Pell Frischmann

100 Chalk Farm Road

Structural Engineering Report

January 2024.

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Site Name	100 Chalk Farm Road
Location	100 Chalk Farm Road, London, NW1 8EH
Longitude, Latitude	51.543041, -0.1513118
Grid Reference	TQ 28297 84302
Eastings, Northings	528297, 184302
Summary	The following report has been prepared by Pell Frischmann for Regal London Chalk Farm Limited. A general overview of constraints which impact the structural engineering design of the development has been undertaken as part of this study, along with a proposed concept design. The proposed structure consists of four towers of varying height, with 12 storeys at its highest. Situated close to the historic Roundhouse theatre and the Northern trainline on the west and south sides of the north sloping site, ground settlements are critical. As well as this, a Thames Lee Tunnel directly under the side limits the positioning of the basement and the available depth for the piles.

1 Introduction

1.1 Scope & Objectives

The following report has been prepared by Pell Frischmann on behalf of Regal Chalk Farm Ltd and it covers the RIBA Stage 2 civil & structural concept for the proposed development at 100 Chalk Farm Road, London.

The purpose of the report is to prepare the structural concept design by defining the scope, scale and form of the structure, whilst integrating it with the other design disciplines and informing the cost plan and programme. They key areas the report focuses on are as follows:

- Overview of the desk study and survey information available, with an emphasis on the main constraints and risks impacting the design and construction of the development.
- Design criteria and performance specification, also focusing on clear embodied carbon targets.
- Development of substructure and superstructure options and assessing the impact on the structural grids and zones and material quantities/embodied carbon values.
- Review strategies for deconstruction and reuse, specifically the existing building structures.
- Preliminary site wide drainage strategy considering the various phases and coordinating the SUDS design with the landscape proposals.
- Preliminary material quantities, specifically the substructure and superstructure elements of the detailed plots that can be used to inform the Stage 2 Cost Plan and embodied carbon assessment.
- Overview of key areas that will require further development in the next design stage.
- CDM Risk Assessment.
- Site wide drainage strategy.

The information presented in this report covers the work undertaken during the Concept Design stage of the project in accordance with the RIBA 2020 Plan of Work (see Figure 1). It should be noted this is a concept design and subject to refinement and amendment during the following stages of design.

Information has been provided to allow the Cost Consultant to develop the Stage 2 project cost plan. This information is preliminary and subject to refinement and amendment during the following stages of design. A suitable cost contingency should be made to allow for ongoing design development, including unknowns and associated risks to the project.

Figure 1 - RIBA 2020 Plan of Work

1.2 Sources of Information

The information used during Pell Frischmann's RIBA Stage 2 work has been gathered from a multitude of sources. This includes, but is not limited to:

- Drawings retrieved from Pell Frischmann's archives for the existing buildings at 100 Chalk Farm Road.
- Topographical surveys by Cloud 10, dated 2022
- Geotechnical Assessment Report by IDOM, dated 2022
- Environmental noise and vibration survey report by Sandy Brown, dated Nov 2022
- Documents from Camden Council Planning Portal (related to previous planning application in 2013)
- Pre-demolition audit report by Pell Frischmann, dated November 2022.

2 Project Overview

2.1 Overview

100 Chalk Farm Road project is a new mixed-use development, creating approximately 265 new student rooms, 24 affordable residential units, and around 783 sq.m. of ground floor commercial space.

Four new building structures that resonate with the form of the Roundhouse are proposed under the new development comprising three linked cylindrical towers with 6, 9 and 12 storeys to be used predominantly for student accommodation and one 10-storey block dedicated for affordable housing. A basement structure is proposed beneath the cylindrical towers to house MEP plant rooms and various building services. Additionally, the project will include associated public spaces, landscaping, and amenity areas.

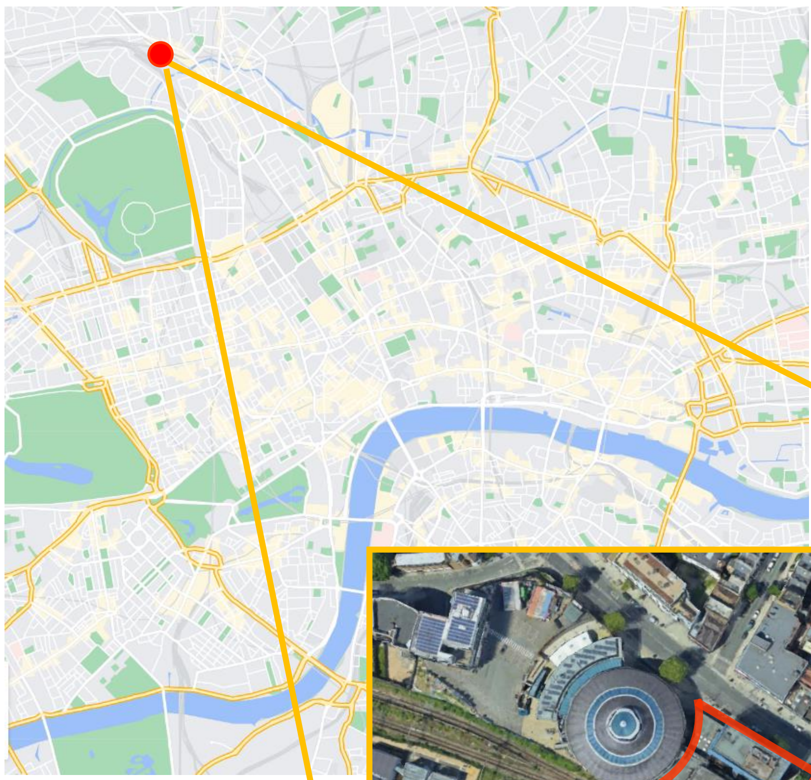


Figure 2 - Site Location within Map of London (Google Maps)

Plan View of the Proposed Site (Google Maps)

2. 2 Site Location

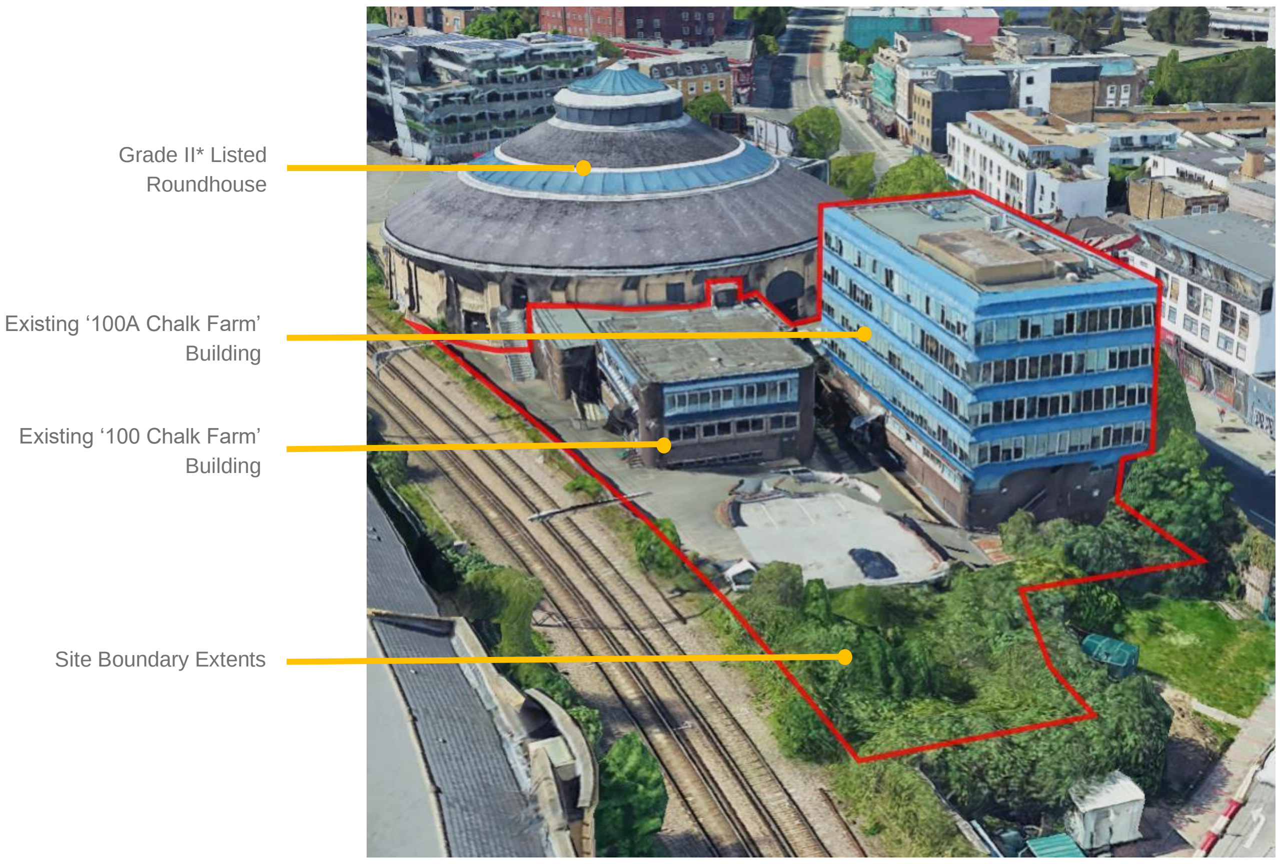
The site is 0.28 hectares in size and is located along Chalk Farm Road(A502), adjacent to the Grade II* listed Roundhouse theatre / live music venue (approximately at grid reference TQ 28297 84302). The site falls within Camden Town Centre and is covered by the Camden Goods Yard Planning Framework SPD (2017). To the rear (south), the site is bounded by live train tracks of mainline National Rail services towards London Euston Station. (See Figs 2 and 3)

Currently, the site contains two office buildings and an underground car park structure. The larger of the two office buildings is 5-storeys in height and is situated next to Chalk Farm Road. A smaller 3-storey office building is located to the rear closer to the southern boundary next to the railway line (Fig3). Lower storeys of both buildings lie below ground. It is proposed to demolish these structures as part of the proposed development.

The terrain of the site ascends from the northern perimeter along Chalk Farm Road to the southern boundary towards the Network Rail train tracks. At present, there is an elevation difference of approximately 4.5 meters in the surface level.

An underground tunnel of the London Underground tube network runs beneath the A502.

Figure 3 - 3D View of Site Boundary Extents and Existing Building (3D Google Maps)



3 The Site

3.1 Site History

In this section, a concise history of the site is provided based on the findings of a desk study. It outlines the diverse activities that occurred in chronological order.

3.1.1 1820 Industrial History

Prior to the industrial revolution, Camden was rural, and its primary purpose was agricultural. That was until Regents Canal was completed in 1820 (Figure 5).

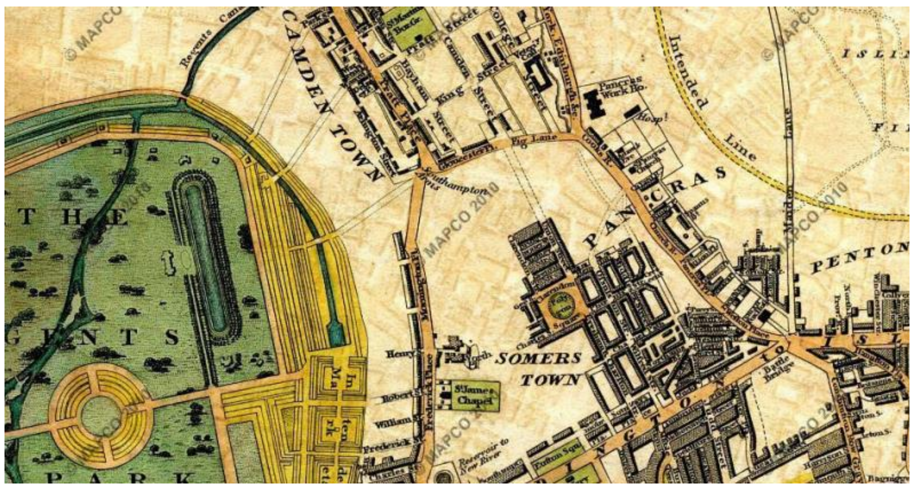


Figure 5 - Historical Map of Rural Camden

Figure 4 - The Diagonal Bridge (Regents Canal)

Bridges such as the Diagonal Bridge (Figure 4) connected Camden to Central London and were designed with the intent of horses and carriages crossing the canal. Many stables were later developed on the land adjacent to the site.

3.1.2 1830 Railway Construction

In 1833, a plan for a London & Birmingham Railway was approved by Parliament, with Robert Stephenson appointed as Chief Engineer.

The railway crosses the Regents Canal around 4.5m above ground level (15ft). An important factor towards the gradient of the site. The steepest portion of the Northern Railway Line is known as the “Camden Incline”. The first locomotive to pass via the Roundhouse from Euston to Birmingham was in 1837.

3.1.3 1846 Construction of the Roundhouse

The incline to Euston soon became an issue, as the locomotives heading north could not gain the momentum to travel up the “Camden Incline”. Up until this time, huge winding gears had been hauling cargo up the line. Thus, construction began in 1846 on the Roundhouse, to maintain and store engines.

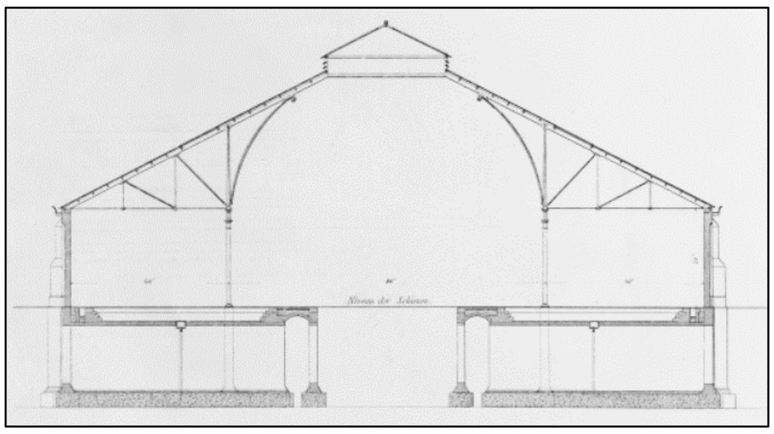


Figure 6- The Roundhouse Section (RIBA Library Collection)

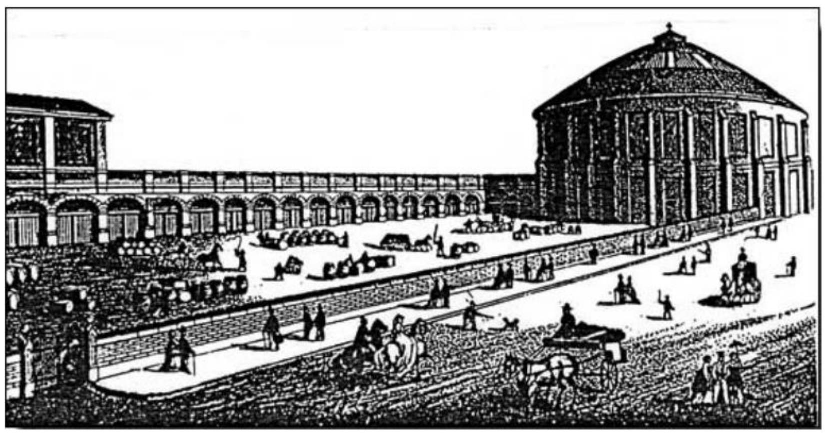


Figure 7 - The Roundhouse during Gibleys Ownership

The Roundhouse is known to have taken on many roles within its lifespan. Initially it catered for railway infrastructure, and in the 1860s it was used as shed for corn and potatoes. In 1869 it became a warehouse, leased to W. & A. Gilbey Ltd for wines and gins.

In 1963 the Gibleys vacated the premises, and the building became Grade II listed. It was decided that it would become a centre for the arts and was renamed “Centre 42”. It remains to date an events house for entertainment.

3.1.4 1847 Site Development

The Network Rail plans from 1847 show a cattle landing dividing the now ‘Juniper Crescent’ development and overground railway lines to the south of the site. To the east were stables, and to the north the Hampstead Road.

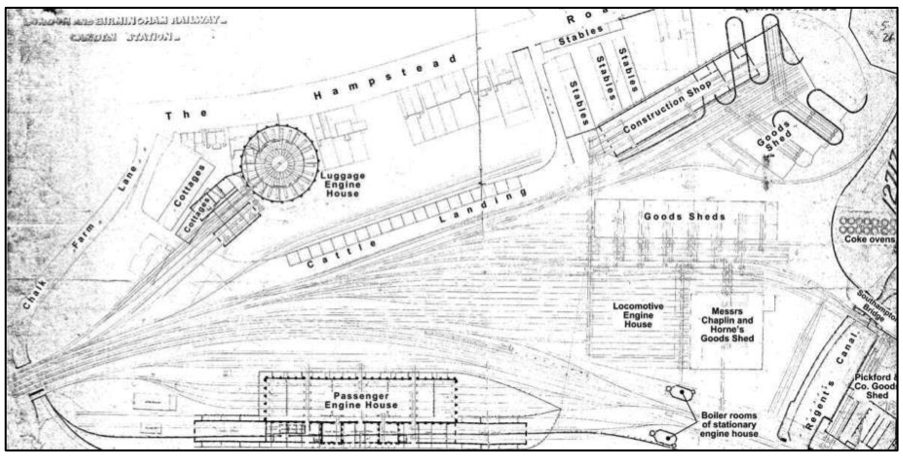


Figure 9- 1847 Plan Goods Depot (Network Rail)

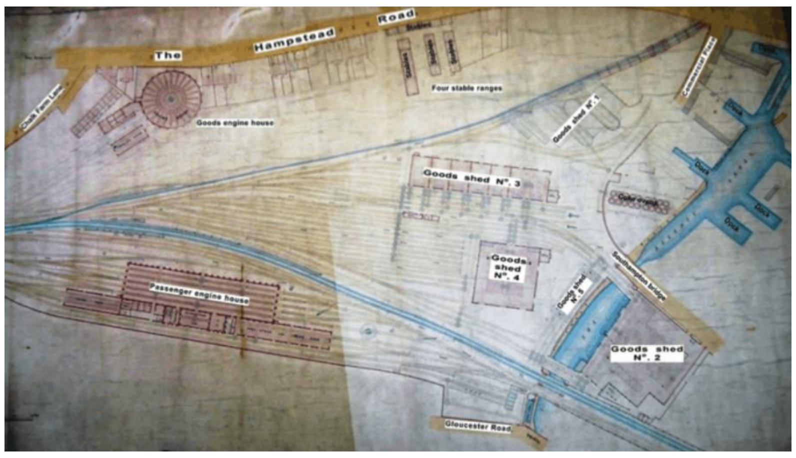


Figure 8 - 1852 Railway Track Plans (Nationals Archives)

3.1.5 1853 North London Railway

The Rail Freight Line was re-aligned and named the North London Railway line in 1853. A viaduct was constructed, and railway offices demolished.

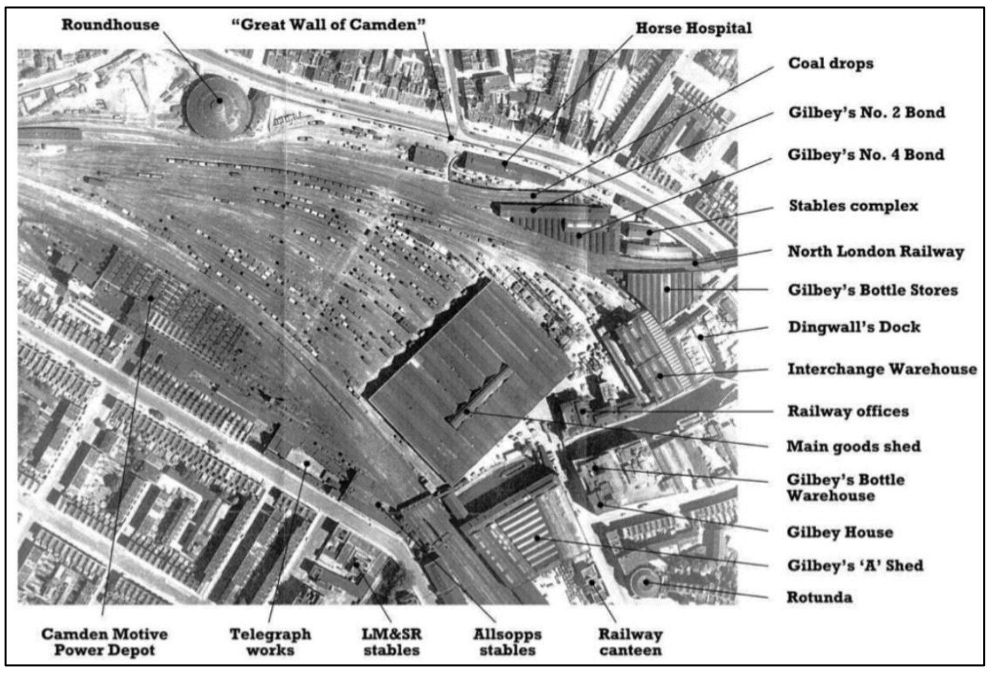


Figure 2 - Developments post 1856 (Historic England)

Figure 10 - Discontinuation of Brick Wall

The "Great Wall of Camden" distanced Chalk Farm Road from the soot of the railway. The wall appears to have been built with "Yellow Stock Brick" in an English bond formation, due to the period and location, which ran from Commercial Place to Roundhouse. To make way for the new access road and later a petrol station on the corner of the junction, 113m of the wall was demolished. The discontinuation can be observed today from the edge of the site to the access road.

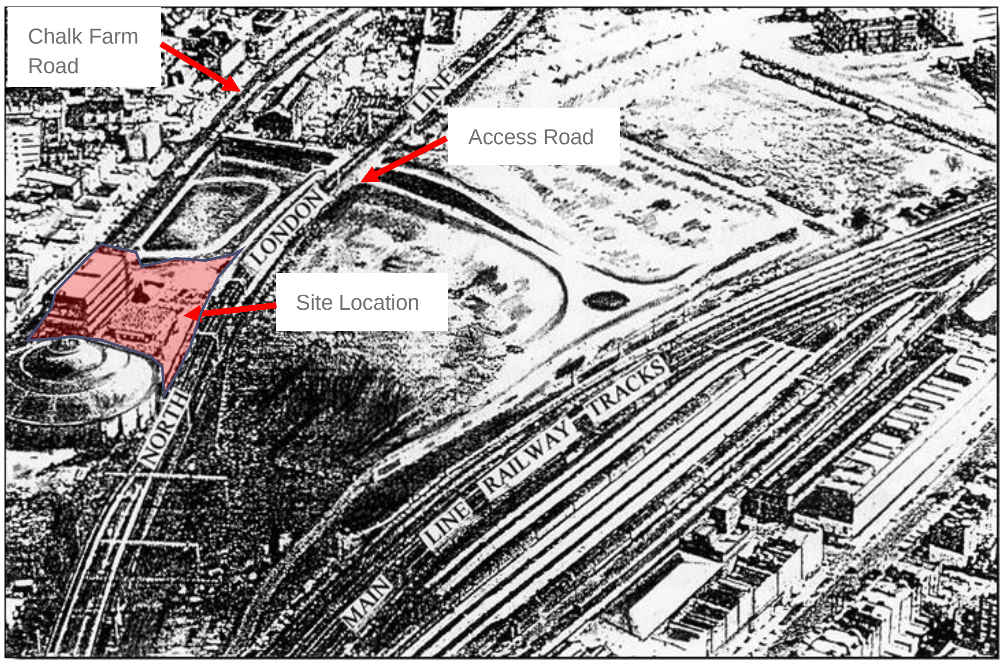


Figure 3 - 1990 Site Clearance and Access Road Built

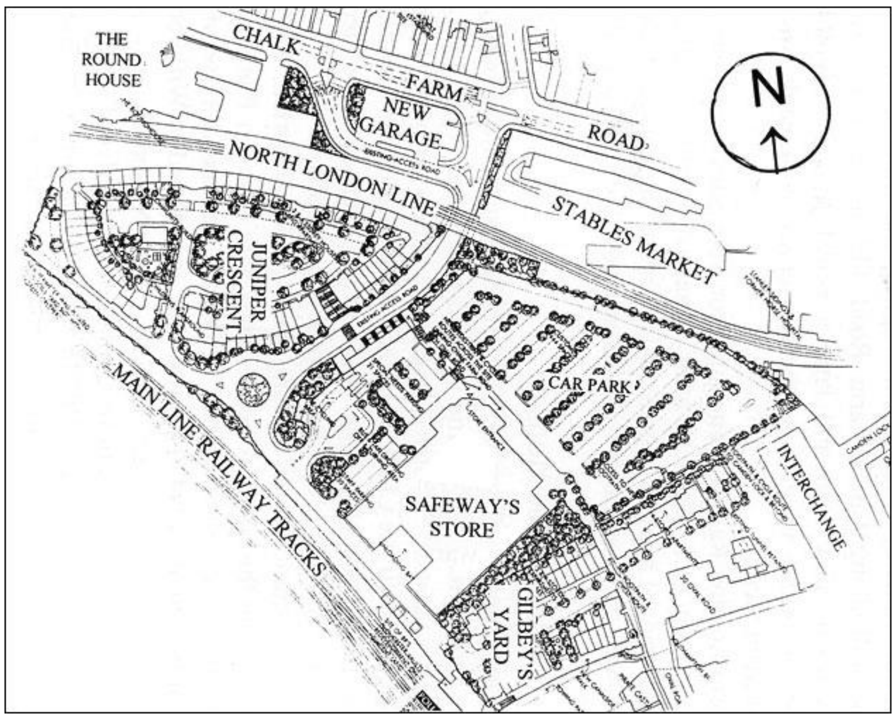


Figure 4 - 1990 Development Layout Site Plan

The new access road led to the existing Juniper Crescent development, built in 1996. A new garage was built adjacent to the Roundhouse, and the site belonged to the Roundhouse site.

3.1.6 1907 London Underground tube line beneath Chalk Farm Road

The London Underground Northern line connecting Chalk Farm to the city centre was opened for use in 1907, this runs beneath Chalk Farm Road.

3.1.7 1920 Camden Goods Yard

Photographs from 1920 Camden Goods Yard show the ‘Roundhouse’, previously known as the ‘Goods Engine House’. This Grade II listed building is 160ft in diameter and once held 24 rail tracks.

Figure 5 - 1920 Aerial Photograph of Camden Goods Yard (Historic England)

3.1.8 1950s- Construction of Thames Lee Tunnel

The Thames Lee Water Main was constructed between 1955 and 1959 to aid in the supply of treated water to eastern areas of London. The water main transports raw water from the River Thames to East London for treatment.

The tunnel is 19 miles in length (31km), and approximately 2.6m in width (102 inches). It runs at a depth between 68 to 190 feet (21m to 58m). The tunnel can be accessed via one of its 24 access shafts, shaft no. 15 would be most suitable. This tunnel runs beneath the site closer to its east boundary.

3.1.9 1970s – Construction of Buildings at 100 and 100A Chalk Farm Road

The site consists of three commercial buildings, with carparks, both underground and surface level to the rear of the site. It is thought that the large office building facing the Chalk Farm Road was constructed in the 1970s.

3.1.10 2000s Developments

A Petrol station and a supermarket have been built on the adjacent site to the east and the site is currently being redeveloped as part of a wider development known as Camden Goods Yard (CGY).

3.2 Site Geology

There are four records of historic boreholes within the site boundary. All four BGS boreholes were undertaken in 1972 for C.J. Pell Frischmann & Partners, extending to a maximum depth of 21m below ground level.

The IDOM report includes site investigation information for five window sample boreholes (WS) excavated to a depth of 5.0m below ground level (bgl) in July 2022. All five WSs encountered Made Ground over London Clay. The depth of Made Ground ranged from 2.4m to 4.1m bgl.

A single BGS record ~160m to the southwest (TQ28SE6) identified bedrock strata comprising London Clay over Woolwich and Reading Beds (Lambeth Group) to a depth of ~69m.over ~2.5m of Thanet Sand (Formation) over Chalk encountered at 71.3m depth.

The historic borehole data shows presence of made ground varying between clay, sand and gravel as shown in Table 1.

Anticipated Thickness (m)	Top of the Stratum (m AOD)	Geological Unit	Typical Description	Saturated Unit Weight (kN/m^3)	Youngs Modulus (E’) (MPa)	Undrained Shear Strength (Cu) (kPa)
0-4.5	~33	Made Ground	Sandy gravelly clay, sandy gravel or clayey gravelly sand.	-	-	-
4.5-20	30.4	London Clay	Greyish brown/bluish grey slightly gravelly clay	20	05-20	45 – 200
>20-35	18.5	London Clay		20	20 - 45	200-350

Table 1 - Preliminary Geotechnical Parameters

Available information related to the historical events affecting the site geology suggests the soil to be of original London clay topped with Primrose Hill Clay.

3.3 Site Constraints

A number of constraints exist that could potentially impact the construction activities of the proposed new development.

3.3.1 Site Access

The site is bounded by Grade II* listed Roundhouse to the west, a private car park and a petrol station to the east, Chalk Farm Road (A502) to the north and live Network Rail train lines to the south. Therefore, main access/egress for the site during the construction works will be via Chalk Farm Road only.

3.3.2 The Roundhouse (Grade II* Listed)

The Roundhouse is a grade II* listed building of national significance and is a prominent landmark in the London Borough of Camden. It features approximately 650mm thick perimeter brick wall, circular on plan with distinctive external buttresses spaced approximately 6.4m apart. This brick perimeter wall provides support to several steel beams in the roof structure of the existing three-storey building. Therefore, removal of these existing steel elements shall be carried out without causing damage to the Roundhouse's existing brick fabric. All the impacted areas of the wall will need localized restoration to meet the standards set by English Heritage.

The extent and depth of the foundation of the Roundhouse perimeter wall is currently unknown. Various historical records and drawings (see Fig.4) suggest that the perimeter wall of the Roundhouse is founded at a depth well below the existing ground level near the site boundary along Chalk Farm Road. Consequently, it is unlikely that underpinning will be needed for the foundations of the perimeter brick masonry wall of the Roundhouse during construction of the proposed new development. However, excavation works of the proposed development will induce ground movements that could damage the brick wall. Therefore, design and sequencing of temporary works for excavations must ensure that the ground movements remain within acceptable limits. Other construction activities such as mobilisation of HGV's, vibrators etc., could also create damage to sensitive areas of the Roundhouse structure. The implementation of a movement monitoring regime, complete with "trigger levels" and an "action plan", will be imperative. Implementation of movement monitoring is anticipated to commence before the initiation of on-site activities and is expected to remain operational throughout the entire project duration. This precautionary measure is intended to safeguard the historic brick structure of the Roundhouse from potential harm.

There are two staircases providing access to the Roundhouse which are visible from the site. One is a concrete staircase located at the northwest corner just outside the property boundary providing access to the Roundhouse users from Chalk Farm Road. The other is a steel framed escape staircase located inside the site boundary near the southwest corner of the site. While the concrete staircase at the Chalk Farm Road front will be retained, the steel escape staircase will be replaced with a new staircase as part of the proposed development. The escape route from the Roundhouse will be kept operational by providing a temporary staircase during the construction works. Archived drawings indicate existence of a shallow "stepped footing" for the concrete wall supporting the concrete staircase. The upper part of this stepped footing will lie above the proposed ground level for the new development. Therefore, underpinning will be required to the foundation of this concrete wall. The RC wall supports steel beams of the existing building roof structure. Although it is unlikely that the RC wall relies on the steel roof for lateral support, a detailed structural assessment of this wall will be required in the next design stage and temporary supports shall be provided to this RC wall and the staircase during the proposed construction works if required.

3.3.3 TFL/LUL Tunnel– Northern Line running below the Chalk Farm Road.

"Northern line" of the London Underground tube network runs beneath Chalk Farm Road. Driven or percussive piles are not permitted within 15m of the tunnel edge. Additionally, a 3m protection zone is necessary to prevent damage to the underground tunnel structure.

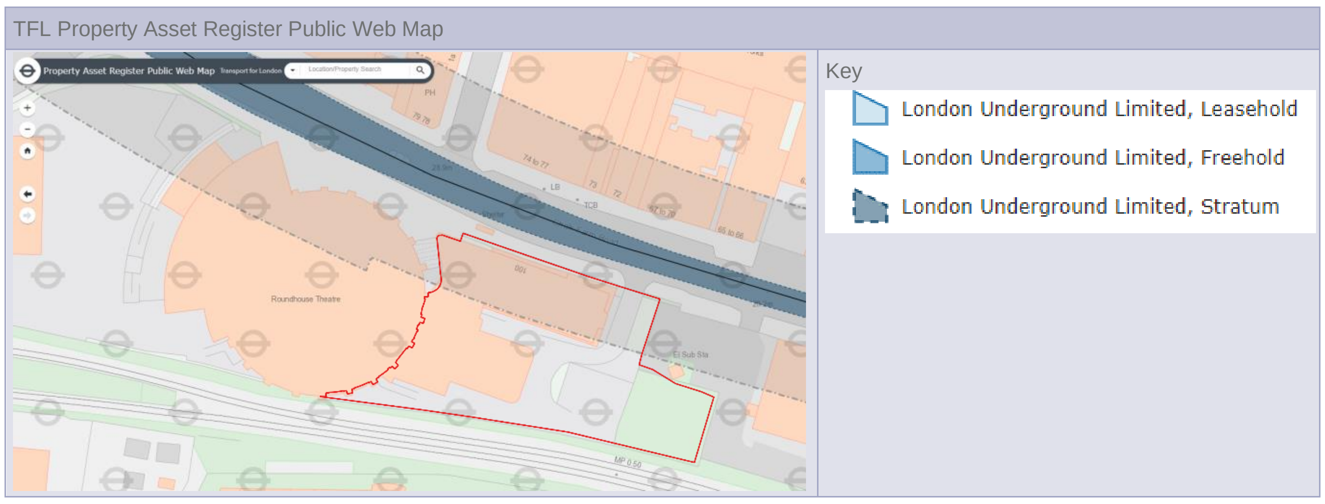


Table 2 - TFL Property Asset Register Public Web Map

3.3.4 Network Rail Assets - North London Railway Line.

The constraints exist to protect the ongoing operation and maintenance of the railway lines. Detailed engineering-led technical submissions will be required for both the permanent and temporary works. The process and content are prescribed by Network Rail and strict adherence is essential to be able to gain the shortest approval time. Currently, a Basic Asset Protection Agreement (BAPA) is in place between the client and Network Rail.

The current proposals allow a 3m clear zone above ground level, from the property boundary with Network Rail. A brick masonry boundary wall (~1.7m high) and a fence line currently separate the site from the Network Rail land. It is envisaged that these boundary walls will be retained and protected throughout the construction phase and the future maintenance strategy for those will be agreed with Network Rail.

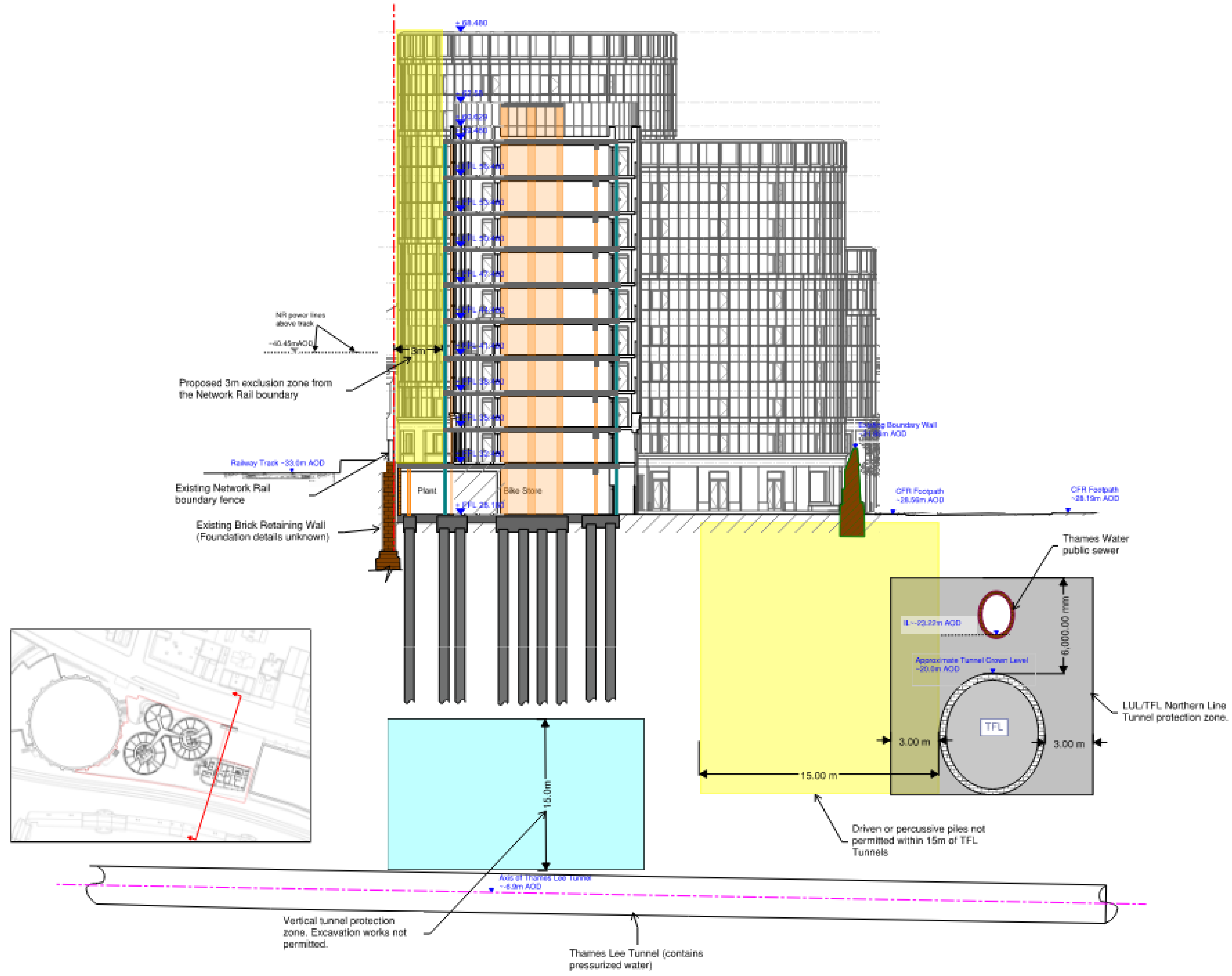
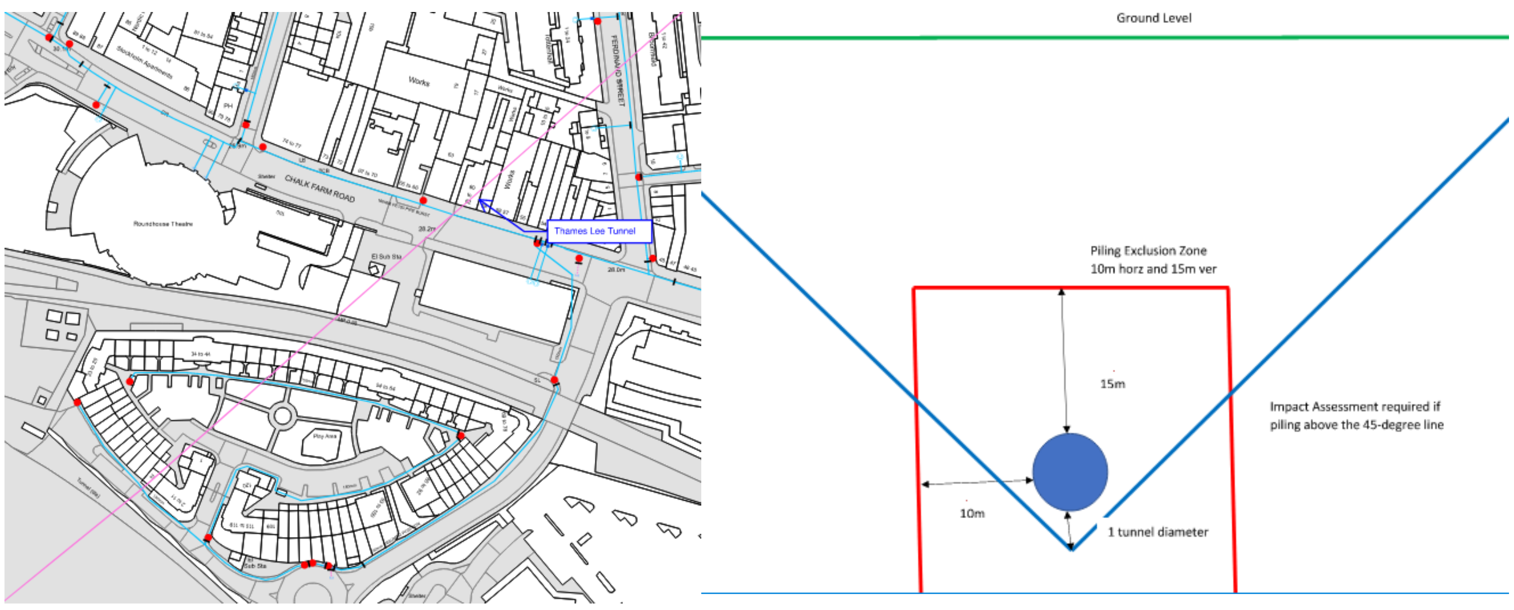


Figure 15- Site Constraints Section across the Residential Block

3.3.5 Thames Lee Tunnel

Thames Lee tunnel is a 2.5m diameter pressurised water tunnel and is a strategic asset for Thames Water. The tunnel is known to be formed using unbolted concrete wedge block lining and as such is held together by the weight of the soil above and around the tunnel. Any excavation above or adjacent to the tunnel carries a risk of causing catastrophic failure of the tunnel. Therefore, Thames Water request that any proposed developments within 5m of the outside face of the tunnel be reviewed by Thames Water prior to works commencing on site. Thames water applies exclusion zones of 10m horizontally and 15m vertically measured from the outside face of the tunnel for piling. An impact assessment will also be required for piling operations for the site.

Figure 6 - Thames Lee Tunnel (Extract from Thames Water Asset Search 2022)



3.3.6 Remains of the Great Wall of Camden

The Yellow Stock Brick Wall is believed to be part of the Great Camden Wall remaining to date. Although this part of the wall is not currently listed, it will be retained as part of the proposed development. The wall is located parallel to the property boundary along the Chalk Farm Road and could potentially stand as an obstruction to construction traffic. A small portion of this wall lies within the property redline boundary.

Figure 8 - Remains of the Great Camden Wall

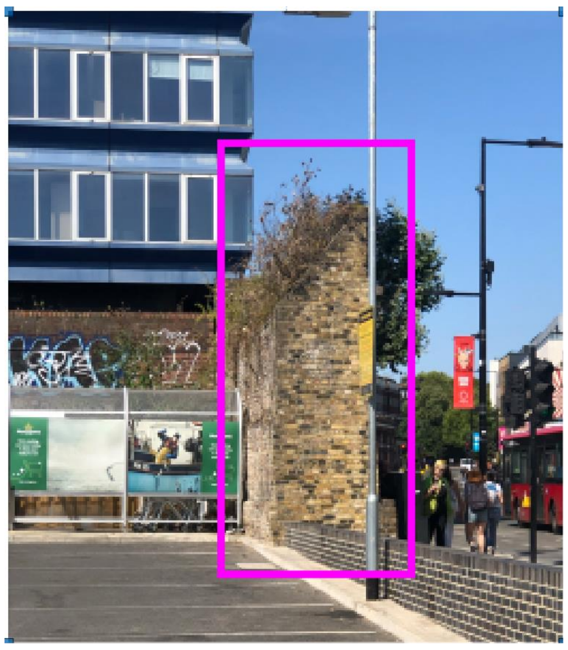
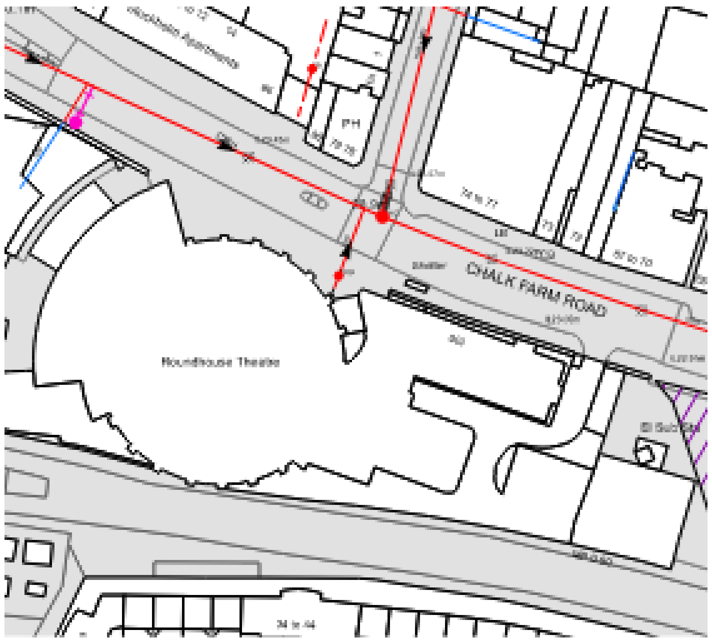


Figure 7 - Existing public sewer (Extract from Thames Water Asset Search 2022)



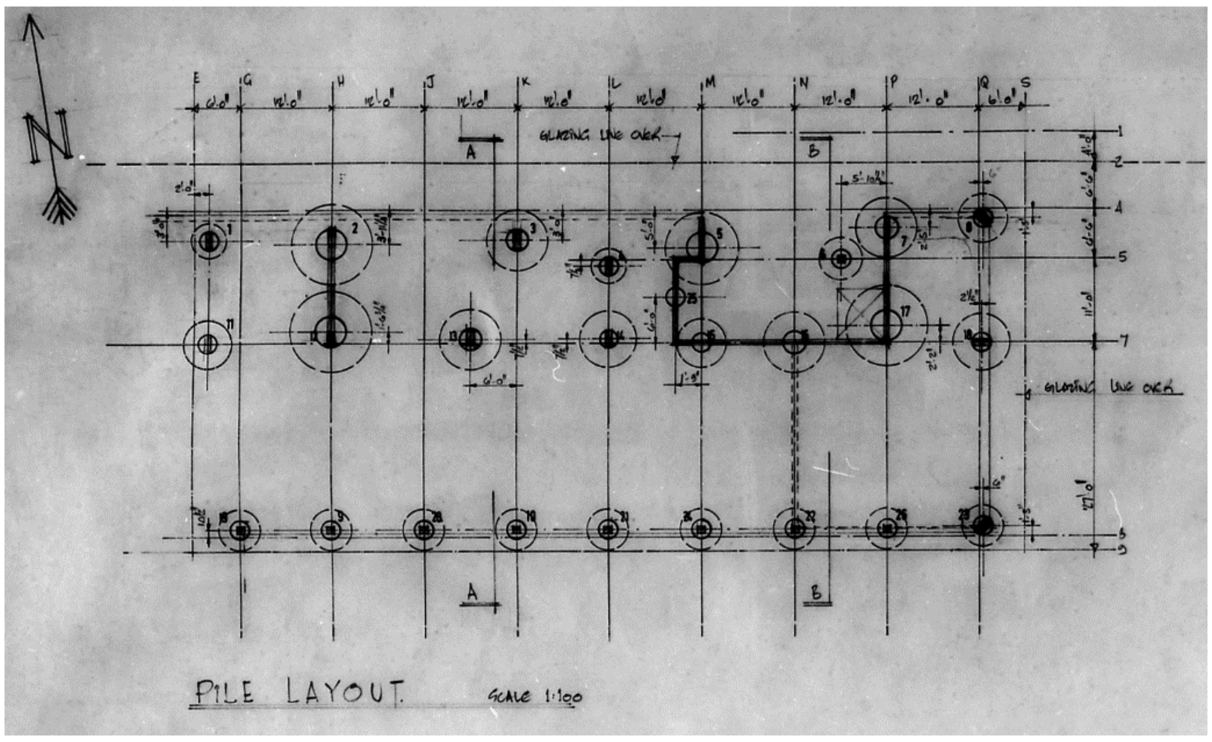
3.3.7 Existing brick sewer beneath Chalk Farm Road & other buried utilities in the foot path.

There is an existing combined public sewer owned by Thames Water that runs beneath Chalk Farm Road within close proximity to the site boundary. A few clean water pipes run beneath the footpath of the opposite side of the Chalk Farm Road. Proposed demolition, excavation and piling operations for the development could impact these assets depending on their distances from the site. An impact assessment study on these assets and/or pre and post condition surveys of the sewer may be required.

3.3.8 Existing concrete piles and other concrete foundation structures

The existing 5 storey office building is founded on concrete piles. The record drawings of this building retrieved from Pell Frischmann archives indicate that these piles could extend up to about 14m below the existing ground level near Chalk Farm Road. There are other concrete basement walls and footings extending up to about 1m below the existing ground level. While the concrete footings, walls and pile caps are expected to be removed as part of cut & fill operations during construction stage, the RC piles may remain on site and may cause obstructions during new piling operations.

Figure 19 Existing Piles (Extract from Pell Frischmann & Partners' drawing 3301/2- 1972)



4 Basis of Design

4.1 Sustainability Targets

4.1.1 KPIs

To quantify how the various performance criteria or design decisions taken impact the embodied carbon values of the proposed development, Pell Frischmann are utilising the LETI targets and as a starting point looking at the 2025 and 2030 values. This allows for the various options considered to be benchmarked and provide a clear indication to the client and the rest of the team which solutions are worth developing in more detail. For RIBA stage 2, a traditional concrete frame has been used as a base solution against which other typologies can be assessed in the next stages of design. As such this section focuses on the approach to specifying sustainable concrete.

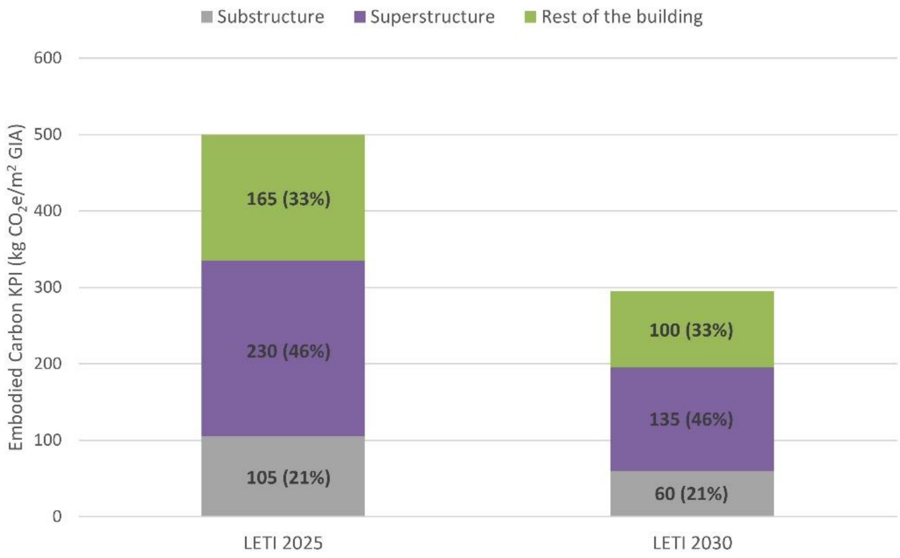


Figure 20: LETI Targets

4.1.2 Specifying Sustainable Concrete

Concrete specification affects not only the material strength and workability during construction, but also its embodied carbon content.

Cement

Cement is responsible for 58% of embodied carbon in structural concrete, making it the largest source of potential carbon reduction (see Figure 21).

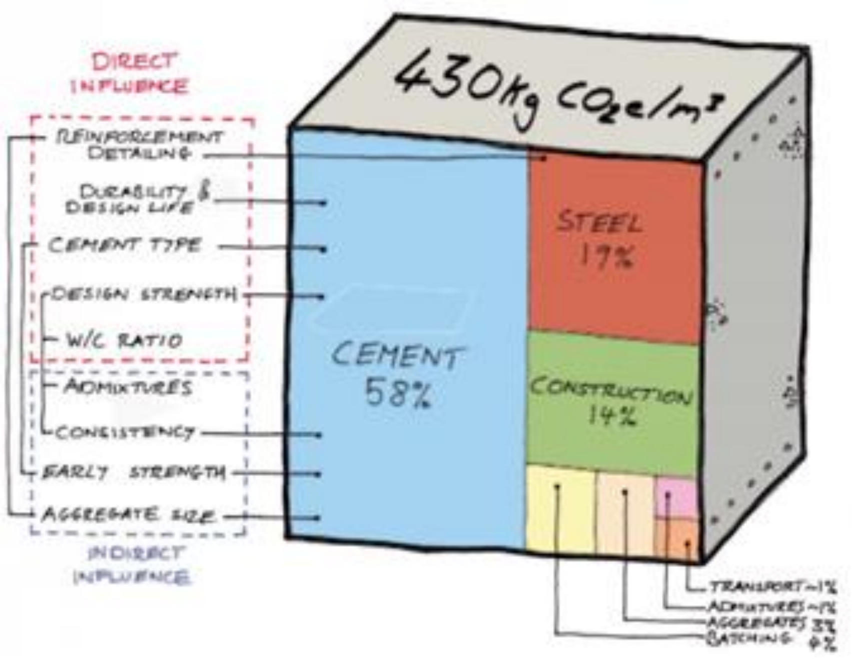


Figure 21: Embodied carbon in 1m³ of a typical structural concrete, *The Structural Engineer, February 2021*

Portland Cement, also known as CEM 1, is a fine powder made by grinding clinker with the addition of gypsum. Given that the average carbon footprint of cement is around 0.913 tonnes CO2e/tonne, over 50% of the carbon footprint is due to the chemical reaction taking place rather than the energy required to manufacture the cement. A common way to reduce the embodied carbon is by adding Supplementary cementitious materials (SCMs). These SCMs are typically wastes or by-products from other manufacturing processes. Common SCMs are listed below:

- Ground granulated blast slag (GGBS)
- Fly ash
- Silica fume
- Limestone fines
- Natural pozzolana and natural calcined pozzolana

An alternative to the common SCMs is to use low embodied carbon substitutes, namely geopolymers or alkali-activated cement produced using innovative technologies (refer to

Table 4). With the low clinker content, such cements contain about 20-30% of embodied carbon compared to CEM 1. It is worth noting these novel cements might not be as commercially attractive as CEM 1.

Table 3: Embodied carbon of cements, *Specifying Sustainable Concrete, 2020*

Cement types in BS 8500[a]		Secondary Main Constituent (smc) or Addition Low – High Content %	Embodied CO_2[c] smc content Low – High, kg CO_2/tonne
Produced at the cement factory	Produced at the concrete mixing plant		
CEM I Portland cement			860
CEM II/A-LL or L Portland limestone cement	CIIA-LL or L	6 - 20 limestone	842 - 721
CEM II/A-V Portland fly ash cement	CIIA-V	6 - 20 fly ash	825 - 686
CEM II/B-V Portland fly ash cement	CIIB-V	21 - 35 fly ash	694 - 555
CEM II/B-S Portland slag cement	CIIB-S	21 - 35 ggbs	712 - 585
CEM III/A Blastfurnace cement	CIIIA	36 - 65 ggbs	594 - 350
CEM III/B Blastfurnace cement	CIIIB	66 - 80 ggbs	359 - 232
CEM IV/B-V Siliceous fly ash cement	CIVB-V	36 - 55 fly ash	564 - 381

Notes

a For CEM I 1% minor additional constituent (mac) and 5% gypsum is assumed. For CEM II, CEM III and CEM IV at the highest proportion of the smc it is assumed that no mac is incorporated and at the lowest proportion of smc it is assumed that mac is added at 1% with the appropriate proportions of limestone, fly ash and ggbs.

b For Combinations the CO_2e figure for CEM I is used together with the figures for limestone, fly ash and ggbs in the appropriate proportions.

c CO_2e figures for CEM II, CEM III and CEM IV and their equivalent combinations are based on the range of smc proportion, where the range is from the minimum to maximum proportion of smc or addition. CO_2e can be interpolated for proportions of smc or addition between the minimum and maximum, noting that the minimum CO_2e is associated with the highest proportion of smc or addition.

Table 4: Novel concrete and cement

Concrete/ Cement	Manufacturer	Carbon Reduction
Earth Friendly Concrete (EFC)	Capital Concrete	50%
H-UKR – structural concrete H-EVA – site concrete H-P2A – mortar adhesives	Hoffmann Green Cement Technologies	70-80%
Solidia cement	Solidia	Up to 70%

Aggregates

Aggregates makes up for 3% of the embodied carbon in concrete. Other than natural aggregates, recycled aggregates and secondary aggregates can be used to further reduce this embodied carbon contribution. Recycled aggregates consist of concrete and other building materials from demolition. To make recycled aggregates more sustainable, carbonation in demolished concrete can be enhanced. Over time, carbonation occurs in concrete as cement absorbs and reacts with carbon dioxide in the air. This process can be sped up by crushing the concrete and exposing the material to air.

Secondary aggregates are made by processing waste from other industries. Carbon dioxide gas is added to the waste material, turning it into a more stable carbonate form (see 22). As carbon is captured in the process, secondary aggregates are often found to be carbon neutral or even carbon negative.

Although recycled and secondary aggregates contain lower embodied carbon, these should be sourced locally to avoid inducing carbon in long distance transportation.

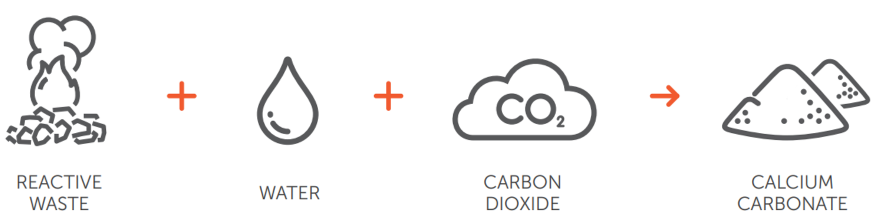


Figure 22: Carbon capture in secondary aggregates, *O.C.O brochure*

Table 5: Sustainable aggregates

Aggregates	Manufacturer	Carbon Reduction
Manufactured limestone (M-LS)	O.C.O	Carbon negative
Lightweight aggregate	Carbon8	Carbon negative

Curing process of concrete

Other than the material specification, carbon reduction can also be achieved during the curing of concrete. In general, concrete achieves 99% of its strength in 28 days. By allowing for longer curing time, the cement content can be removed or replaced. In addition, innovative technologies allow concrete to be cured with carbon dioxide instead of water. This lowers the carbon in concrete.

Earth Friendly Concrete

Earth Friendly Concrete, or EFC for short, is a product manufactured by Australian firm Wagners and is a zero cement, geopolymer concrete supplied by Capital Concrete in London. The cement from traditional concrete is replaced by a geopolymer binder system made from the chemical activation of blast furnace slang and fly ash.

Keltbray, a demolition and foundations specialist contractor, has already committed to using this type of concrete and has managed to recently do it with great success on the piled foundations of a new development in Canada Water, where an estimated 240 tonnes of carbon have been saved.

As with any new type of material, it still requires further project-based testing, especially if the intention is to use it for the superstructure elements. Currently, it has mainly been used within foundations and the data available seems to suggest that EFC can provide some performance advantages such as improved durability, lower shrinkage, earlier strength gain, higher flexural tensile strength and increased fire resistance.

4.1.3 Materials Reuse

The reuse of existing assets and materials is one of the first things that should be considered when redeveloping a site, especially when it comes to existing foundations or the main structural frame. The decision to reuse any of these elements can influence the way the rest of the design progresses and it is therefore extremely important that this is evaluated properly at the early stages of the project.

When the reuse of an existing asset is not feasible and a new one is proposed, then the design of the new structure needs to cater for as many of the following:

- Longevity, flexibility, or adaptability.
- Ability to be disassembled and reused somewhere else.
- Potential for elements to be standardised and modularised.
- Usage of low impact materials, that either have a high recycled content or make use of secondary material.
- Minimise waste, both during construction and at the end of life; and
- Reduce construction impacts, by prefabricating as many elements as possible in a factory.

The above list is not exhaustive and as many of these items need to be captured during the design process to ensure that the proposed development is in line with the Net Zero Carbon agenda. One approach would be to extend the design life of the structural frame and foundations from the normal 50 years to say 100 years.

4.2 Design Standards

The main Codes of Practice to be used on the project are as follows:

Table 6: Design Standards

Reference	Title
BS EN 1990-1-1:2005 + UK National Annex	Eurocode 0: Basis of design
BS EN 1991-1-1:2002 + UK National Annex	Eurocode 1: Actions on structures
BS EN 1992-1-1:2004 + UK National Annex	Eurocode 2: Design of concrete structures
BS EN 1992-1-2:2004 + UK National Annex	Eurocode 2: Design of concrete structures; Part 1-2; Structural fire design
BS EN 1993-1-1:2005 + UK National Annex	Eurocode 3: Design of steel structures
BS EN 1994-1-1:2005 + UK National Annex	Eurocode 4: Design of steel-concrete composite structures
BS EN 1997-1:2004 + UK National Annex	Eurocode 7: Geotechnical design

This list is non-exhaustive and will be updated as required.

4.3 Design Life & Durability

The ‘design working life’ for the ‘structure’ (structural frame and main structural elements) will be minimum 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.

Some specified structural elements, such as concrete wearing surfaces, will require periodic inspection and maintenance in order to ensure serviceable life for at least 50 years.

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 the contiguous piled wall retaining the network rail boundary, those elements may need to be designed for the ‘Intended working life at least 100 years’ designation in the requisite substructure Eurocodes.

4.4 Robustness

The approach to robustness in the design is to follow the recommendations of BS- EN 1991-1-7 Eurocode 1 Part 1-7 Actions on structures – Part 1-7: General actions – Accidental actions and the Building Regulations Approved Document A – A3 Disproportionate collapse.

The methodology described in Eurocode 1 Part 1-7, Annex A and Annex B, follows three steps:

- Step 1: Identification and modelling of relevant accidental hazards. Assessment of the probability of occurrence of different hazards with different intensities.
- Step 2: Assessment of damage states to structure from different hazards. Assessment of the probability of different states of damage and corresponding consequences for given hazards.
- Step 3: Assessment of the performance of the damaged structure. Assessment of the probability of inadequate performance(s) of the damaged structure together with the corresponding consequence(s).

In general, the new building structures will not be designed for explosive devices beyond the requirements set out above on the basis that the security strategy will be in place to prevent explosive devices being placed close to structures.

Vehicular impact on columns close to highways

In the design, reference has been made to BS EN 1991-1-7 Eurocode 1 Part 1-7. Table 4.1 shows the indicative equivalent static design forces due to vehicular impact on members supporting structures.

The columns close to Chalk Farm Road front that could be at risk from vehicular impact, will be assessed using the criteria above during the next design stage.

All the columns are reinforced concrete, and the longitudinal reinforcement has been checked to ensure that it has sufficient capacity, utilizing the reduced load factors and combinations from BS EN 1990 Eurocode – Basis of Structural Design and the reduced material factors from BS EN 1992-1-1 Eurocode 2 Design of concrete structures – Part 1-1: General rules and rules for buildings.

4.5 Fire Performance Criteria

Typically, the structural fire rating of buildings depends on the height from ground level to the highest occupied floor and are as follows:

- Over 30m height 120 mins
- Between 18m and 30m height 90 mins
- Between 5m and 18m height 60 mins
- Below 5m 30 mins

According to these criteria, it is likely that the towers with 9, 10 and 12 storeys will require 120 mins fire rating, while the smaller 6-storey tower will require only 90 mins fire rating. The fire strategy report for the project will confirm the fire rating requirements.

4.6 Materials Specification

For the purpose of the structural studies and the initial designs for the detailed plots, the following materials have been considered. It should be noted that the information is preliminary and subject to refinement and alteration during the ongoing stages of design.

4.6.1 Concrete

Element	Material Specification
Concrete Slabs & Walls	Grade C32/40, 30% GGBS recommended
Concrete Columns	Grade C35/45, 30% GGBS recommended
Foundations	Grade C32/40, 50% GGBS recommended
Reinforcement	B500, 92% recycled content recommended
Steel beams & columns	Grade S355, 92% recycled content + 7% reuse EoL

Table 7 - Typical Concrete Grades

4.6.2 Reinforcement

All reinforcement is to be B500 high yield, with a characteristic strength of 500N/mm^2, conforming to BS4449.

Typical rates for this stage should be taken as follows:

Element	Rate
Slabs	105 kg/m^3
Columns	350 kg/m^3
Core Walls	150 kg/m^3
Pile caps	250 kg/m^3

Table 8 - Typical Reinforcement Rates

4.7 Design Loads

Following design loads, typically suitable for preliminary stage design have been considered for the purpose of current study. It is envisaged that these loads will be reviewed further during the detail design stage.

Table 9 - Design Loads

Area	Super-imposed Dead Load	Imposed Distributed Load
Typical floors (Residential areas)	Floor finishes, services/ceiling = 2.0 kN/m^2	1.5 kN/m^2
Ground floors -Commercial use	Floor finishes, services/ceiling = 2.0 kN/m^2	3.5 kN/m^2
Ground floors -Communal areas	Floor finishes, services/ceiling = 2.0 kN/m^2	5.0 kN/m^2

Area	Super-imposed Dead Load	Imposed Distributed Load
Stairs	Finishes, services/ceiling = 2.0 kN/m^2	3 kN/m^2
Corridors and Hallways	2.0 kN/m^2	5 kN/m^2
Typical Roof Area (Access only)	Insulation, waterproofing, services & ceiling = 2.0 kN/m^2	0.6 kN/m^2
Roof Areas with tree pits	Insulation, waterproofing, services & ceiling = 2.0 kN/m^2	20 kN/m^2
Cladding	Aluminium/glazed façade 3.0 kN/m2 (on elevation)	
MEP plant rooms	Floor finishes, services/ceiling = 1.0 kN/m^2	7.5 kN/m^2

4.8 Movement & Tolerances

Tolerances

A full set of construction tolerances will be issued as one of the deliverables during the next design stage. As a guidance the following tolerances are expected for concrete construction:

Table 10 - Construction Tolerances

Element	Tolerance
RC slab level	+/- 10mm
RC slab edge plan position	+/- 10mm
Core wall position in plan	+/- 25mm
Foundation top surface level	+/- 15mm
Pile position in plan (without guide walls)	+/- 75mm
Pile verticality	1 in 75

The frames will be constructed to be within the tolerances set down in the technical specifications and the recommendations of the National Structural Concrete Specification for Building Construction by The Concrete Centre complying with BS EN 13670:2009. All finishes, cladding, services and internal partitions are required to be detailed to accommodate the worst combination of these.

Allowable deflections

The following deflection criteria is recommended for the primary structure.

- Envelope tolerance of +/-25mm at the time of fitting cladding. This is split into +/-10mm construction tolerance and +/-15mm deflection tolerance at 100 days which is the assumed time for cladding installation.
- Differential deflection +/-15mm deviation between floors after time of fitting cladding to long term. This is interpreted as +/- 15mm from cladding fix to 50 years.

Additionally, there are Eurocode deflection guidelines which in general are less onerous than those defined in the Employers Requirements, these are:

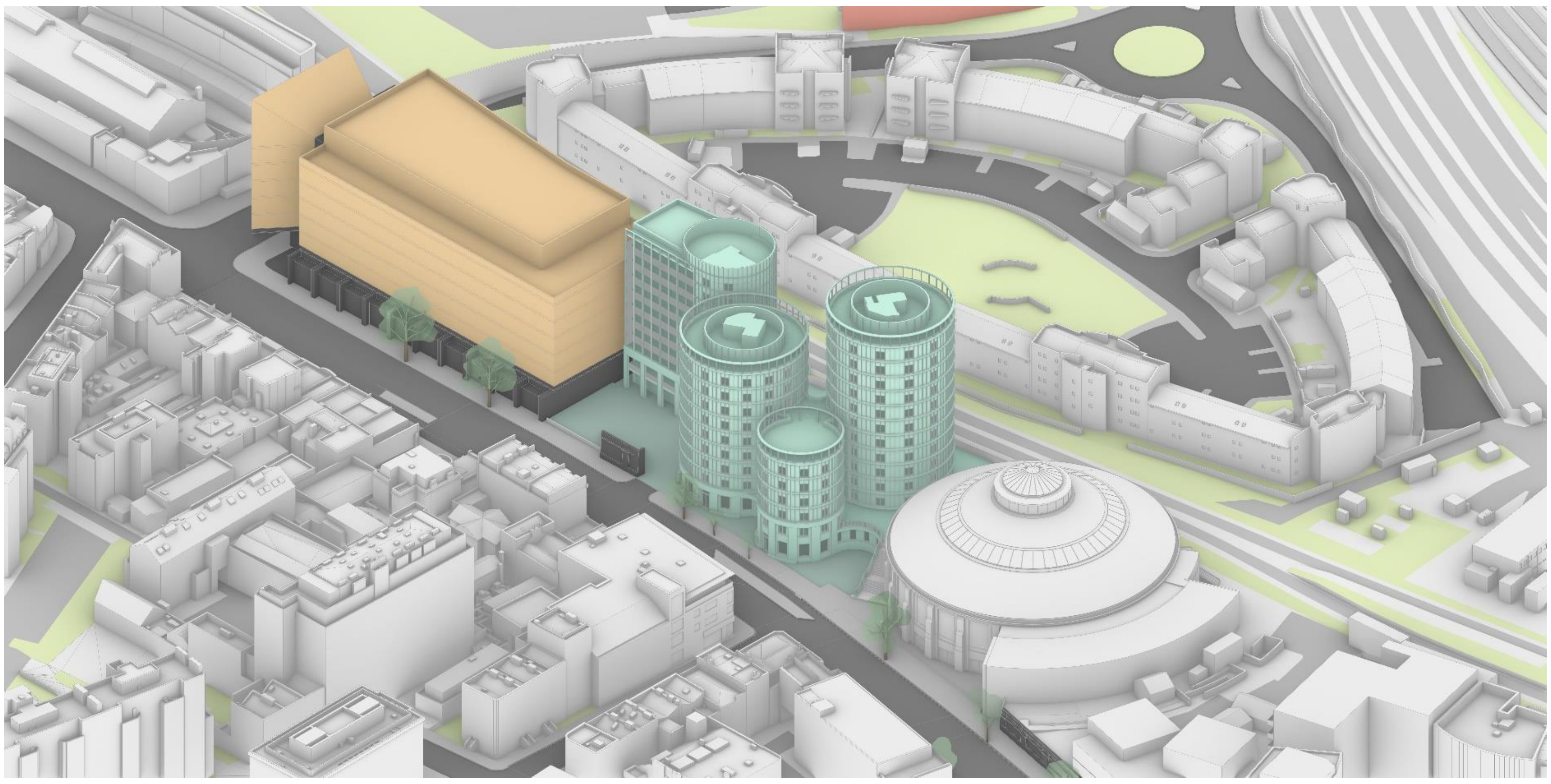
- Total self-weight, dead and live deflection must be less than span/250.
- Finishes and live load deflection must be less than span/500 Long term (at 50 years).
- Total self-weight, dead and 30% live deflection must be less than span/250.
- Super imposed dead and 30% live load deflection must be less than span/500 at 50 years.

The deflection criteria need to be reviewed and finalised in the detail design stage once All finishes, cladding, services will need to be detailed and designed in the next design stages to accommodate the movements indicated above.

5 Proposed New Development

Several structural studies were undertaken throughout this design stage to inform the client and the design team of the potential options for various elements of the superstructure and substructure. The studies are in accordance with the design criteria and performance specification and focused on exploring the balance between the optimum structural zones, associated material quantities, and limiting the embodied carbon.

Figure 23: Proposed new development.



5.1 Superstructure

Given the existing constraints on the site, such as limited access (access to site only available from Chalk Farm Road), challenges faced with manoeuvring heavy construction vehicles, and safe handling of large or long-span construction materials & equipment, the most suitable form of construction for the primary structure is identified as in-situ concrete for the development. Hence, reinforced concrete (RC) framed structures with in-situ cast elements, featuring blade columns and two-way spanning flat slabs are proposed for all four new buildings. Figure 23 shows the proposed new development in green.

Solid concrete slabs provide a multifaceted approach to enhancing acoustic performance. Their substantial mass acts as a robust barrier, effectively blocking airborne and impact noise and significantly improving sound insulation between different floors and rooms. Moreover, the density and rigidity of concrete minimize the transmission of vibrations, making it particularly valuable in settings where mitigating vibrations is essential. Beyond acoustics, the thermal mass of concrete aids in stabilizing temperature fluctuations, offering an added advantage for consistent acoustic performance.

5.1.1 Floor Construction

The flat slabs for typical floor plates, accommodating student rooms and residential units, will have a thickness of 225mm. Roof slab thicknesses will vary based on the proposed roof finishes; for example, the 6-storey cylindrical tower, with three large tree pits on the roof top, will require a thicker slab (approximately 350mm-400mm).

The roof slab of the affordable housing block will support MEP plant and equipment. A 250mm thick flat slab is proposed for this roof.

A 6m x 6m column grid is proposed where possible as shown in Figure 24.in order to achieve an economical and efficient solution. It aligns with a lean design approach, contributing to a reduction in the carbon associated with the structure. Our approach to the sizing of the columns is further discussed in section 5.1.4

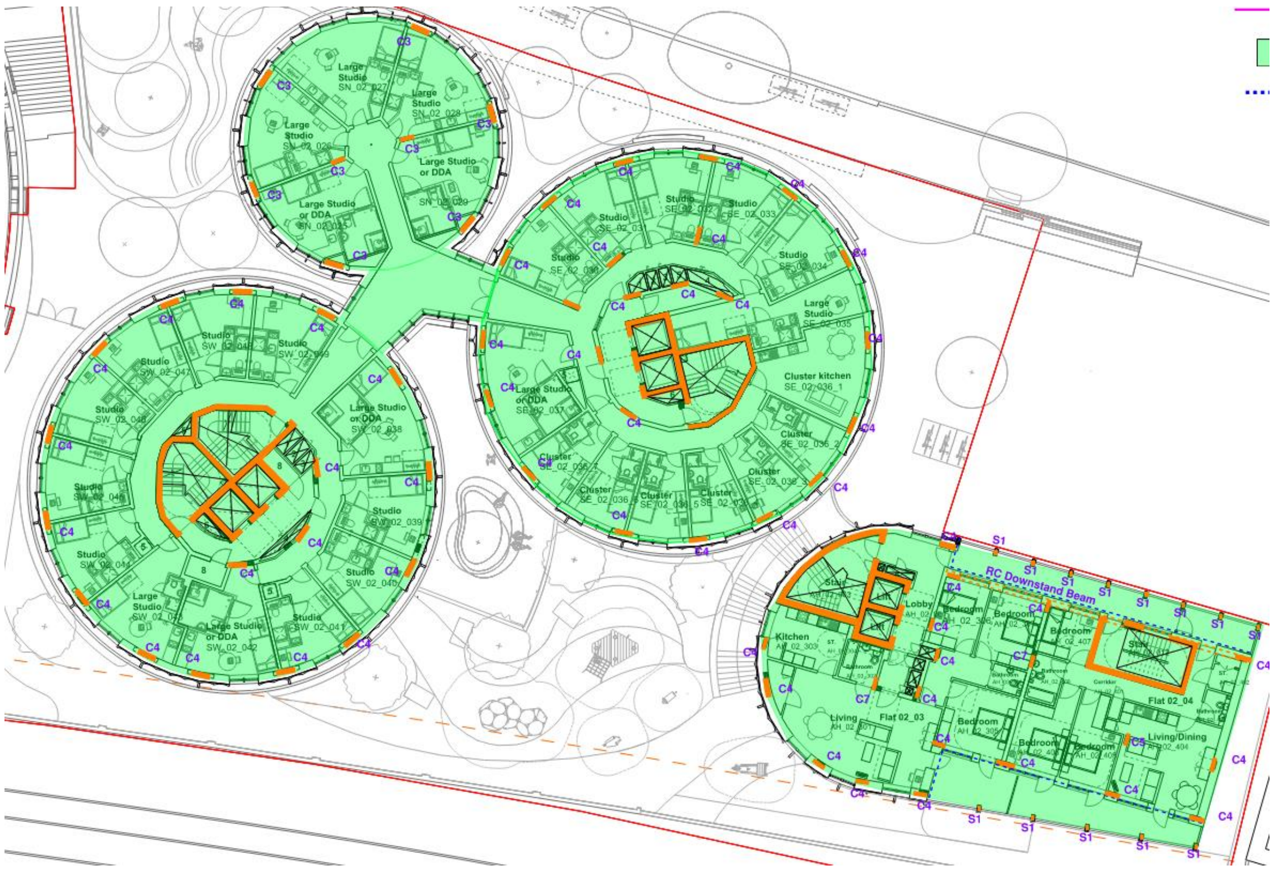


Figure 94 - Typical Floor Column Grid

5.1.1.1 First Floor Slab

The first-floor slab will accommodate various communal and landscaped areas and hence will need a slightly thicker slab (circa 250mm). The new replacement escape staircase of the Roundhouse near the southwest corner of the site will also be supported by the first-floor slab.

It will be designed as a suspended slab spanning between RC columns, RC walls and the concrete capping beam of the contiguous piled wall. Next to the Roundhouse, new RC columns and pile caps will be located at a sufficient distance from the Roundhouse wall foundations. The ground floor slab in this area including the localised areas between the buttresses of the Roundhouse will have cantilevering edges.

The area outside the footprint of the proposed buildings will be open to external environment and will need waterproofing. At the interfaces with the building footprints, consideration shall be given to provision of necessary thermal barriers between the external environment and the heated internal spaces of the buildings. It is envisaged that this will be achieved without the use of proprietary thermal break systems inserted within the depth of the slab. Structural slab levels need to be adjusted at the interfaces to accommodate the additional surface insulation required for the thermal isolation.

The first-floor slab will also require to adequate measures to control thermal and shrinkage cracking during the detailed design stage.

5.1.1.2 Ground Floor Slab

Ground floor slab will accommodate commercial units, communal spaces, cycle storage facilities, an electrical substation and various MEP plant rooms. A courtyard with a large tree pit is proposed between the two 11 and 9 storey cylindrical towers.

A 250mm thick RC flat slab is proposed for the ground floor, which will be supported by RC columns, basement walls, and the new contiguous piled retaining wall along the southern boundary. Outside the basement footprint, the ground floor slab will be spanned between RC pile caps (Figure 31).

The courtyard will be open to sky and therefor will need waterproofing. Additionally, the interfaces with the rest of the building around the courtyard, shall be provided with necessary thermal barriers between the external environment and the heated internal spaces of the buildings. Structural slab level needs to be adjusted at the interfaces to accommodate the additional surface insulation required for the thermal isolation.

5.1.2 Stability

Two cylindrical towers with 9 and 12 storeys will have RC core walls structures providing stability to those buildings. The RC core walls will form the lift shafts and stair enclosures and are located centrally within each cylinder. These RC core walls will extend from basement level through the full height of the buildings.

The cylindrical tower with 6 storeys will be stabilised by designing the structure as a rigid frame with moment-resisting joints between slabs and columns. This tower is structurally linked to the two 9 and 12 storey cylindrical towers at each floor level and will also benefit from the combined lateral resistance offered by those two buildings.

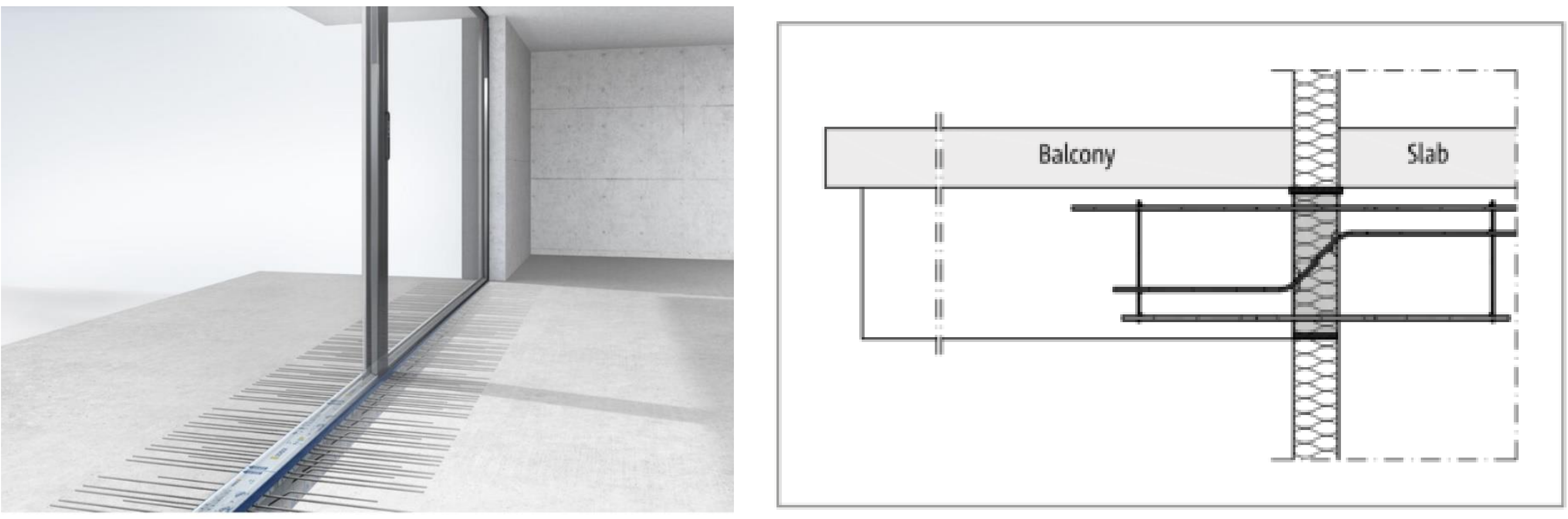
The 10/11-storey high residential block will be stabilised by concrete walls located around the stair enclosures and lift shafts extending over the full height of the building.

It is envisaged that lateral loads due to wind and other notional loads will transfer through diaphragm action of the RC flat slabs into the RC walls at each floor level.

5.1.3 Terraces

External terraces are proposed at the front and end elevations of the affordable housing block on all floor levels from Level 1 and above. At the front elevation facing Chalk Farm Road, these extend about 1.5m from the perimeter column line of the building footprint and at the rear elevation facing the Network Rail boundary the extension varies from 1.5m to 3.0m.

Figure 25 - 3D Image of concrete cantilever with thermal break

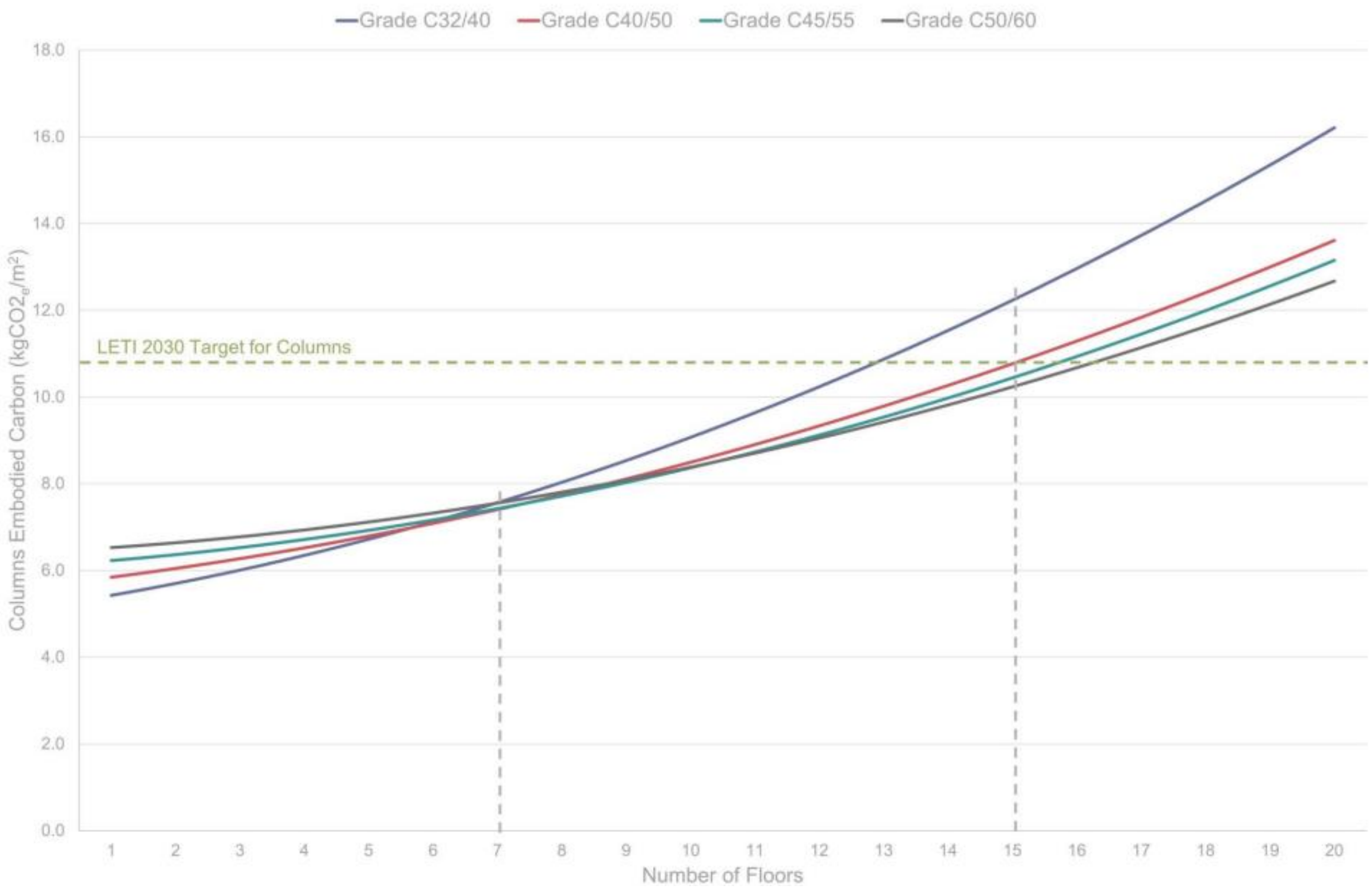


It is proposed to form these terraces in insitu concrete with a line of proprietary thermal break system installed within the depth of the concrete slab to achieve the necessary thermal separation and providing the structural integrity at the same time.

5.1.4 Columns Study

The choice of column typology is often driven by the type of slab and material chosen. It is beneficial to have the same main material for the entire structural frame as this helps with both the procurement process but also the speed and quality of the construction. The following study focuses on concrete columns and specifically looking at how the size of an internal column varies throughout the building and what the impact is on the material quantities and embodied carbon. The grid considered is (6.0m x 6.0m). One of the main issues that concrete columns have is that they tend to be fairly large and therefore can impact the internal areas. The best solution to get around this is to hide the columns within the partition walls or integrate them with the external envelope build -up. To do this, the columns generally require to be long and thin, almost like walls, basically becoming blade columns. While designing and building such columns is the same as a more standard rectangular or square column, they do require a bit of extra detail, especially when designing for a specific fire rating (the fire rating for the development considered is 2 hours). This can impose strict limits on the minimum sizes that are achievable for such blade columns. For example, the simplified method recommended by Eurocodes suggests that the minimum width for a 2 -hour fire rated concrete column should be 350mm. Trying to conceal such a column within a partition wall, which is generally 300mm -350mm thick, is therefore not a feasible option as it will impact the NIA. To reduce the minimum 350mm width requirement, a more complex analysis and design is needed, where the fire temperature for a 2 -hour fire is calculated throughout the cross section of the column to quantify the resistance more accurately under such conditions. This study has taken this more complex approach to "slim" down the blade columns as much as possible. The choice of concrete material, specifically the grade, can have a significant impact on both the size of the column and the amount of embodied carbon associated with it. Larger concrete grades contain more cement and therefore a bigger carbon footprint, but at the same time they can also lead to smaller sized column. The graph presented in Figure 26 considers 4 different concrete grades and compares the embodied carbon of a typical internal blade column starting from ground and going up to 20 floors. For the top 6 -7 floors, where the loads are less, the lowest concrete grade considered (C32/40) tends to be the most efficient from an embodied carbon point of view. However, beyond levels 6 -7, the tables turn, and a higher concrete grade tends to be more beneficial. As a result, it is recommended that a higher concrete grade (C35/45) is chosen for the columns. For a building over 6 storeys, the overall embodied carbon impact tends to be the smallest and it will also allow for slimmer blade columns to be designed and therefore positioned within the internal partitions.

Figure 26 - Internal RC Blade Columns EC vs Concrete Grade



5.1.5 Ground Borne Vibrations.

Proposed structure could potentially be subject to ground borne vibrations from the London Underground Northern Line tube trains running beneath Chalk Farm Road, live trains running along the Network rail tracks adjacent to the southern boundary at ground level and from the activities within Roundhouse music/concert venue.

Sandy Brown's "*Noise and vibration planning report", December 2023* suggests that student accommodation and residential units of proposed developments are likely to remain below the London Underground compliant threshold level of LAS_{max} *40* dB.

Current structural proposal does not include provisions for ground borne vibration isolation. However, if required in the next design stage, a proprietary vibration isolating floor system will be required to the affected floor areas which can be installed on top of the concrete floor slabs and the slabs will need to be designed for the extra loads.

5.1.6 Crowns for the roof tops

Figure 27 - Proposed roof top construction

Circular colonnades are proposed on roof tops of all four buildings. These could be built by either extending the mullions of the facade or introducing a series of galvanized steel posts (RHS sections) fixed on top of the roof concrete slab with thermal isolation and water proofing. Typical details are shown in Figs 28-30.

Figure 28 - Crown construction: Option to extend the facade mullions.

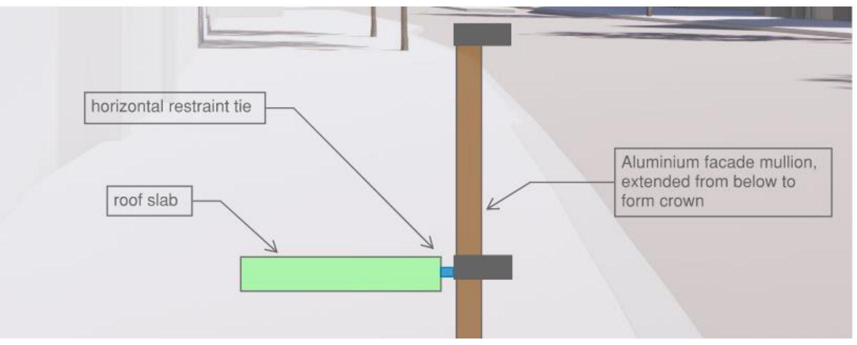


Figure 29 - Crown construction: Option with steel columns.

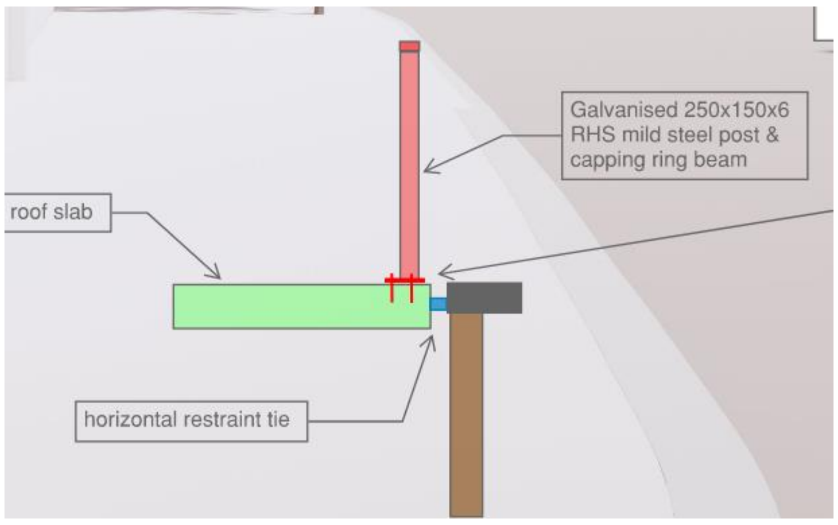
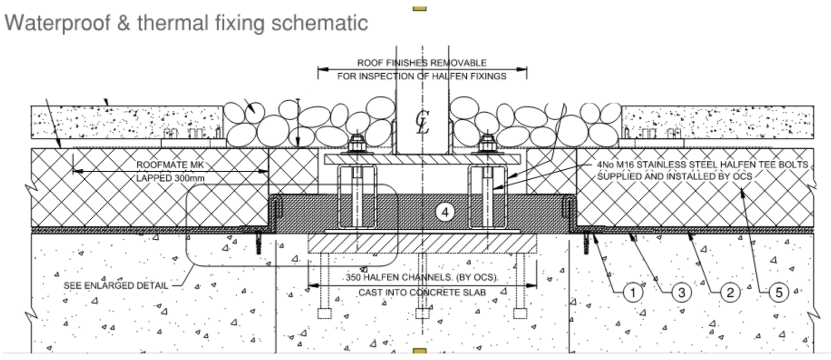


Figure 30 - Typical base plate fixing detail for steel columns on roof top slab.



5.2 Substructure

5.2.1 Contiguous piled wall adjacent to Network Rail boundary

A contiguous piled wall is proposed along the site boundary with Network Rail, adjacent to the existing brick masonry boundary wall that currently separates the site from Network Rail land. The foundation details of the existing boundary wall are currently unknown. It is suspected that the remains of the historic North London Railway brick masonry via duct still exist beneath the boundary wall, which could potential stand as a ground obstruction to the piling operations.

The existing ground level (~32 m AOD) is proposed to be lowered by approximately 4m for the proposed ground floor slab level, and by a further 4m within the area of the proposed basement. This wall will provide retention for the adjacent site with operational train tracks (Network rail), and therefore, should be of sufficient stiffness to maintain the lateral movements through its full retained height within the maximum permitted by Network Rail to prevent any damage to the rail tracks and train operations.

In the temporary condition, during the construction phase of the project, this wall will be laterally restrained by temporary works specifically designed for this purpose, taking into consideration all the construction activities, various stages of construction and sequences. The movements of the piled wall will be monitored throughout the duration of the project. The movement monitoring target types, locations, installation details and monitoring action plans will be agreed with Network Rail.

In the permanent condition, the piled wall will provide vertical support to the ground floor slab and the basement floor slab, and it will benefit from the lateral restraint offered by those concrete slabs.

750mm diameter piles at 900mm c/c or 900mm diameter bored piles @ 1050mm c/c are likely to be required for this wall.

Figure 31 - Proposed ground floor plan showing the extent of the proposed contiguous piled wall.

5.2.2 Basement structure

A basement is located within the central part of the site outside the horizontal “tunnel protection zone” of the Thames Lee tunnel that crosses the site.

Southern perimeter of the basement is formed by the contiguous piled wall along the boundary. A concrete lining wall (minimum 225 thick) is proposed to the contiguous piled wall within the basement. The remaining perimeters of the basement are formed by two-storey high concrete retaining walls (225mm to 300 mm thick). The retained heights vary from circa 4m to 8m from north to south. The walls will provide vertical support to the ground floor slab and will be founded on bearing piles and pile caps at the basement level.

It is anticipated that these walls will be built as “open excavation” with the necessary temporary supports provided during the construction phase. Alternatively contiguous piled wall construction could be used, in particular for the basement wall closer to Roundhouse where control of ground movements is of significance. Traditional sheet piling may also be viable within the central part of the site outside the restricted areas such as tunnel protection zone of London Underground tunnel beneath Chalk Farm Road and areas not within close proximity to the Roundhouse.

Waterproofing to the basement walls and floor slab will be required. Type of waterproofing will depend on the basement grade that is needed. A combination of concrete lining wall cast with waterproof concrete and an externally applied waterproofing membrane will be able to achieve a Grade 3 basement environment typically suitable for habitable spaces.

5.2.3 Piled Foundations

Considering the potential for thick, highly variable, and poorly compacted made ground at the site due to the historic construction activities it is proposed to adopt pile foundations for the proposed development.

The London Clay found below the made ground is suitable for bearing piles.

Preliminary pile capacities and working pile test for various diameters are presented in Figure 32 and these have been used to inform the foundation layouts for the detailed plots of the development. Pile solutions with 600mm, 750mm or 900mm diameter have been analysed for typical internal and edge columns. The proposed foundation strategy is to use 600mm diameter piles on blocks up to 6 storeys and 750mm or 900mm diameter piles on taller blocks with more the 9 storeys and up to 12 storeys. Preliminary Pile tests are recommended with the benefit of reducing of number of piles across the entire site. The piles are to be spaced no closer than 3 x the pile diameter and column loads are to be transferred to the piled foundations using pile caps.

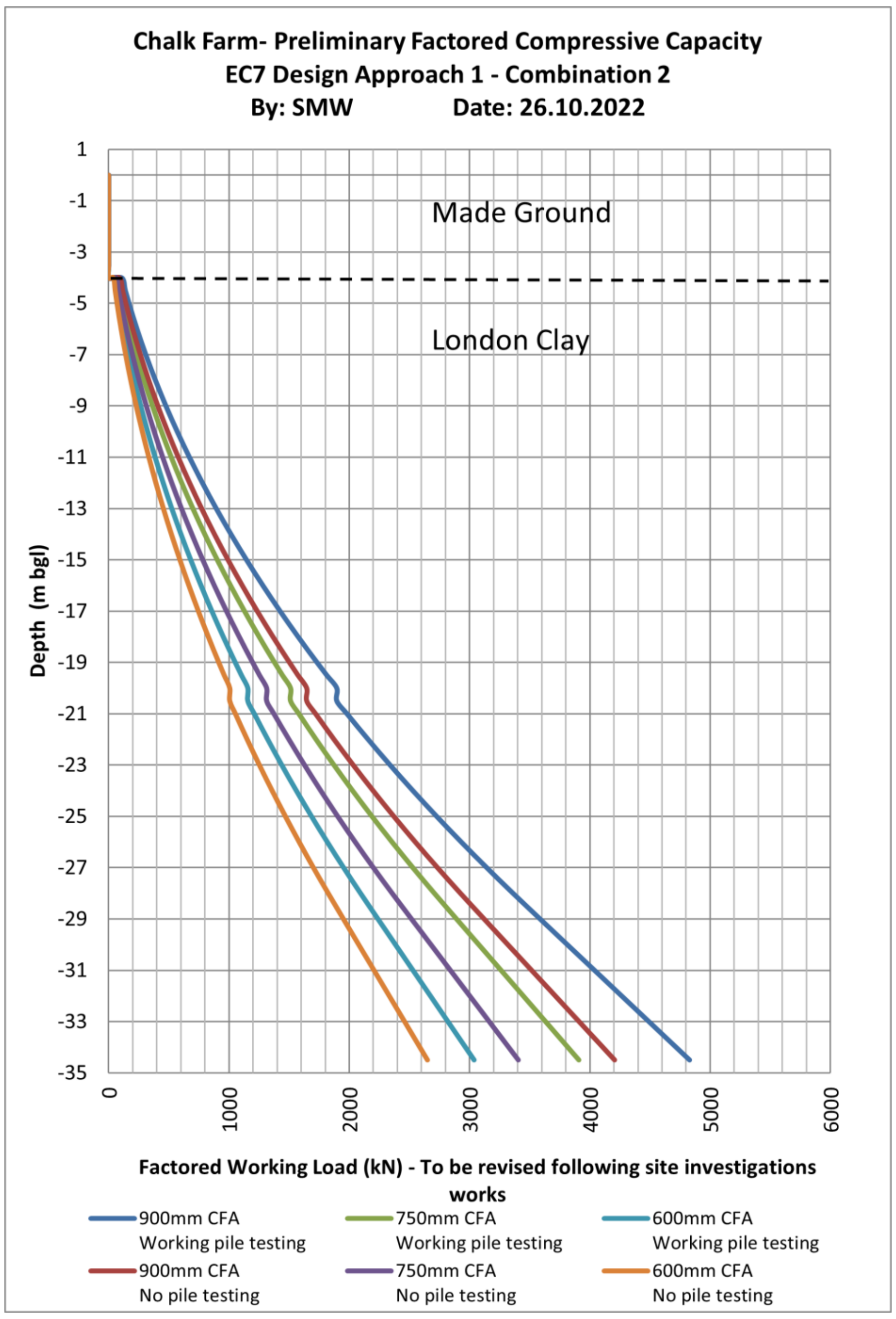


Figure 32 - Preliminary Pile Foundation Compressive Capacities

Pile length have been designed to limit the settlement to no more than 10mm (long term settlement).

5.2.4 Option for Raft Foundations

Due to the potential of encountering a thick made ground layer, up to 4.5m within the site, a raft foundation option is deemed to be less favourable, in general for the site. The affordable housing building is located directly above the Thames Lee Tunnel and excavation for a raft foundation may not be possible.

6 Options Considered for Retention & Retrofit with Extension

In the interest of sustainability, options to include the existing structures on the site were explored. These options are outlined below and included as part of Appendix A.

6.1 Option 1:

6.1.1 Structural approach

Retrofit and extend as commercial office space with necessary upgrades to meet current regulations. This involves a light CLT/timber framed partial, single storey to the existing large building. It is anticipated, at this stage, this will be a modest increase in load on existing structure and therefore any structural intervention will be minimal.

6.1.2 Temporary works:

The temporary works in this option are minimal as the existing structure is unaltered. Routing temporary works for maintenance and repair will be required and this is likely to include an external scaffold.

6.1.3 Impact on existing foundations:

None envisaged, except local hard landscaping, these are anticipated to be minor.

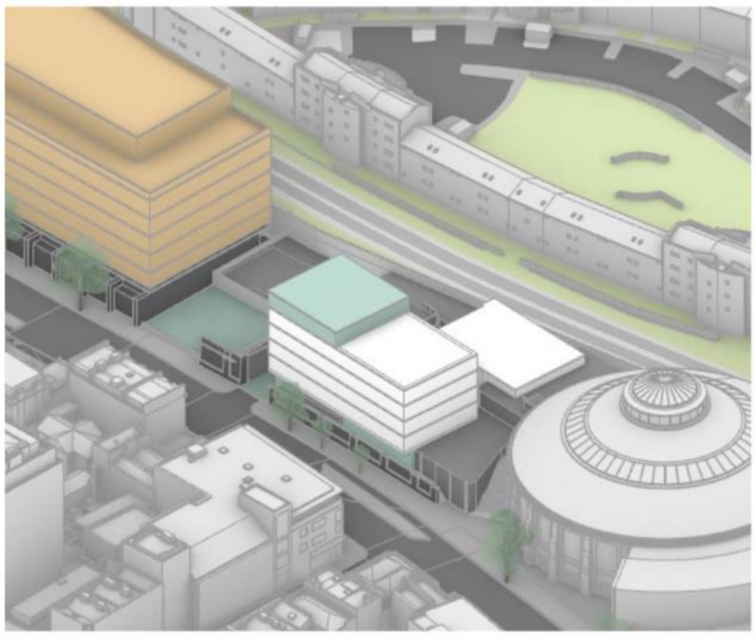


Figure 33 - Option 1, Retention & Retrofit with Extension

6.2 Option 2:

6.2.1 Structural approach

This option seeks to retain and reuse as much of the existing substructure and superstructure as possible. However, the addition of several stories to a building with little spare capacity and complex existing foundations\basement is a significant undertaking. Hence additional new foundations, column strengthening, and new shear walls are all required in this option. There are primary cantilevered transfer beams at first floor, all will need strengthening..

6.2.2 Temporary works:

There is major intervention to an existing building and the temporary works will be extensive, will have multiple phases and will be complex.

6.2.3 Impact on existing foundations:

The additional stories impose significant additional vertical load lateral load on the existing foundations. New supplementary piles and new pile caps will need to be installed alongside existing, this will be slow and complex.

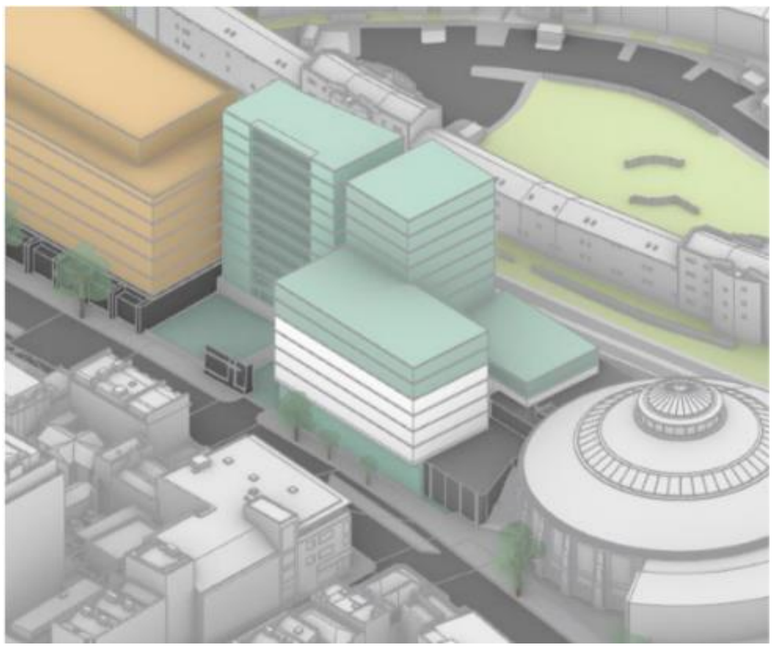


Figure 34 - Retention & Retrofit with Extension & New Build

7 Health and safety risks

The risks associated with the site, it's clearance, excavation and construction on it are outlined in Table 11 below.

Table 11 - Health and Safety Risk Assessment Table

Site Risks							
Ref	Risk	Consequence	Impact	Probability	Risk Indicator	Mitigation Measure	Action Owner
1.1	Presence of live Network Rail tracks adjacent to site.	Agreements with Network Rail needed for all phases of the project, construction and future use. Proposed new superstructures to be built leaving the agreed clear distances from the Network Rail boundary.	3	3	9	Early engagement with Network Rail.	Design Team / Contractor /Client
1.2	Presence of grade II listed Round House structure adjacent to the site. The escape staircase of the round house at south-west side of the site will be replaced under the proposed scheme, however, the escape route needs to be kept operational throughout the construction works by temporary means. The staircase at the Chalk Farm road front sits outside the property boundary, however the proposed site levels are likely to undermine the foundations of the staircase support structure. Foundation depths of the Round House perimeter masonry walls are currently unknown.	Risk of undermining/damage to foundations of the round house due to excavation works. May result in changes to the foundation design post design freeze.	3	3	9	Contractor carry out necessary trial pit surveys to verify the existing foundation depths. Early engagement with English Heritage/ party wall surveyors.	Design Team / Contractor /Client
1.3	Presence of buried Thames Water public sewer running beneath Chalk Farm Road and other Thames Water assets such as clean and foul water mains buried in the footpath of Chalk Farm Road adjacent to site and buried live LV ad HV cables.	Potential damage to third party assets leading to additional costs and delays in the construction programme. Objections from London Borough of Camden / HE or third-party asset owners.	4	3	12	Early engagement with asset owners. Contractor to carry out trial trenches in the foot path to verify buried water mains. Working around LV and HV cables to be carried out by qua	Design Team / Contractor
1.4	Presence of Thames Lee Tunnel beneath the site with vertical and lateral exclusion zones imposed by Thames water for the developers. The tunnel may contain pressurised water and all site activities in particular, excavation works directly above the vicinity of the tunnel will require prior approval of Thames Water.	Objections from Thames Water, London Borough of Camden etc. May result in changes to the foundation design post design freeze	3	3	9	Early engagement with Thames Water. Build close/build over agreements to be initiated at early stages of the detail design.	Design Team / Contractor /Client
1.5	London Underground Northern Line tunnel runs beneath Chalk Farm Road adjacent to the site. Restrictions of type of piles that can be used within 15m of this tunnel apply. i.e., driven piles are not permitted within 15m. Prior approval from TFL/LUL will be required for the proposed construction phase activities.	Objection of LUL/TFL. May result in changes to the foundation design post design freeze	3	3	9	Early engagement with TFL and LUL.	Design Team / Contractor /Client
1.6	Presence of part of historic Camden wall along Chalk Farm road boundary of the site which is to be retained and protected during the construction works.	May cause an obstruction to construction traffic.	3	3	9	Construction activities to be planned accordingly.	Contractor
Risks Associated with Site Clearance, Demolition and Excavation and Construction							
Ref	Risk	Consequence	Impact	Probability	Risk Indicator	Mitigation Measure	Action Owner
1.7	Working at height close to live Network Rail tracks adjacent to site.	Injury threat to site personnel. Disruptions due to emergency access to train tracks via the site by Network Rail staff.	4	2	8	Early engagement with Network Rail.	Design Team / Contractor /Client
1.8	Risk of damage to Roundhouse structure due to vibrations and excessive ground movements.	May result in post design freeze changes. Re-design of temporary works. Delays to construction programmes.	3	3	9	Movement monitoring strategy to be in place prior to start of works and shall be implemented by the contractor. Temporary works design to be reviewed and checked by a third party.	Design Team / Contractor /Client
1.9	Risk of damage to Thames Lee Tunnel due to excessive excavation over the tunnel protection zone.	Potential delays to construction works. Objections from Thames Water.	3	2	6	Extent of protection zones to be clearly displayed on site. Construction staff to be informed of the risk.	Design Team / Contractor
1.10	Risk of damage to public brick sewer beneath Chalk Farm Road, buried clean water mains, buried live services in the footpath of Chalk Farm Road.	May result in changes to the foundation design post design freeze. Delays to construction programme.	3	3	9	Contractor to accurately identify the locations of services by trial trenches where necessary.	Design Team / Contractor /Client
1.11	Risk of damage to London Underground Northern Line tunnel beneath Chalk Farm Road from impact/driven piing operations for temporary works, within 15m	Objections of LUL/TFL. Delays to construction programme.	3	3	9	Exclusion zones to be identified and displayed on site. Construction staff to be informed of the risk.	Design Team / Contractor /Client
1.12	Risk of damaging the retained portion of the historic Camden wall along Chalk Farm Road boundary of the site from construction operations and construction traffic.	Additional remedial works and possible delays in the construction programme.	3	3	9	Construction activities to be planned accordingly. Swept path analysis for construction vehicles to be carried out.	Contractor

1.13	Deep excavations for below ground structures (e.g., attenuation tanks, pipework, manholes, etc) and basement excavation. Encountering hazardous materials	Injury/illness to site staff.	3	2	6	Temporary works for excavation works to be designed to suit site conditions. Waste management plan to be in place and necessary test	Contractor
1.14	Site access to construction traffic.	Access to site is restricted to via Chalk Farm Road.	3	2	6	Construction works to be planned accordingly.	Contractor
1.15	UXO's- Risk of encountering unexploded bombs buried in the site.	Injury or death to site staff.	5	1	5	Contractor to carry out necessary surveys and scans to detect presence of unexploded bombs within the site prior to piling and deep excavations.	Contractor
1.15	Temporary stability of the structures during construction phase, including the public access staircase of the Roundhouse adjacent to northwest corner of the site.	Injury to site staff. Injury to public.	4	1	4	Contractor will have to assess the temporary stability of the buildings based on his specialist construction knowledge, site restrictions, access restrictions and intended construction sequence.	Contractor
1.16	Risk of exceeding noise, vibration, and dust due to construction activities above the limits imposed by Camden council.	Possible delays to site activities. Complaints for neighbours.	3	2	6	Contractor to ensure noise and dust levels to be maintained within Camden Council allowable limits. Dust control measures are to be adopted if required.	Contractor
1.17	Construction works within proximity to public footpath of Chalk Farm Road.	Injury to public footpath users.	4	2	8	Temporary hoarding and safety nets to be provided throughout construction phase.	Contractor
1.18	Transfer structures	There are a number of transfer structures in the structural engineering scheme, which need to be accounted for in the construction sequence. Transfer Beam/slabs being loaded before gaining full strength could result in the structure being overloaded.	3	1	3	Temporary works to be sequenced considering the transfer structures. Temporary works design to be reviewed by the Structural Engineer.	Contractor

The impact, probability and risk indicator numbers associated with each risk are determined by Table 12 - Risk Assessment Score. The risk indicator is the product of probability and impact, with a lower score being desirable.

Table 12 - Risk Assessment Score

		Impact				
		1 None	2 Minor	3 Moderate	4 Serious	5 Major
Probability	1 Very Low	1	2	3	4	5
	2 Low	2	4	6	8	10
	3 Medium	3	6	9	12	15
	4 High	4	8	12	16	20
	5 Very High	5	10	15	20	25