height.

VIBRATION

The deflection of floor structures is influences by the floor stiffness and mass, which also determines the frequency of the floor-plate. The frequency behaviour can affect the resonant behaviour of the floor and ultimately the comfort level of occupants, so it is considered carefully in the design of the structure. Floor structures will be designed in accordance with the following minimum requirements:

- Individual beam natural frequency: 3.5 Hz minimum
- System frequency: 3.0 Hz minimum

Where the floor is a structure has low natural frequency of less than 7Hz, the design guides recommend that they should be assessed on the basis of its response to an appropriate near-resonant component of a regular walking force.

The base-line for determining the response factor is taken from ISO 2631-2 adapted by BS6472 as 0.005 m/s^2 of root mean square acceleration.

The floor response is calculated based on the floor root mean square (RMS) acceleration divided by the baseline. The criterion adopted for the design of floors on all occupied (non-plant) floors is based on the following recommended response factors:

- Typical office floors: Response Factor R < 8, or min floor RMS acceleration = 0.005*8 = 0.04 m/s^2

- Trading floors: Response Factor R < 6, or min floor RMS acceleration = 0.005*6 = 0.03 m/s²

For additional robustness, floors will also be checked to AISC 11 design guide for the following peak accelerations:

- Typical office floors: 0.50%g

With an assumed floor damping of:

- Typical office floors: 3%

CONSTRUCTION TOLERANCES

The tolerances, to which the structure can be constructed, together with the deflection of the floor slabs, will affect the space available for building services in the floor and ceiling voids.

The tolerances adopted are based on the principles described in BS5606: 'Guide to accuracy in building' and the preferred tolerances published by the specialist trade associations. These are summarised in the movement and tolerances report.

ACOUSTIC CONSIDERATIONS

To maintain the required acoustic separation between the office floors, the CLT floor panels are to be enhanced with a 25mm thick layer or mineral wool insulation board with a density of 180kg/m³ and 2 no. 20mm thick Celecta screeboards.

To maintain the required acoustic separation between the retail space and the 1st floor, the top of the floor slab is to be enhanced akin to the office floors with a 25mm thick layer or mineral wool insulation board with a density of 180kg/m³ and 2 no. 20mm thick Celecta screeboards. A suspended ceiling is then to be hung on resilient hangers supporting a layer of mineral wool insulation and two layers of plasterboard.

ENVIRONMENTAL CRITERIA/EXPOSURE CONDITIONS

Steelwork Corrosivity Categories have been determined in accordance with BS EN ISO 12944-2.

Table 5

Location	Corrosivity Category	Description
Internal steelwork	C1 Very Low	Inside heated buildings with clean atmospheres, eg offices
Steelwork within external cladding	C3 Medium	Urban and industrial atmospheres, moderate sulphur pollution.

Concrete exposure classes have been determined in accordance with BS8500-1.

Table 6

Location	Face	Exposure Class	Class Description
Foundations	Sides & Bottom	XC3 & XC4	Moderate humidity or cyclic wet and dry
All other concrete	All	XC1	Dry or permanently wet

9.6 MATERIAL FINISHES

STEELWORK FINISHES

The steelwork in the office spaces are to be exposed. The specification is to be developed in Stage 3.

CONCRETE FINISHES – WORKED FINISHES (SLABS)

Table 7

Slab Location	NBS Clause	Description
Slabs generally	E41/310	Smooth floated finish - Even with no ridges or steps.

CONCRETE FINISHES – FORMED SURFACES

Table 8

Element	NBS Clause	Description
Below ground, unexposed	E20/610	Basic finish - Faces fully compacted and cover to reinforcement provided.
Columns and walls – normal quality	E20/620	Plain finish – Even and dense finish. Irregularities: max 3mm. Surface blemishes: Permitted: Blowholes less than 10 mm in diameter and at an agreed frequency. Not permitted: Voids, honeycombing, segregation and other large defects.

9.7 DESIGN STANDARDS AND REFERENCE DOCUMENTS

STATUTORY CODES OF PRACTICE

The structural design complies with the Building Regulations 2004. This is achieved by complying with the Eurocodes as 'approved documents' and the relevant national annex. The codes of practice used in design are:

BASIS OF DESIGN

- BS EN 1990: Basis of structural design

LOADING

- BS EN 1991-1-1: General actions. Densities, self-weight, imposed loads for buildings
- BS EN 1991-1-2: General actions. Actions on structures exposed to fire
- BS EN 1991-1-3 General actions. Snow loads
- BS EN 1991-1-4 General actions. Wind actions
- BS EN 1991-1-5 General actions. Thermal actions
- BS EN 1991-1-6 General actions. Actions during execution
- BS EN 1991-1-7 General actions. Accidental actions
- BS EN 1991-3 Actions induced by cranes and machines
- PD 6688-1-2 Background paper to the UK national Annex to BS EN 1991-1-2
- PD 6688-1-4 Background information to the National Annex to BS EN 1991-1-4 and additional guidance
- PD 6688-1-7 Background paper to the UK National Annex to BS EN 1991-1-7

CONCRETE DESIGN

- BS EN 1992-1-1: General rules and rules for buildings
- BS EN 1992-1-2: General rules. Structural fire design
- BS EN 1992-3: Liquid retaining and containing structures
- PD 6687: Background paper to the UK National Annexes to BS EN 1992-1
- BS 8102: Code of practice for protection of below ground structures against water from the ground
- BS 8500: Concrete – Complementary standard to BS EN 206-1

STEEL DESIGN

- BS EN 1993-1-1: General rules and rules for buildings.
- BS EN 1993-1-2: General rules. Structural fire design.
- BS EN 1993-1-5: Plated structural elements.
- BS EN 1993-1-8: Design of joints
- BS EN 1993-1-10: Material toughness and through-thickness properties.
- BS EN 1993-1-11: Design of structures with tension components
- PD 6695-1-10: Recommendations for the design of structures to BS EN 1993-1-10

COMPOSITE STEEL AND CONCRETE DESIGN

- BS EN 1994-1-1: General rules and rules for buildings
- BS EN 1994-1-2: General rules. Structural fire design

MASONRY DESIGN

- BS EN 1996-1-1: General rules for reinforced and unreinforced masonry structures
- BS EN 1996-1-2: General rules. Structural fire design
- BS EN 1996-2: Design considerations, selection of materials and execution of masonry
- BS EN 1996-3: Simplified calculation methods and simple rules for masonry structures
- PD 6697: Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2

GEOTECHNICAL DESIGN

- BS EN 1997-1:2004: General rules

EXECUTION STANDARDS

The following documents are referred to in relation to the execution of the works:

- ICE Specification for piling and embedded retaining walls
- BS EN 12699: Execution of special geotechnical work – Displacement Piles
- BS EN 1536: Execution of special geotechnical work – Bored Piles
- BS EN 1090-1: Execution of steel structures and aluminium structures
- BS EN 1090-2 Technical requirements for the execution of steel structures and aluminium structures
- BS EN 13670: Execution of concrete structures
- National structural steelwork specification for building construction.

→ National structural concrete specification for building construction.

DESIGN REFERENCES

Other publications used include:

- IStructE/ConSoc: Standard method of detailing structural concrete
- CIRIA: Design of Shear Wall Buildings CIRIA Report 102
- CIRIA: Design for Movement in Buildings, CIRIA Technical Note 107
- CIRIA: New paint systems for the protection of construction steelwork, CIRIA Report 174
- CIRIA: Early age thermal crack control in concrete, CIRIA C660
- SCI: Design of floors for vibration: A new approach P354
- SCI: Design of composite beams with large web openings, P355

9.8 MATERIAL PROPERTIES

STEEL GRADES

Grade S355 in accordance with BS EN 10 025 parts 2 to 6, BS EN 10210-1 and BS EN 10219-1.

CONCRETE GRADES

The following concrete grades and cement replacement will be used.

Table 9

Location	Compressive Strength Class (Cylinder/Cube) Minimum	Cement Replacement % Minimum GGBS
Concrete generally	C32/40	30%

GROUT

Grout for post-tensioning, around anchor bolts and under base plates is to be a non-shrink or expansive grout.

REINFORCEMENT

Reinforcement type 'H': grade 500, deformed type B conforming to BS4449.

Fabric reinforcement conforming to BS4483.

TIMBER

Timber Grade: C24

9.9 ANALYSIS SOFTWARE

UNITS OF CALCULATION

The structural calculations will be completed using the following units:

Length:	m and mm
Mass:	kg and ton
Force:	N and kN
Stress:	N/mm^2, kNmm^2 and kN/m^2
Moment:	kNm and Nmm
Velocity:	m/s and km/h
Acceleration:	m/s2 and proportion of g

COMPUTER SOFTWARE

- ETABS 2017 - Building Analysis and Design
- RAM Concept - Concrete Floor Plate Design Software
- RCC-2000 Spreadsheets - General Element Design
- WSP Spreadsheets - General Element Design
- Tekla Structural Designer - General Structural Analysis and Design
- CSC Tedds - General Analysis and Design Calculations

10 APPROVALS

10.1 ASSET PROTECTION

Various stakeholders have strategic assets in the proximity of the site or even inside the footprint of the site to be developed. Each stakeholder will be engaged in consultations in order to arrive to an agreement and eventually to a sign off of our design with the ultimate view of achieving results for our client while satisfying the stakeholder need for asset protection. Reuse of foundations

LONDON UNDERGROUND

For works over, under or adjacent to the London Underground Limited (LUL) operational railways and to all LUL assets, a set of procedures and approval processes have to be followed. These procedures are set in the “LUL standards 1-538-ASSURANCE” document.

Following the submission by the project manager of a risk based assurance plan for the proposed changes, a Conceptual Design Statement (CDS) will be issued to LUL in order to obtain approval in principle (AIP). The CDS outlines the details for the scheme and will need to be signed off by a checking engineer which could be an Independent Design Organization for complex engineering works.

Following approval of the CDS the full design and detailing of the project will be progressed resulting in construction issue drawings, documents and calculations.

Part of the approval process is to agree on monitoring procedures which are expected due to the nature of the works involved.

THAMES WATER

In February 2015 Thames Water released a document titled “Guidance for Working Near our Assets” which affects the majority of the London projects.

Thames Water (TW) are interested in certain activities within 15m of their assets, sewers and water mains typically. These activities include demolition, piling, excavation, new construction, dewatering, tunnelling and the placing of heavy loads (cranes, abnormal loads etc).

If the development activity is within 15m of their asset and is deemed to pose a risk then we are expected to provide an Engineering Impact Assessment, pre and post work surveys and results of monitoring of vibration and ground movements.

During the next phase of the design we will contact TW to assess constraints into our design.

10.2 DESIGN APPROVAL

BUILDING CONTROL

Calculations for the design of the structure will be submitted to the Approved Inspector for approval to suit the design and construction programme.

The report on fire engineering of the main structure will be submitted to the Approved Inspector with the main fire strategy report.

11 PROJECT MANAGEMENT

11.1 FROZEN INFORMATION

It is important to sign off and then freeze a certain set of information after each design stage to enable efficient and timely design. Should this not take place this may impact upon design costs and programme.

The following items should be frozen at the end of Stage 2:

- Building massing
- Target budget

The following items should be frozen at the end of Stage 3:

- Structural grid
- Framing material & type
- Floor usages
- Floor sandwich
- Stability system location and type
- Foundation type
- M&E strategy
- Major plant location
- Large builderswork holes & holes through beams
- Cladding type
- Vertical transportation
- Movements & tolerances
- Design criteria

12 KEY PROJECT RISKS & OPPORTUNITIES

Risk Category*	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIc Action Required (*eg. hazard elimination/risk mitigation action, information to be provided to others)*	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes (*eg. traceability of ERIc action, communication of significant residual risk, critical design criteria, etc*)
Design	General	Accuracy of record information	ASW	Undertake intrusive investigations to confirm accuracy of record information	Need vacant possession to undertake soft strip to confirm accuracy of record information	We have used the survey information as far as possible to confirm the record information, areas that remain unknown have been communicated to the team by the notes on the drawings
Design	General	Accuracy of setting out of existing structure	ASW	Undertake soft strip to expose all existing structure and survey	Need vacant possession to undertake soft strip to confirm accuracy of record information	We have used the survey information as far as possible to confirm the record information, areas that remain unknown have been communicated to the team by the notes on the drawings
Design	General	Capacity of the existing stair cores that are to be retained.	ASW	Undertake intrusive investigations to identify the concrete grade, construction and reinforcement to assess their capacity to be extended.	Need vacant possession to undertake soft strip	
Construction	Foundations	Unknown ground obstructions/foundations where new foundations are to be located	ASW	Undertake intrusive investigations		We have used the survey information as far as possible to confirm the record information, areas that remain unknown have been communicated to the team by the notes on the drawings
Construction	General	Condition of existing structure	ASW	Undertake intrusive investigations to confirm on-going performance of existing structural elements		Petro chemical testing of the existing concrete elements to be undertaken.
Construction	General	LUL approval of the proposed scheme	ASW	Seek early engagement with LUL		Scheme presented at high level to LUL; a correlation survey of the North Line running along Kentish Town Road is to be undertaken to confirm if an asset approval process needs to be undertaken.
Construction	General	Thames water approval of the proposed scheme and confirmation on who owns the sewer running beneath the south of the site.	ASW	Seek early engagement with Thames water		We believe an oval brick sewer crosses the southern part of the site below the existing foundations.

Risk Category*	Work Element/Location (where appropriate)	Hazard or Risk Issue Identified	Risk Management Owner	Design ERIc Action Required *(eg. hazard elimination/risk mitigation action, information to be provided to others)*	Significant Temporary Works Requirements/Management Arrangements and/or any Special Erection/Installation Sequences or Requirements	Design Action Status/Final Resolution Notes *(eg. traceability of ERIc action, communication of significant residual risk, critical design criteria, etc)*
Design	Basement Ground floor and Foundations	Rain water attenuation tank size (if any) is yet to be confirmed - potential impact to structural design	ASW	Planning application to be made on the basis that no attenuation is required, as such not included within the stage 2 design.		Acceptance of not rainwater attenuation to be confirmed after planning.
Construction	General	Damage to retained structure during construction	ASW	Contractor to provide detailed method statements on how retained structure is to be protected during the works	Contractor method statement	To be addressed with the contractor
Design	Basement	Condition of existing basement waterproofing and suitability for intended use.	ASW	Adequacy of existing basement waterproofing needs to be confirmed, record information providing details of the system have not been found as such testing of the basement should be undertaken during detailed design.	Investigations	It is assumed that the existing basement waterproofing is satisfactory, during stage 3 moisture testing of the existing basement structure should be undertaken.
Construction	Basement	Ground Gas	ASW	Undertake a ground gas assessment as recommended in the contamination report	None	Undertake a non intrusive ground gas assessment during stage 3.
Construction	General	Unexploded ordanance	ASW	Confirm if desk study is required	None	If necessary undertake desk study