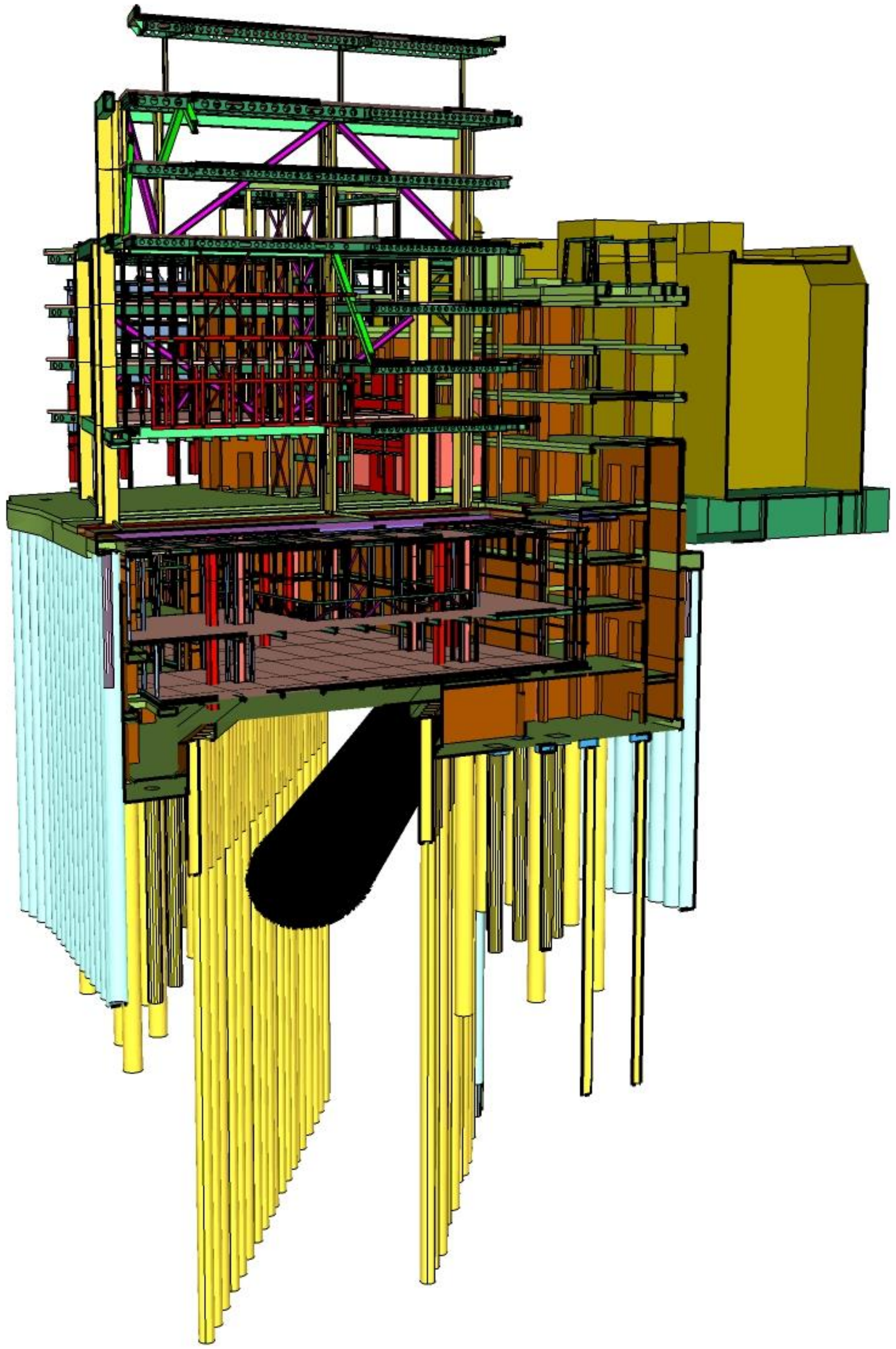

engenuiti

ST GILES CIRCUS

BASEMENT CONSTRUCTION PLAN ZONES 1 & 2

for

Consolidated Development Limited

18th October 2016

029-Z1-REP-011
Rev 01

Engenuiti
2 Maltings Place
Tower Bridge Road
London, SE1 3JB

BASEMENT CONSTRUCTION PLAN ZONES 1 & 2

CONTENTS

Revision History

Rev	Date	Purpose/Status	Document Ref.	Comments
00	26 July 2016	For Comment	029-Z1-REP-011	Issued for Arup Review
01	18 October 2016	For Approval	029-Z1-REP-011	Revised to incorporate comments from Arup Review. Changes shown in RED

Prepared by: **Clive Fussell**, Director

Reviewed & Approved by: **Paul Grimes**, Director

1 EXECUTIVE SUMMARY

1.1.1 This Basement Construction Plan report has been prepared by Engenuiti who has been appointed by Consolidated Developments Limited as the Basement Design Engineer in accordance with the requirements of CPG4 and the S106 conditions Claus 3.2.2.

1.1.2 This report has been prepared by Clive Fussell, Director at Engenuiti. It has been reviewed and Approved by Paul Grimes, Director at Engenuiti who is also named as the Basement Design Engineer. CVs are given in Appendix D14.

Clive Fussell, Director MEng (Oxon) MSt (Cantab) CEng MIStructE
Paul Grimes, Director BEng (Hons), MSt (Cantab), CEng MICE

1.1.3 The Basement Construction Plan has been formulated in accordance with the requirements of the S106 conditions 3.2.2 (a), (b) and (c) as described in the following:

Requirements for Basement Construction Plan given in S106 3.2.2	**How this has been addressed**
(a) that the design plans have been undertaken in strict accordance with the terms of this Agreement incorporating proper design and review input into the detailed design phase of the Development and ensuring that appropriately conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties have been incorporated into the final design taking into account the Basement Impact Assessment and intrusive Site Investigation Report submitted and approved under planning reference 2015/3072/P; and	The Basement Impact Assessment (BIA) and intrusive site investigation reports (Appendices S1 and S2) are the key documents in all assessments made by the Basement Design Engineer in relation to the design of all permanent and temporary works for the formation of the proposed basement. The structural condition of the Neighbouring Properties has been assessment by Engenuiti and reviewed by the Basement Design Engineer – (Appendices S4, S5 and S6). The Engenuiti design for the permanent basement works has been reviewed by the Basement Design Engineer and refined accordingly. Relevant Design documents are given in (Appendices D1 to D13). The temporary works and pile design calculations and sequencing prepared by the main contractor and specialist contractors are given in (Appendices C1 to C6). The Basement Design Engineer has reviewed the calculations and proposed sequences. The main contractor and specialist contractors have revised their calculations accordingly.
(b) that the result of these appropriately conservative figures ensure that that the Development will be undertaken without any impact on the structural integrity of the Neighbouring Properties beyond "Slight" with reference to the Burland Category of Damage; and	The Basement Design Engineer has made an assessment of the Neighbouring Properties and incorporated the design and temporary works conditions into an assessment of the impact of construction on the Neighbouring Properties that has been prepared by A-Squared Studio. The Basement Design Engineer has reviewed the damage assessment prepared by A-Squared Studio and can confirm that the assessment incorporates conservative modelling relating to the local ground conditions and local water environment and structural condition of properties. The damage assessment concludes that the impact on the structural integrity of the Neighbouring Properties is no worse than " Very Slight" with the majority of Neighbouring Properties experiencing "Negligable" damage according to the Burland Category. Refer to Appendix M2.
(c) that the Basement Design Engineer having confirmed that the design plans have been undertaken in strict accordance with this Agreement and includes a letter of professional certification confirming this and that the detailed measures set out in sub-clauses (i)-(vii) below have been incorporated correctly and appropriately and are sufficient in order to achieve the objectives of the Detailed Basement Construction Plan;	A letter of professional certification will be written by the Basement Design Engineer to accompany this report.
(c) (i) reasonable endeavours to access and prepare a detailed structural appraisal and conditions survey of all the Neighbouring Properties to be undertaken by an independent suitably qualified and experienced chartered surveyor (and for details to be offered if this is not undertaken in full or part);	This is addressed in Appendices S3, S4, S5 and S6. Appendix S3 is survey drawings of Neighbouring Buildings. Appendix S4 is a structural appraisal of the Neighbouring Buildings. Appendix S5 is trial pits to Neighbouring Buildings and Appendix S6 is condition survey reports prepared by an independent and suitably qualified chartered surveyor as part of the Party Wall award.

(c) (ii) a method statement detailing the proposed method of ensuring the safety and stability of Neighbouring Properties throughout the Construction Phase including temporary works sequence drawings and assumptions with appropriate monitoring control risk assessment contingency measures and any other methodologies associated with the basement and the basement temporary works;	The Construction Methodology is summarized in Sections 8 and 9. Construction sequences proposed by the Basement Design Engineer are given in Appendices D5 for Zone 1 and D12 for Zone 2. A construction methodology prepared by the main contractor is given in Appendix C1 for Zone 1 – this is in line with Engenuiti proposals. Temporary works drawings are given in Appendices D8 and C4. The Basement Design Engineer has reviewd the above information prepared by the main and specialist sub-contractors. The monitoring regime and methodology proposed by the Basement Design Engineer is given in Appendix M3 and baseline results are given in Appendix M4. Construction risk assessment and control measures are given in Appendix M5. The contingency plan in Appendix M7 highlights the actions to be taken if the monitoring shows that the movements are greater than the trigger levels. The amber trigger levels are set at the predicted movements. The requirements of Appendix M7 are included in the piling specification.
(c) (iii) detailed design drawings incorporating conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties prepared by the Basement Design Engineer for all elements of the groundworks and basement authorised by the Planning Permission together with specifications and supporting calculations for both the temporary and permanent basement construction works;	The following Appendices are given: Appendix D1 Engenuiti Design Philosophy & Criteria Report Appendix D2 Donaldson Geotechnical Interpretative Report Appendix D3 Engenuiti Piling Specification Appendix D4 Engenuiti Zone 1 Drawings & IFC Model Appendix D6 Engenuiti Zone 1 Load Take Down Appendix D7 Engenuiti Zone 1 Basement Permanent Works Calculations Appendix D8 Engenuiti Zone 1 Temporary Works Drawings Appendix D9 Engenuiti Zone 1 Temporary Works Vertical Loading Calculations Appendix D10 Engenuiti Zone 1 Horizontal Temporary Works Loads on Concrete Structure Appendix D11 Engenuiti Zone 2 Drawings Appendix D13 Engenuiti Zone 2 Basement Permanent Works Calculations Appendix C1 Skanska Construction Methodology Appendix C2 Cementation Pile Design Drawings Appendix C3 Cementation Pile Design Calculations Appendix C4 RKD Zone 1 Horizontal Temporary Works Drawings Appendix C5 RKD Zone 1 Horizontal Temporary Works Design Calculations The Basement Design Engineer has either prepared or reviewed the above documents to ensure that they incorporate conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties.
(c) (iv) the Basement Design Engineer to be retained at the Property throughout the Construction Phase to inspect approve and undertaking regular monitoring of both permanent and temporary basement construction works throughout their duration and to ensure compliance with the plans and drawings as approved by the building control body;	This is addressed in Section 9. The Basement Design Engineer shall act as an external independent reviewer of the monitoring reports. The Basement Design Engineer will maintain a specific role on site during basement construction and will have a representative based on site 2-3 days each week to monitor the construction process of the basement. They will feedback any concerns to the main contractor and employer so that all concerns are addressed.
(c) (v) measures to ensure the on-going maintenance and upkeep of the basement forming part of the Development and any and all associated drainage and/or ground water diversion measures order to maintain structural stability of the Property the Neighbouring Properties and the local water environment (surface and groundwater);	This is addressed in Section 9 and Appendices D5 and C1. Following construction there are no ongoing maintenance requirements for the basement.
(c) (vi) measures to ensure ground water monitoring equipment shall be installed prior to Implementation and retained with monitoring continuing during the Construction Phase and not to terminate monitoring until the issue of the Certificate of Practical Completion	All monitoring will continue until issue of the Certificate of Practical Completion. A series of three ground water monitoring wells have been specified in or adjacent to the Neighbouring Properties and will be installed prior to implementation.

(or other time agreed by the Council in writing); and,	
(c) (viii) a refined ground movement analysis/building damage assessment with all the construction activities analysed including specific details s that actual movements can be compared with predicted values during the construction process in order to minimise potential damage	This is given in Appendix M2 and has been reviewed by the Basement Design Engineer.
(c) (ix) detailed underpinning proposals for 28 Denmark Street and detailed proposals for the monitoring of ground movements on surrounding properties	This is given in Appendix D12 and D13. Proposals for the monitoring of ground movements are presented in Appendix M3.

2 INTRODUCTION

2.1 General

2.1.1 Engenuiti has been appointed by Consolidated Developments Limited to provide civil and structural engineering design services for the proposed St Giles Circus development.

2.1.2 The purpose of this Basement Construction Plan is to present the detailed information on the design and construction of the new basement at the development and demonstrate that the construction of the basement does not adversely affect the Neighbouring Properties or the water environment.

2.1.3 The full scope of the Basement Construction Plan is defined in section 3.2.3 of the Second Deed of Variation to the Section 106 document for the St Giles Circus Site. This defines the Neighbouring Properties "as 25, 27 and 28 Denmark St London WC2H; and the following demolished properties 54-59 St Giles High St London WC2H 8LH and 1-6 Denmark Place London WC2H only in the event these are replaced prior to the basement works being complete." Note that 59 St Giles High Street will not be demolished as part of the scheme.

2.1.4 The interface of the proposed basement with the adjacent LUL assets has been separately addressed. LUL Infrastructure Protection have reviewed the Conceptual Design Statement, associated Ground Movement Impact Assessment and Category III checks prepared for their assets and issued a Letter Of No Objection (LONO) for the permanent works, therefore the Basement Construction Plan does not repeat the assessments of the LUL assets.

2.1.5 Similarly, submissions have been made to Crossrail regarding the interface with the Eastbound Crossrail tunnel that passes under the site. These have been reviewed and agreed with Crossrail and are not repeated here. Both Crossrail and LUL have released the planning conditions relating to the site on the condition that the methodologies presented to them (which are the same as presented in the Basement Construction Plan) are followed.

2.1.6 This report has been produced for the exclusive use Consolidated Developments Limited and should not be used in whole or in part by any third parties without the express permission of Engenuiti in writing.

2.2 Proposed Development

2.2.1 The St Giles Circus project involves the redevelopment of this Central London site adjacent to Tottenham Court Road station and is bounded by Charing Cross Road, Andrew Borde Street (current location of D4 bus diversion), St Giles Circus and Denmark Street. The overall project also includes the refurbishment of some properties to the south of Denmark Street and the refurbishment of a property on Endell Street. The properties to the south of Denmark Street and at Endell Street are outside the scope of this Basement Construction Plan as they are not affected by the basement that is constructed adjacent to the Neighbouring Properties. Refer to figure 2.1 for a site plan. The development will include Retail, Hotel, Residential, Commercial and Leisure facilities.

2.2.2 The new build part of the site north of Denmark Street (incorporating the basement, buildings A, B, C and D) is referred to as Zone 1. Zone 2 comprises the existing buildings on the north side of Denmark Street (Nos 20 to 28 Denmark Street and No. 59 St Giles High Street). Refer to figure 2.2 for the location of the buildings within Zone 2.

2.2.3 The refurbishment of existing buildings to the south of Denmark Street (Nos 4, 6, 7, 9 and 10 Denmark Street, No 4 Flitcroft Street and No 1 Book Mews) are referred to as Zone 3 and are outside the scope of this Basement Construction Plan.

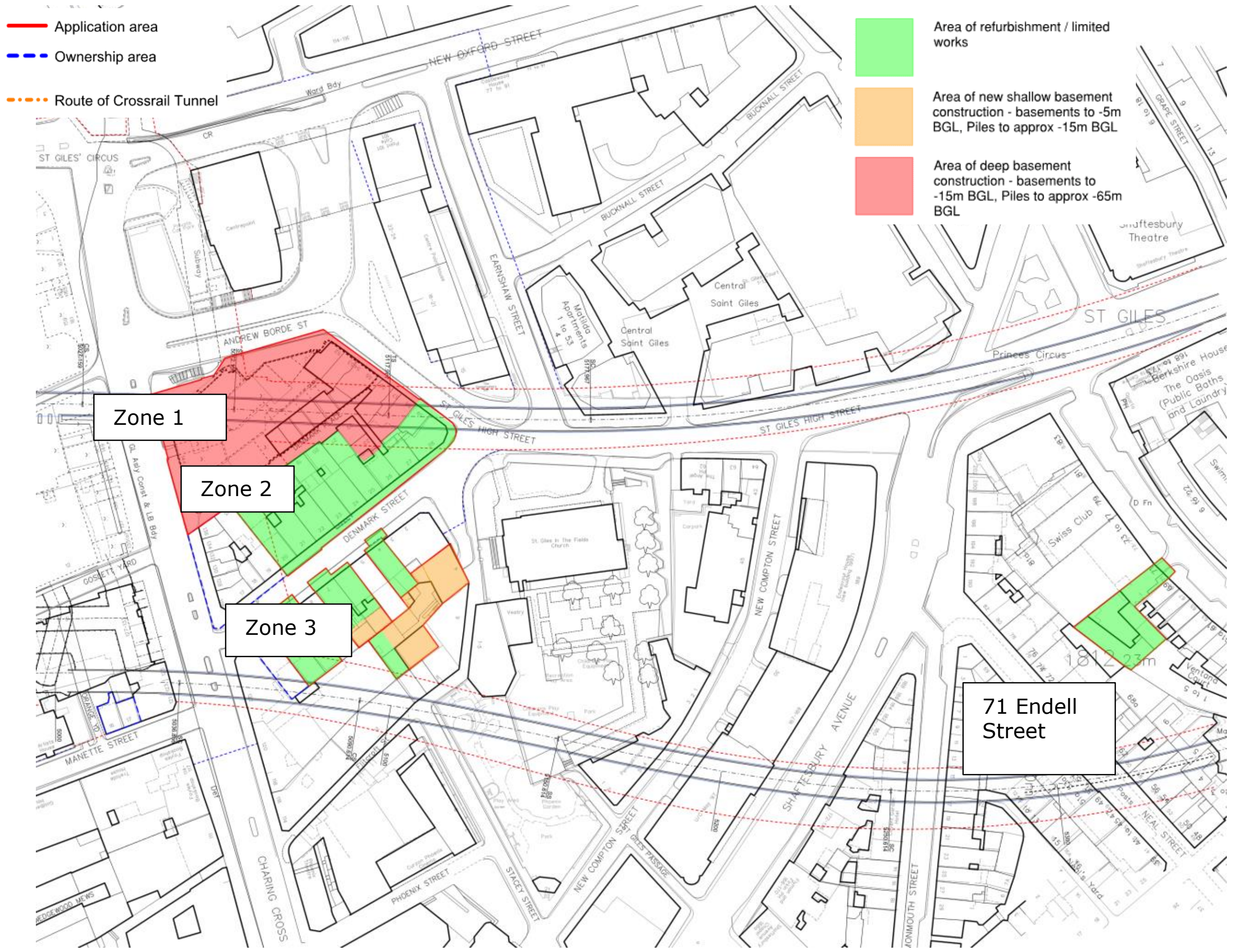

Figure 2.1: Site Plan

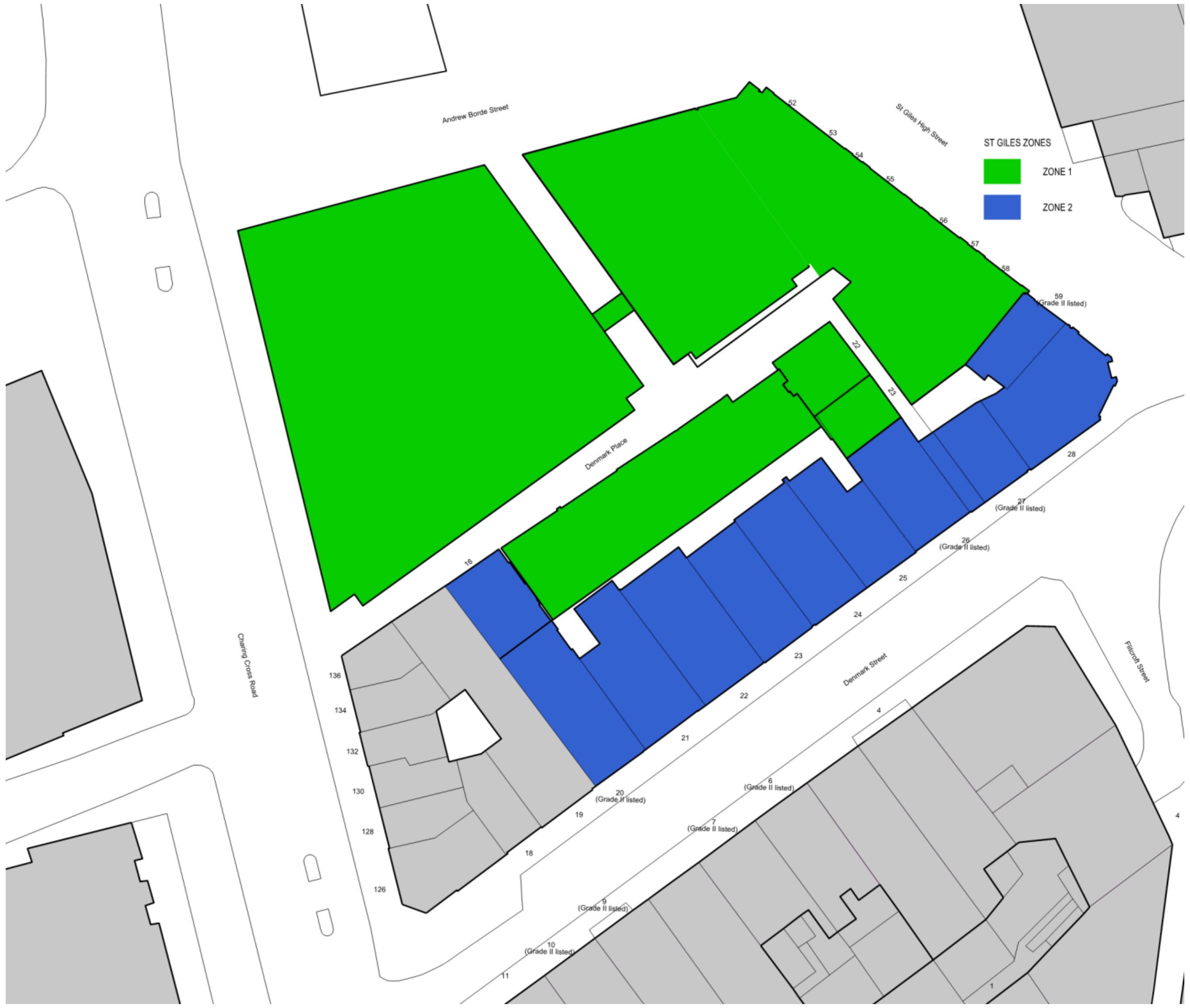

Figure 2.2: Adjacent buildings in Zone 2.

3 EXISTING SITE

3.1 Site Context

The site is located within the London Borough of Camden at National Grid Reference TQ 298 812. Zone 1 and 2 are bound to the west by the Charing Cross Road, to the south by Denmark Street and to the north and east by St Giles Street.

3.1.1 The site currently comprises several commercial buildings and an area of ground cleared for LUL's works at Tottenham Court Road station. Single level basements are present below a number of the properties that line Denmark Place, Denmark Street and St Giles High Street. The Northern and North-Western part of the site has been cleared of buildings to allow for the construction of the Northern Line Escalator Box.

3.1.2 Existing London Underground Northern Line station tunnels (Northbound and Southbound) are located immediately to the west of the site and lie in a north-south direction. The Southbound Northern Line tunnel is the nearer of the two to the proposed location of the piles. The recently constructed Eastbound Crossrail tunnel runs below the site from west to east.

3.2 Infrastructure Asset Summary

3.2.1 The following London Underground assets that form part of the Tottenham Court Road Station Upgrade interface with the St Giles Circus project:

- The new Escalator Box structure that provides improved access to the Northern Line.
- The new Northern Line Lower Concourse tunnel that connects the Escalator Box to the Northern Line Platform Tunnels.
- The Southbound and Northbound Northern Line tunnels and associated cross passages.

3.2.2 The following Crossrail assets interface with Zones 1 and 2 of the St Giles Circus project:

- The contract C300 Eastbound running tunnel approximately between chainage points 5050m and 5140m (see Appendix A, Crossrail drawings).

3.3 Site Handover

3.3.1 Part of the site was until recently occupied by London Underground (LUL) as part of the upgrade works at Tottenham Court Road that include the construction of a new escalator box and associated tunnels for access to the Northern Line beneath the Charing Cross Road frontage of the site. An Agreement is in place between the Secretary of State for Transport and the Project Sponsor that allows LUL to utilise the part of the site and divert Charing Cross Road across the site during the construction of the escalator box and new ticket hall at Tottenham Court Road station.

3.3.2 As part of this Agreement LUL installed 7 piles (known as the 'Consolidated Piles') which will support part of the new build element of the St Giles Circus project where it extends above the new escalator box. The Agreement also requires LUL, Crossrail and the Project Sponsor to proactively work together and share information regarding over-site development on the St Giles Circus site.

3.3.3 The scheme for Zones 1 and 2 of the St Giles Circus project involves the construction of four new buildings on the site (known as Buildings A, B, C and D), the refurbishment of the existing building stock on Denmark Street and the construction of a new basement below Buildings A, B, C and D. Refer to figure 3.1 for the extent of the basement.

3.3.4 The existing buildings that are adjacent to the south side of the site are considered in Section 5 of the report.

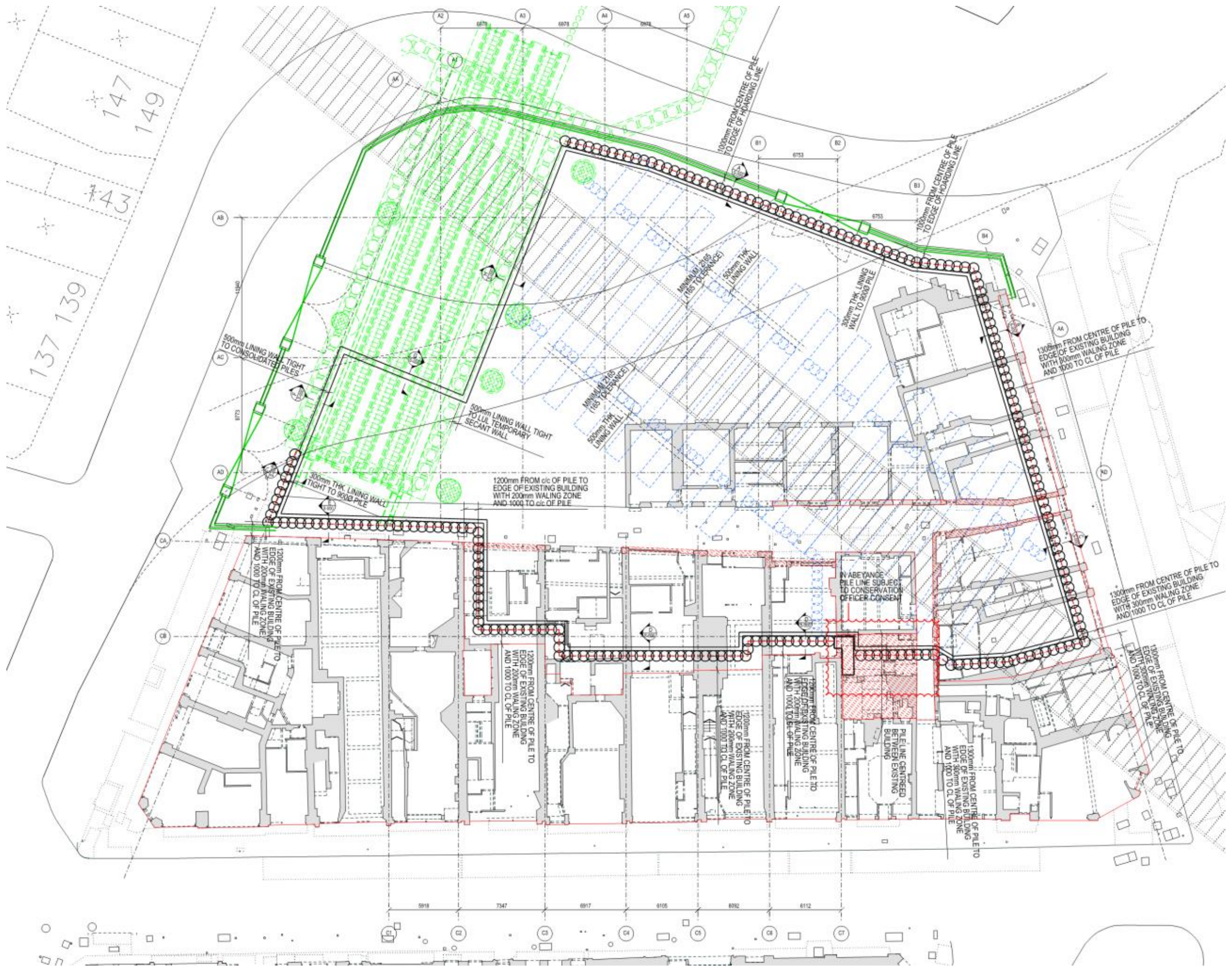

Figure 3.1: Extent of Basement

4 GROUND CONDITIONS

4.1 Site Investigation Reports

4.1.1 An initial site investigation has been carried out at the site by STATS Ltd on behalf of Consolidated Developments Ltd. The works were carried out during the period between 8th April and 16th May 2008.

4.1.2 The investigation included the sinking of two cable percussive boreholes (BH) to a depth of 7.6mbgl. BH101 was extended to 63.5mbgl by rotary coring and BH102 was extended to 54.0mbgl using open hole rotary drilling. Nine self-boring pressuremeter tests were carried out within BH102 and further in-situ and laboratory testing was conducted. Four piezometers were installed to depths of 15.0, 24.1, 35.05 and 55.0 metres below ground level (mbgl).

4.1.3 Full details of the Ground Investigation are presented within the STATS Factual Report on Ground Investigation (STATS, 2008), included in Appendix S2.

4.1.4 In order to begin preliminary analysis, additional ground investigation information was used from Crossrail boreholes to better define the stratigraphy and geotechnical parameters. These boreholes occasionally recorded a different stratigraphy within the Lambeth Group to that observed within the STATS boreholes. A further site investigation was undertaken by Concept Consulting between November 2014 and March 2015 to confirm the stratigraphy across the site, this did not significantly change the soil parameters (Appendix S1). Although the STATS investigation considered the laminated beds as a sand stratum, it is considered more conservative when considering the effects of excavation to consider the Laminated Beds as a clay stratum.

4.1.5 The investigations revealed the typical stratigraphy shown in table 4.1. Levels are given in metres above tunnel datum (mATD), which is metres above Ordnance datum plus 100m.

Stratum	Top Of Stratum Level (mATD)	Thickness (m)	Description
Made Ground	125.10	3.90	Clayey GRAVEL comprising brick rubble and ceramic fragments changing with depth to slightly sandy gravely CLAY.
Lynch Hill Gravel	121.20	2.10	Dense to very dense, slightly silty sandy fine to coarse angular to subrounded GRAVEL.
London Clay A3	119.10	13.60	Firm, becoming stiff and very stiff with depth, fissured locally thinly laminated CLAY. Weak mudstone bands present between 112.70 and 103.55mATD.
London Clay A2	105.50	10.90	
Upper Mottled Beds	94.60	10.80	Hard (locally very stiff) closely to extremely closely fissured locally thinly laminated multi-coloured (purple, grey, red brown, orange) CLAY with occasional thin beds to thick laminae of very silty fine sand.
Laminated Beds	83.80	4.20	Within the STATS boreholes the Laminated Beds were recorded as: very dense thinly interlaminated light grey and light brown slightly silty fine SAND. However, the information from the Crossrail boreholes suggests that this sand layer is not continuous across the area. Elsewhere the Laminated Beds are recorded as stiff thickly laminated dark grey black CLAY with laminae of light grey silt.
Lower Mottled Beds	79.60	1.50	Hard indistinctly fissured locally thinly to thickly laminated multi-coloured (mottled green grey, grey green, purple, red brown and orange brown) sandy CLAY with occasional fine sand pockets and partings to 5mm. Sand is fine.
Upnor Formation	78.10	1.80	Very dense thinly interbedded to thinly inter-laminated clayey dark grey mottled dark green fine SAND and light grey silty fine SAND (located on site) and very stiff indistinctly laminated dark greyish brown slightly sandy to sandy CLAY. Occasional partings of light grey silty fine sand, locally greenish grey. Rare rounded fine and medium dark flint gravel (located to the west of the site).
Thanet Sand	76.30	4.60	Very dense silty fine Sand. A 0.7m thick layer of flint cobbled present at the base interface (Bullhead Beds).
Chalk	71.70	Proven to 10.7	Weak to moderately weak, medium density structured Chalk.

Table 4.1: Typical stratigraphy for St Giles Circus site

4.1.6 Geotechnical parameters used for each stratum for the modelling are given in table 4.2. The London Clay and Lambeth Group strata, which are closest to the base of excavation and the Crossrail and LUL assets has been modelled using Hardening Small Strain models; table 8.1.2 presents the E_{50} stiffness (reference secant stiffness taken from drained triaxial testing) for these strata to provide an indication of the relative stiffness assumed.

Stratum	γ_{bulk} [kN/m^3]	c′ [kPa]	ϕ' [deg]	E′ [MPa]	E_{50} [MPa]	ν'	K_0
Made Ground	20	3	25	4	-	0.2	0.577
Lynch Hill Gravel	21	3	34	30	-	0.25	0.441
London Clay A3	20	5	25	-	20	0.2	1.2
London Clay A2	20	5	25	-	26.9	0.2	1.2
Upper Mottled Beds	20.6	5	25	-	38.9	0.2	1.2
Laminated Beds	21	5	25	-	38.9	0.2	1.2
Lower Mottled Beds	21	5	25	-	38.9	0.2	1.2
Upnor Formation	21	3	30	90	-	0.2	0.500
Thanet Sand	19	3	35	300	-	0.2	0.426

Table 4.2: Geotechnical parameters for modelling

4.1.7 Groundwater level is assumed to be at 121.0mATD; based on the results of the Concept Site Investigation and the worst case accidental ground water level identified in the 'Tottenham Court Road Station Upgrade Design Statement – Structures' received from London Underground.

4.1.8 Groundwater monitoring from the STATS and Concept Consulting investigations confirm that the London Clay and Lambeth Group (intermediate aquifer) in this area are currently under drained (i.e. porewater pressures reduce from hydrostatic) as is typical for central London; this is presented in figure 4.1. In the longer term it is expected that generally porewater pressures will increase within the intermediate aquifer towards hydrostatic, however some under drained profile is likely to remain due to pumping required to prevent water ingress to the tube network.

4.1.9 Prior to demolition of the existing buildings an asbestos refurbishment/demolition survey was undertaken and the asbestos discovered removed by an approved specialist contractor to a licenced waste facility.

4.1.10 The planning conditions require that an archaeological investigation is undertaken over part of the site prior to construction of the new basement. MOLA have been appointed to undertake this investigation during the demolition works.

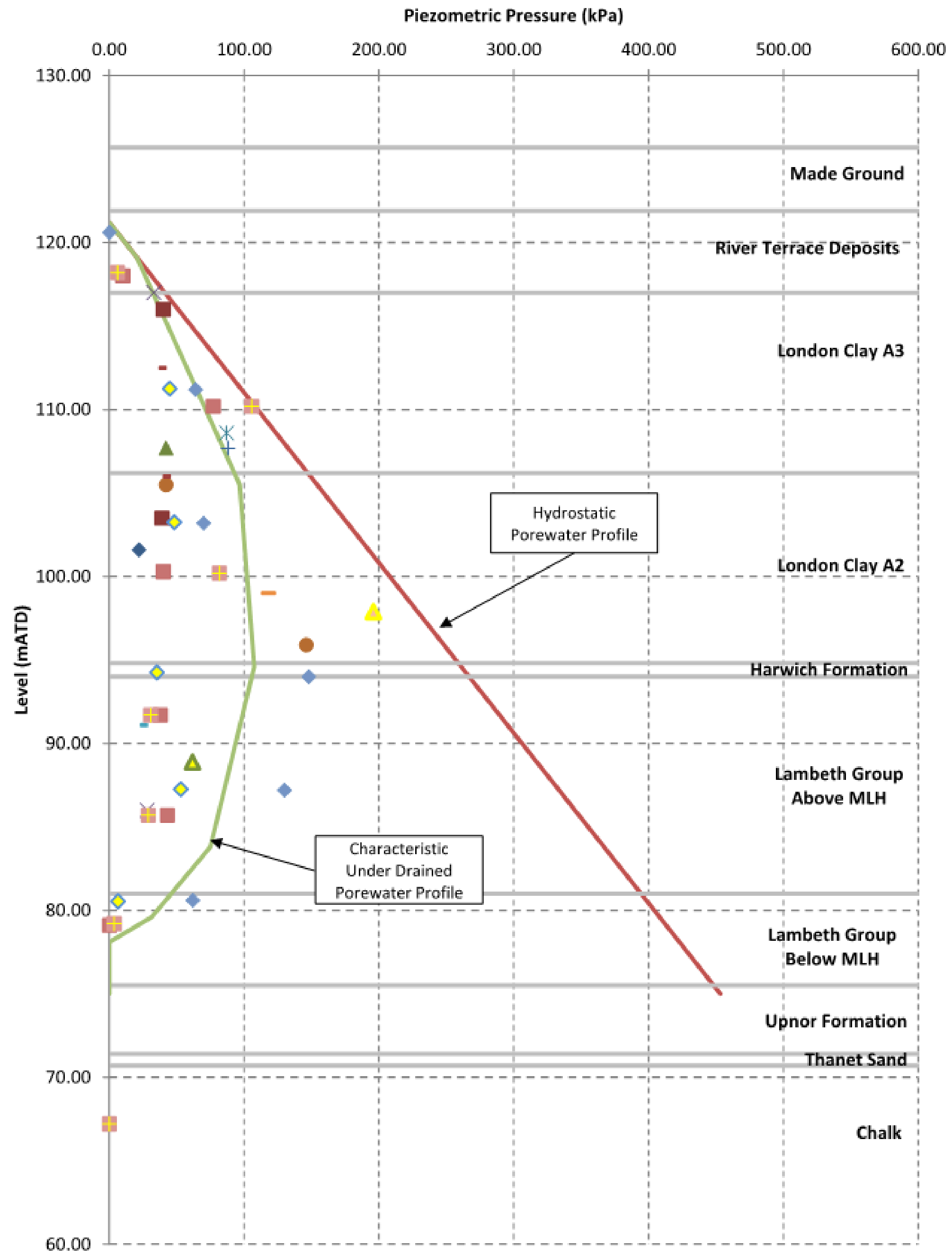

Figure 4.1: Characteristic Porewater Profile

4.2 Additional Site Investigation

4.2.1 An additional site investigation was required to confirm the stratigraphy and soil parameters across the remainder of the Zone 1 site, as access constraints meant that the original site investigation undertaken by STATS was only able to cover the western part of the site near the NLEB. Concept Consulting undertook additional boreholes PB1 and PB2 between November 2014 and March 2015.

4.2.2 The STATS investigation showed a sand channel within the Lambeth Group in one part of the site; the additional ground investigation undertaken by Concept Consulting has not identified this in either PB1 or PB2. The additional ground investigation also confirmed general strength and stiffness parameters across the site following laboratory testing to confirm specific soil parameters required for finite element analysis.

4.2.3 The location of boreholes PB1, and PB2 are shown in figure 4.2. The general position of the boreholes has been reviewed and agreed with the Crossrail and LUL teams.

4.2.4 The depth and drilling technique for the three boreholes are summarised in table 4.3.

Boreholes	Depth [m]	Drilling technique
PB1	55.00	Cable percussive from ground level to the London Clay and rotary coring thereafter
PB2	55.00	Cable percussive from ground level to the London Clay and rotary coring thereafter

Table 4.3: Zone 1 boreholes for additional site investigation

4.2.5 The stratigraphy of the London Clay and Lambeth Group are of particular importance to the project. The Lambeth Group was logged using the most up-to-date nomenclature (see for example Page and Skipper, 2000 and Hight et al., 2004).

4.2.6 The following field testing and sampling was undertaken on PB1 and PB2.

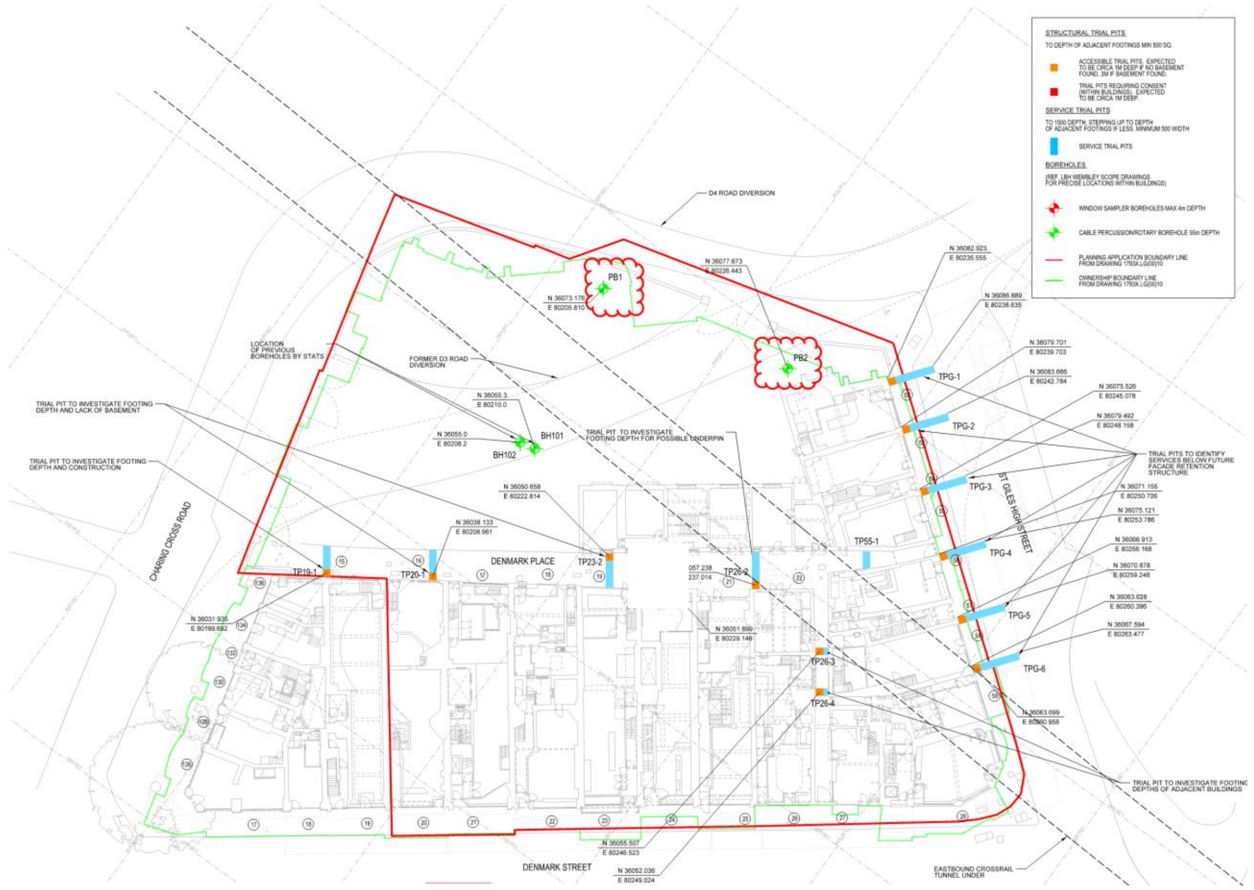

Figure 4.2: Zone 1 Additional Site Investigation (PB01, and PB02).

- Ground level to 4.4mbgl: Small and bulk disturbed samples shall be taken at every change in strata. In addition SPT tests should be conducted every metre starting 0.5m below inspection pit.

- 4.4mbgl to London clay: SPT test at 1.0m intervals. Small disturbed samples at every change in strata.

- Below London clay: Alternate U100 / OS-TK/W samples and SPT tests at 1.5m intervals. Small disturbed samples at every change in strata.

- Size of U100 to be a minimum of 100mm diameter. Size of undisturbed samples to be a minimum of 76mm diameter.

4.2.7 In addition, 9 No. self-bored pressuremeter tests (SBPM) were conducted in PB01.

4.2.8 The following laboratory testing were conducted on PB1 and PB2:

- Atterberg limits
- Moisture content.
- Particle size distribution (PSD)
- Oedometer and swelling test
- Unconsolidated Undrained triaxial test (UU)
- Consolidated Undrained triaxial test (CU)
- Stress path triaxial test
- Chemical testing (in accordance with BRE Special Digest 1:2005, Appendix C1)
- Waste Acceptance Criteria (WAC) testing

4.2.9 A multiple level vibrating wire piezometer was installed within PB01 to monitor the groundwater level within the superficial deposits. As PB1 and PB2 are within the footprint of the basement construction, they will be destroyed by the construction works. Three additional ground water monitoring wells have been specified and will be installed in or adjacent to the Neighbouring Properties prior to Implementation so that ground water monitoring can be maintained throughout the construction period and monitored to assess the impact of construction on the Neighbouring Properties. The position of these wells is shown on 029-Z1-SK213 Rev01 in Appendix M3

4.2.10 The results of the Concept Consulting site investigation are presented in Appendix S1.

5 EXISTING BUILDINGS AROUND SITE

5.1 No. 20 Denmark Street / 16 Denmark Place

Introduction

5.1.1 No. 20 is a four storey masonry building that the Camden listed building register dates from 1686 to 1689. The building is currently used as retail at ground and lower ground floor, with offices at 1st to 3rd floor level.

5.1.2 The building is joined through back to back with the property at 16 Denmark Place, a 19th Century workshop building. A small lightwell separates the structures above first floor level.

5.1.3 Stability of the building is assumed to be provided by the flank walls and front, back and walls to the stairs. It has been noted that there is a missing spine wall at lower ground and ground floor levels, indicating that the structure is likely to have two soft stories. It is also possible that the building does now derive a degree of lateral stability from the adjacent terrace building at number 21.

5.1.4 This building is planned to be fully refurbished, however the use of the building is not intended to change and no significant internal structural works are envisaged.

5.1.5 To ensure that the stability of the building is maintained throughout work to adjacent terraces, the new frame structure in No. 21 has been designed to accommodate the lateral stability load from No. 20. The new frame in No.21 will therefore be packed against the existing walls to ensure that lateral loads acting in the north east direction can be transferred into the new frame.

Existing Structure / Condition

5.1.6 The front wall is of masonry construction with 3 openings per floor. At the rear a later extension for toilets/bathrooms has been connected to the half landing and a single wider window is provided to the rear room. The rear extension for toilets/bathrooms is generally in a poor condition, with cracking to the base and walls.

5.1.7 The party walls are of masonry construction with two chimney breasts on the party wall to No. 21 that extend the full height of the building.

5.1.8 A partial inspection of the floor plates has been undertaken, at third floor the floor boards were observed to run perpendicular to the front facade in both the front and rear rooms, indicating that the joists span parallel to the front facade. At second floor the floor boards in the rear room run the same way, however the floor boards in the front room run parallel to the front facade. This could indicate that the floor boards are finishes applied to a lower floor structure below.

Figure 5.1: Location of No 20 Denmark Street / 16 Denmark Place

5.1.9 Internal load bearing stud walls surround and support the stair structure and also pick up the floors to the rear rooms.

5.1.10 The original masonry front facade has been removed at ground floor level, together with the internal stud wall that separates the front and rear rooms to create a shop. Although no cracking evident to the main structure, there is evidence of cracking in the adjoining bathroom extension.

5.1.11 At lower ground floor level the wall around the stairs is constructed from masonry and a steel frame with column supports the ground floor along the approximate line of the dividing wall between the front and rear rooms.

5.1.12 At the rear of the building there is a two storey masonry building (known as 16 Denmark Place) which is accessed from No. 20. The building has a suspended timber first floor and a timber framed roof with roof light.

5.1.13 The floor structures observed at second and third floor were level and felt solid. Internally some movement had occurred to the internal stud wall, particularly between the stair wall and the rear masonry wall. The rear masonry wall has experienced previous movement, particularly around the larger window openings which have moved considerably. Although no recent cracking is evident any alterations to the windows could adversely affect the masonry around the window. Water ingress was observed to the rear wall at third floor.

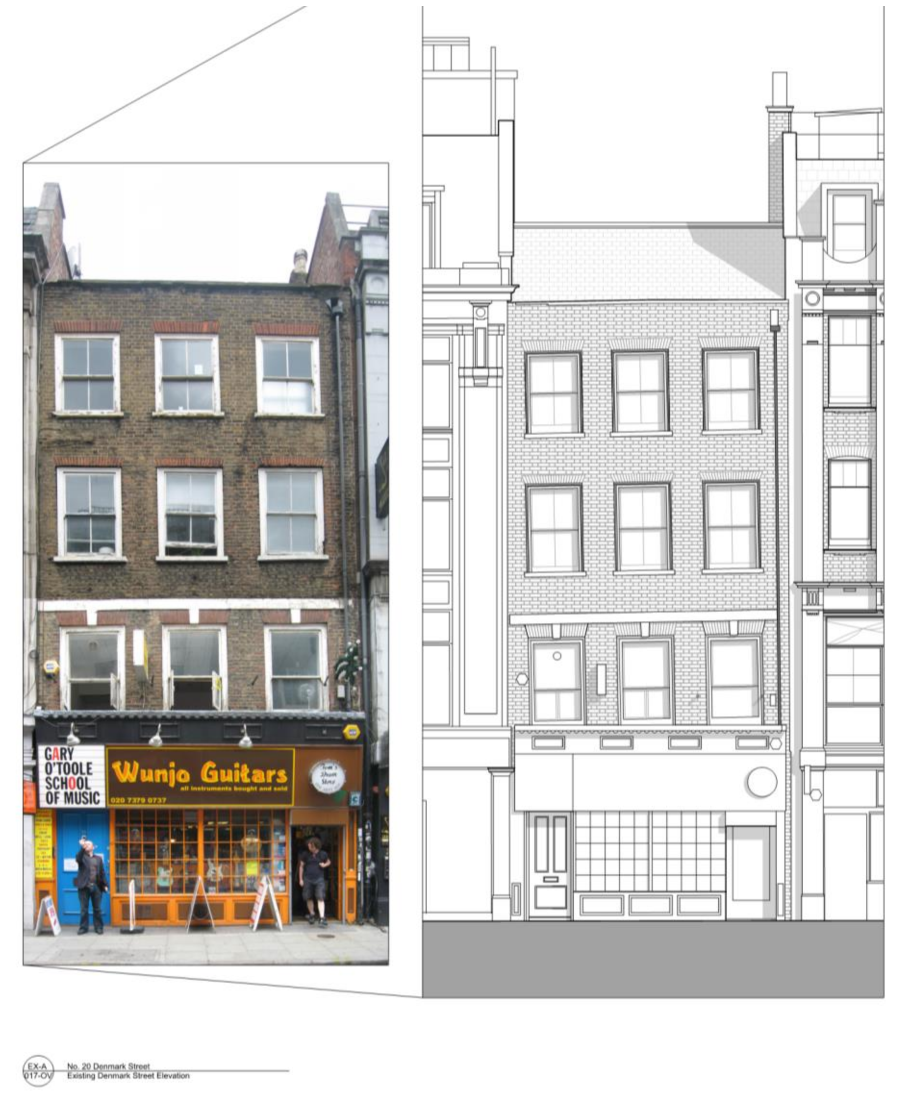

Figure 5.2: Front Elevation

5.2 No. 21 Denmark Street

Introduction

5.2.1 No. 21 Denmark Street is believed to be one of a number of buildings built on Denmark Street in the 1920's by builder/developer Walter J Fryer. The building was until recently in retail use at lower ground and ground floor levels, with office use from first to fourth floor level.

5.2.2 The rear of the building formerly extended to Denmark Place across an internal light-well. The rear of the building up to the inside edge of the lightwell has been demolished. Part of the area will become incorporated into building C in Zone 1, and the remaining portion of the building will be rebuilt without the lightwell and incorporated into the existing structure.

5.2.3 The first floor level as well as the ground floor shop front and rear of the building is intended to be opened up to provide access through the building to Zone 1 behind. The first floor level will be completely removed. At second floor level the office use will be retained and the floor plate linked through to Zone 1 Building C to the rear as well as sideways to 22 Denmark Street by way of a new doorway. At third and fourth floor level the building will be converted to residential use. At roof level, PV's are provided to the rear of the property and an accessible balcony for the residential apartments to the front. In order to maintain stability of No. 21 and the adjacent buildings a new steel moment frame will be inserted between ground and second floor prior to the existing first floor and internal structures being removed.

Figure 5.3: Location of No 21 Denmark Street

Figure 5.4 Front Elevation of No 21 Denmark Street

Existing Structure / Condition

5.2.4 The existing building is formed of masonry walls, steel beams with concrete filler joist floors spanning between the beams. The filler joist slab is approximately 180-200mm thick with a 30 mm lightweight screed zone over, that appears to be a "Magnesite" floor of wood flour and cement.

5.2.5 Generally, the Steel "filler joists" were measured as 44-63mm wide, 100-125mm deep at 660-770mm ctc, increasing to 880mm in the rear area (to be demolished). Samples taken from the Magnesite floor have been tested for asbestos and found to be negative.

5.2.6 If the full 1.0kPa super imposed deadload allowance is to be utilised entirely for new finishes and architectural build-ups, the magnesite screed (along with any cement render to ceilings) must be removed.

5.2.7 Main steel beams were measured at 457mm deep with steel angles fixed to the web to support the filler joists. Walls were observed to be masonry. Wall thickness is thought to be 215mm to the Party Walls. Alcoves have been created within the wall lines to allow a 105mm recess by means of a 230mm steel beam encased in concrete within the wall as a lintel.

5.2.8 The roof construction was opened up and proven to be a similar filler joist construction to the floors, with an increased 100mm screed zone above the filler joists, and a thin hessian bed before a 20mm tar/bitumous waterproofing layer.

5.2.9 The general condition of the building was good. Local corrosion of the steelwork within the floor was noticeable adjacent to water sources and in the front corners of the building. Cracking of the pararpets between properties was also evident and visible within the buildings. The front floor light beneath the pavement shows signs of heavy corrosion and will need to be replaced with a new concrete slab to ensure it is fully trafficable.

Figure 5.5: Location of No 22 Denmark Street

5.3 No. 22 Denmark Street

Introduction

5.3.1 No. 22 Denmark Street is believed to date to the 1890-1900 period. The building is currently in retail use at lower ground and ground floor levels, with office use from first to third floor level. The rear of the building formerly extended to No.18 Denmark Place across an internal light-well.

5.3.2 The building to the rear of the light-well has been demolished and the area will form part of the Zone 1 scheme. A new concrete framed stair and lift core will be constructed in No 22, supported on mini pile foundations at lower ground floor level. This will provide stability to No 22 and the adjacent buildings.

5.3.3 At second floor level the office use will be retained and the floor plate linked through to the Zone 1 Building C to the rear as well as sideways to 21 and 23 Denmark Street by way of a new doorways through the party wall. At third and fourth floor level the building will be converted to residential use.

Figure 5.6: Front Elevation of No 22 Denmark Street

Existing Structure / Condition

5.3.4 A partial visual and intrusive investigation of the structure has been carried out at this time. Access to the basement, ground and second floors was limited by tenants. The front wall is of masonry construction with 4 openings per floor. At 4th floor level a front dormer has been added to the roof level.

5.3.5 The party walls are of masonry construction with two chimney breasts on the party wall to No. 23 that extend the full height of the building. The existing building is of masonry construction with timber joist floors on steel beams. At ground to third floor level the front room is believed to be subdivided by a beam running from the front façade to a steel beam that spans between Party Walls on the former spine wall line. A masonry pier is evident at each end of the beam At second floor this has not been directly observed due to lack of access.

5.3.6 At fourth floor level the floor joists span front-back to the spine beam between Party Walls. At roof level timber flitch beams are used to support the flat roof, spanning between piers built in to Party Walls. The roof is of timber joisted construction (150x50 at 350 ctc recorded)with boards over and a 20mm tar/bitumous layer. The general condition of the building was good. Local corrosion of the steelwork within the floor was noticeable adjacent to water sources. The front façade shows signs of sever corrosion and weathering especially to cills and copings.

Figure 5.7: Location of No 23 Denmark Street

5.4 No. 23 Denmark Street

Introduction

5.4.1 No. 23 Denmark Street is believed to be one of a number of buildings built on Denmark Street in the 1920's by builder/developer Walter J Fryer. The building is currently retail use at lower ground and ground floor levels, with office use from first to fourth floor level. The rear of the building formerly extended to Denmark Place across an internal light-well.

5.4.2 The building to the rear of the light-well has been demolished and the area will form part of the Zone 1 scheme. The first floor level is intended to be directly connected by separate internal stair to the retail unit below to create additional retail space.

5.4.3 At second floor level the office use will be retained and the floor plate linked through to Zone 1 Building C to the rear as well as sideways to 22 and 24 Denmark Street by way of a new doorways through the party wall. At third and fourth floor level the building will be converted to residential use.

Figure 5.8: Front Elevation of No 23 Denmark Street

Existing Structure / Condition

5.4.4 The existing building is load bearing masonry with a concrete filler joist floor between steel beams. The direction of filler joists vary throughout the building. Filler joists span on to an angle bolted to the flange of the steel beams. Loads are spread within the masonry walls by small spreader steels – typically 660 wide. There is one column within the building, to the front adjacent to no. 22 Denmark Street.

5.4.5 Stairs through the building appear to be cast in situ reinforced concrete off similar floor support steelwork. Main steel beams to the basement were measured at 470mm deep. Walls were observed to be masonry. At first floor level a plate girder transfers the masonry wall above to the Party Walls allowing the full width of the building to be open in the shop below.

5.4.6 The roof is of similar filler joist and concrete construction with 110mm of concrete above the filler joists and a 20mm tar/bitumous waterproofing layer over. The general condition of the building was good. Local corrosion of the steelwork within the floor was noticeable adjacent to water sources.

5.4.7 As with 21 DMS, if the full 1.0kPa super imposed deadload allowance is to be utilised entirely for new finishes and architectural build-ups, any magnesite screed (along with any cement render to ceilings) must be removed.

Figure 5.9: Location of No 24 Denmark Street

5.5 No. 24 Denmark Street

Introduction

5.5.1 No. 24 Denmark Street is believed to be one of a number of buildings built on Denmark Street in the 1920's by builder/developer Walter J Fryer. The building is currently retail use at lower ground and ground floor levels, with office use from first to fourth floor level.

5.5.2 The rear of the building formerly extended to Denmark Place across an internal light-well. The building to the rear of the light-well has been demolished and the area will form part of the Zone 1 scheme. The first floor level is intended to be directly connected by separate internal stair to the retail unit below to creating additional retail space.

5.5.3 At second floor level the office use will be retained and the floor plate linked through to Zone 1 Building C to the rear as well as sideways to 23 and 25 Denmark Street by way of a new doorways. At third and fourth floor level the building will be converted to residential use.

Figure 5.10: Front Elevation of No 24 Denmark Street

Existing Structure / Condition

5.5.4 The existing building is of load bearing masonry construction with concrete hollowpot floor slabs spanning between steels embedded within the slab. The hollow pots are typically "3 pots high" with the reinforced ribs between. Main beams span between Party Walls and are embedded within the slab depths. Walls were observed to be masonry.

5.5.5 Floors have a similar 30mm Magnesite floor a screed covering to the other 1920's buildings. The roof construction was opened up and shown to be similar hollow pot construction with 90 mm of concrete above the hollow pots with a 20mm tar/bitumous waterproofing layer over. The general condition of the building was good. Local corrosion of the steelwork within the floor was noticeable adjacent to water sources.

5.5.6 Significant damp was evident adjacent to the front parapet. Externally it was noted that the side wall parapets were also cracked and had open perpends and loose coping stones. As with 21 & 23 DMS, if the full 1.0kPa super imposed deadload allowance is to be utilised entirely for new finishes and architectural build-ups, any magnesite screed (along with any cement render to ceilings) must be removed.

Figure 5.11 Location of No 25 Denmark Street

5.6 No. 25 Denmark Street

Introduction

5.6.1 No. 25 Denmark Street is believed to be one of a number of buildings built on Denmark Street in the 1920's by builder/developer Walter J Fryer. The building is currently retail use at lower ground and ground floor levels, with office use from first to fourth floor level.

5.6.2 The rear of the building formerly extended to Denmark Place across an internal light-well. The building to the rear of the light-well has been demolished and the area will form part of the Zone 1 scheme. The first floor level is intended to be directly connected by separate internal stair to the retail unit below to creating additional retail space.

5.6.3 At second floor level the office use will be retained and the floor plate linked through to Zone 1 Building C to the rear as well as sideways to 24 Denmark Street by way of a new doorway. At third and fourth floor level the building will be converted to residential use.

Figure 5.12: Front Elevation of No 25 Denmark Street

Existing Structure / Condition

5.6.4 The existing building has steel beams supporting reinforced concrete and hollow pot floors. The main steel beams appear to bear directly in to the Party Walls via a small steel spreader section. Beneath the Third Floor slab, there are additional steels that have been added at a later date to reduce the spans of the hollowpot floors.

5.6.5 Walls were observed to be masonry built tight around steelwork. Floors have a similar 30mm Magnesite floor a screed covering to the other 1920's buildings. The roof was opened up and 110mm of concrete measured above the Primary steel line. 20mm of bitumous / tar was found as the waterproofing to the slab.

5.6.6 The general condition of the building was good. Areas to the internal lightwell showed signs of damp that will have to be addressed. As with 21, 23 & 24 DMS, if the full 1.0kPa super imposed deadload allowance is to be utilised entirely for new finishes and architectural build-ups, the magnesite screed (along with any cement render to ceilings) must be removed.

Figure 5.13: Location of No 26 Denmark Street

5.7 No. 26 Denmark Street / 22 & 23 Denmark Place

Introduction

5.7.1 No. 26 is a three storey masonry building with mansard that the Camden listed building register dates from the early 18th Century, although other surveys suggest may date to the late 17th century. The building is currently divided into flats on the upper floors with a bar occupying the ground floor and lower ground.

5.7.2 No.23 Denmark Place immediately abutted No.26 Denmark Street and 22 Denmark Place and was built through to both at ground floor level. The building is thought to be a Victorian warehouse building and has been demolished as part of the enabling works package.

5.7.3 The building at no.23 was used as bar space at ground floor level, toilets at first and office at second as part of the ground floor bar use. No. 22 Denmark Place or "The Smithy" or "Forge" is a single story masonry building thought to date to the early 18th century. It includes a small mezzanine area built into the roof rafters, and there is also an existing vault beneath the portion of the building facing Denmark Place.

Figure 5.14: Front Elevation

5.7.4 The building was used as part of the bar at the ground floor of 26 Denmark Place and 23 Denmark Place. In order to facilitate the construction of the proposed basement under No. 22 Denmark Place the building will be supported on a new concrete raft slab and lifted out of the way of the piling works. Specialist contractor Abbey Pynford have been engaged to undertake the lift. Once the piling works are complete the building will be returned to its original position and supported by the new piled basement construction.

5.7.5 A new building will be constructed at 23 Denmark Place which will tie into the existing lower ground floor levels at 25 and 26 Denmark Street. The existing building at 26 Denmark Street will be repaired and refurbished.

Existing Structure / Condition

26 Denmark Street

5.7.6 The front facade of No. 26 Denmark Street is of masonry construction with three windows at each floor. The original masonry structure at ground floor has been removed to form the facade to the bar.

5.7.7 At the rear of the building there is a three storey masonry extension that houses bathrooms for the flats. The party walls are of masonry construction, with the wall to No. 27 in the front room retaining a chimney breast. The internal wall around the staircase appears to be of timber stud construction, however immediately behind this there is a masonry chimney stack that runs the full height of the building which served the rear room.

5.7.8 At lower ground floor level the walls around the stairs are masonry. There is a vault that extends under Denmark Street, although this is not shown on the survey drawings. The third floor is housed within a timber mansard roof which has a valley gutter that runs parallel to the front facade. The valley is supported on the internal stud wall that separates the front and rear rooms and extends from ground floor to roof level with a masonry wall at lower ground floor level.

5.7.9 The condition of the listed building at 26 Denmark Street has been identified as a cause for concern and the building has been placed on the English Heritage at risk register of listed buildings. It is apparent that the structure has experienced significant differential settlement and that the on-going cracking within the building was reported by the facilities manager in 2012. Movement monitoring has been installed in this area and since May 2014 there has been little sign of further movement.

5.7.10 The external masonry walls of the 18th Century house have experienced considerable movement with the front facade having settled considerably on the side adjacent to No. 27. This has resulted in some cracking around the windows as was observed in the second floor flat. Internally the spandrel panels have visibly moved and large cracks are evident.

5.7.11 Although the finishes in this room are relatively recent, the movement would appear to have been on-going over a significant period of time as the window frames have been eased considerably to accommodate movement in the masonry.

5.7.12 Similar cracking was observed in the rear masonry wall around the stairs with the cracks consistent with settlement on the side adjacent to No 27. A shear crack is visible on the rear façade adjacent to the No. 25 Party wall showing cracking directly through brickwork. Significant settlement of the internal wall around the stairs was also noted which has resulted in a significant fall across the landings and half landings between the party wall and the internal wall.

5.7.13 In order to arrest further movement and allow the construction of the proposed lower ground floor on the site of 23 Denmark Place, it is proposed to underpin the rear wall of No 26 Denmark Street. Trial pits have confirmed that this rear wall has shallower foundations than the other walls (including the chimney) in No 26, therefore underpinning is proposed to increase the bearing capacity and width of the existing footing.

5.7.14 The internal spine wall has been resupported above the bar below, however the capacity and size of this structure is not considered to be adequate and a series of temporary props have been installed following the soft strip. The internal stud wall shows signs of extreme distortion generally, with additional rot visable at the top floor level beneath the roof.

5.7.15 The building settlement appears to be the result of more significant foundation settlement on the No. 27 side of the site compared to the No.25 side of the site. It is further noted that the passageway between 26 and 27 has experienced more movement at the Denmark Street end.

5.7.16 Where the masonry side wall to the adjacent alley joins with 23 Denmark Place a large crack is visible for the height of the building indicating differential movement. There are a number of possible causes for the differential settlement, these include:

5.7.17 Different foundation depths between the more recent construction of No. 25 and the 17th century construction of No 26 (as confirmed by trial pitting), resulting in differential settlements. Possible compaction of wall structures (internally and in the passageway) due to rotting timber or other decay. Possible loss of fines in the Terrace Gravel formations as a result of leaking drains. Movement monitoring of the Denmark Street façade installed in February 2015 has shown no significant further movement.

5.7.18 Internally the suspended floor structures have sagged considerably and have been re-levelled by building up the finishes. The second floor is springy when walked upon. Floors span front-back to the central spine wall. Joists appear original, many of rounded timber.

5.7.19 The floor to the toilet extention at the rear is heavily rotten and shows signs of previous repair to the timber ends. At roof level the movement has resulted in the gable on the No. 27 side leaning over to the extent that its stability is a cause for concern. The gable has been propped by means of a scaffold built on the roof of No. 27 Denmark Street.

5.7.20 The valley gutter has an internal downpipe that is prone to blocking and is of inadequate size. The condition of the mansard roof is generally poor with missing flashings.

23 Denmark Place

5.7.21 23 Denmark Place is 3 storey masonry and timber floored building, thought to be Victorian and built as a warehouse building. The building directly abuts both No. 26 Denmark Street to the front and the "smithy" at No. 22 Denmark Place behind. The building shows considerable signs of movement and cracking.

5.7.22 At the junction between No. 26 Denmark Street and 23 Denmark Place a crack runs from ground for the full height of the building indicating that the building as settled towards the North. As the Eastbound Crossrail tunnel runs north of this structure it seems likely that this has been recently exacerbated however the crack is historic.

5.7.23 At first floor the metal framed window shows signs of the building spreading with cracking on the East Elevation. The spandrel panel below the window is extensively cracked and shows signs of distortion. The steel lintel below this is heavily corroded.

5.7.24 On the North Elevation the window at first floor has been infilled with blockwork on account of the spreading of the brick arch lintels.

5.7.25 At second floor level, the significantly cracked masonry gable appears to be fully supported by the window frame. There are signs of masonry distortion and cracks to the returns of the gable indicating the façade is moving outwards. In order to protect members of the public a scaffold has been installed immediately below the gable end.

5.7.26 At high level on the North façade there is evidence of the facades separating and cracks opening up. Internally the same cracks are visible at the returns of walls on both east and west sides. On the North side at ground floor level a steel beam has previously been inserted beneath an arch. The arch has not been supported off the beam. Subsequently, the arch shows signs of failure, cracks at hinge points and rotation at the springing point being evident. The demolition of 23 Denmark Place allows the structural separation of the listed building at 26 Denmark Street from the Smithy at 22 Denmark Place, preventing relative movement between the piled basement supported 22 Denmark Place and the spread footing supported 26 Denmark Street causing further damage to either building.

22 Denmark Place

5.7.27 To the North there is a single storey building known as the "Smithy" or "Forge". The building was once used as a smithy but was incorporated as part of the bar use. The building is of masonry construction with a timber roof structure. Internally, the original chimney place is still in position. A later mezzanine has been added to the space.

5.7.28 The roof of the structure that has been historically modified is not strapped to the adjacent walls and has rotated. Internally the roof shows signs that it has been significantly repaired and joists replaced as well as modern insulation being packed between rafters.

5.7.29 Approximately 1/3 of the floor area of the Smithy is underlain by a masonry arch vault. The vaults appear to have been extensively rebuilt. Part of the floor is modern joists built off joist hangers.

5.7.30 A historic photograph shows the original use of the Smithy. Prior to lifting extensive repairs to the masonry wall of the Smithy will be made.

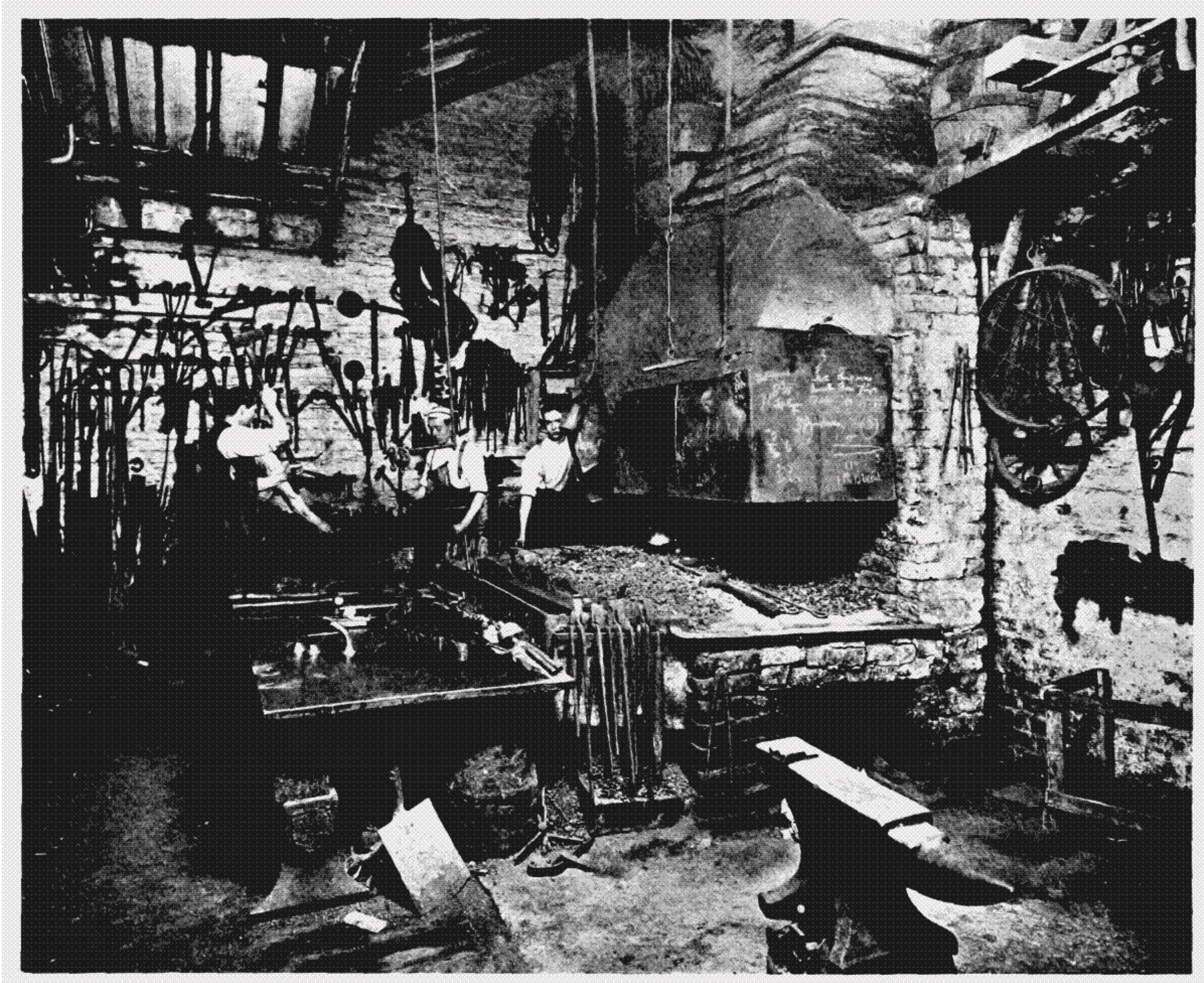

Figure 5.15: Historic Photo of Smithy

5.8 No 27 Denmark Street

Introduction

5.8.1 No.27 is a four storey building which the Camden listed building register dates from the late 17th Century. Part of the building extends over the ginnel between No's 26 and 27.

5.8.2 At ground floor level the front facade has been replaced to form a music shop, above this there is masonry facade with three windows. At third floor level steel ties restrain the masonry wall back to the floor structure. A small rear extension off the half landing houses toilets there are two further windows to the rear of the property.

Figure 5.16: Location of No 27 Denmark Street

5.8.3 The floors are of timber construction with the floor boards at third floor level running perpendicular to the front facade, indicating that the joists would span parallel to the front facade. A large chimney breast is located in the centre of the floor at first, second and third floor levels.

5.8.4 At ground floor level this is located in the wall to the ginnel and is considerably smaller than on the upper floors, the eccentric loading from the chimney above is supported by a first floor beam that spans across to party wall. At first and second floor, the floors have been finished with later floor boards to provide a level floor structure, the facilities manager reported that this was done around 2011.

5.8.5 It is not possible to confirm either the direction of the floor span, or if the floor structures have been replaced during the levelling exercise. The original London valley roof has been replaced with a flat roof with asphalt finishes.

Figure 5.17: Front Elevation

5.8.6 At third floor level the original internal wall arrangement remains with stud walls forming a complex of small rooms. With the exception of the stud wall to the stairs and an internal wall at first floor level these walls have been removed on the other floors.

5.8.7 The underside of the ground floor structure is partially exposed in the lower ground floor with a large Bressemer beam running perpendicular to the front facade supporting floor joists that span parallel to the front facade. The vaults to the front of the property were inaccessible. Further vaults extended under the ginnel between Nos 26 and 27.

Condition and Observed Maintenance issues

5.8.8 The property has experienced some movement, particularly adjacent to No 26 where there is some settlement however this is less than at No. 26. As a result of this movement some minor cracking in internal finishes to the front facade was noted at third floor level. These finishes are old so it was not possible to determine how recent this movement was. Movement monitoring of the Denmark Street façade installed in February 2015 has shown no significant further movement.

5.8.9 The rear façade shows evidence of historic movement and rebuilding at high level. The floor structures at ground, first and second floor have been re-levelled and are in reasonable condition. The floor structure at third floor is much older and has sagged noticeably and is more mobile than the other floors.

5.8.10 There has been some movement to the internal stud wall around the stairs, although this is less pronounced than some of the other properties on Denmark Street.

Figure 5.18: Location of No 28 Denmark Street

5.9 No 28 Denmark Street

Description of structure

5.9.1 No. 28 Denmark Street is a 5 storey plus lower ground floor building, believed to have been built early in the 20th century. The building occupies the corner site of Denmark Street and St Giles High Street. The building is abutted on both sides by listed buildings. A high degree of fenestration is apparent on the façade.

5.9.2 The building is currently retail use at lower ground and ground floor levels and office use from first to fourth floor level. The lower ground floor of the building is to be adapted to accommodate a UK Power Networks (UKPN) Switch room. This room is to meet UKPN infrastructure requirements, which includes increased loading, head heights and fire protection. The above floors are to be retained in their current use.

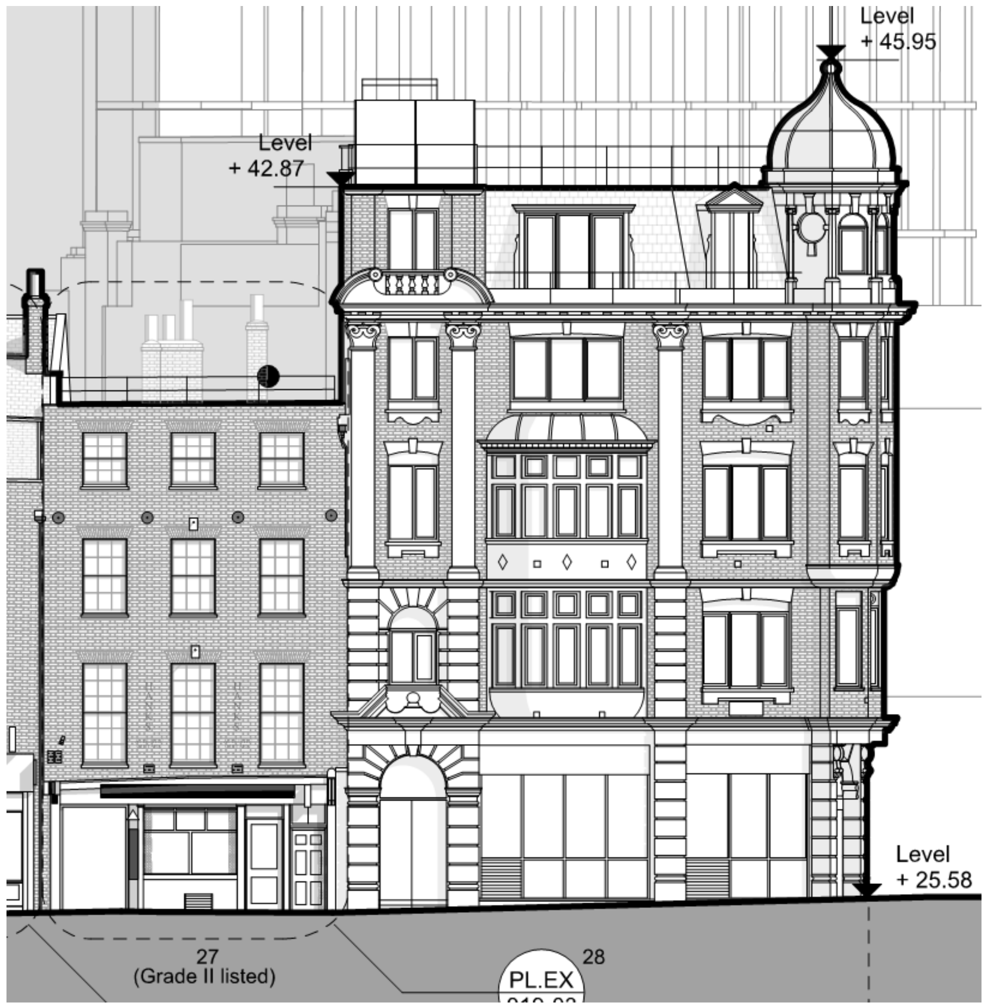

Figure 5.19: Front Elevation – Denmark Street

Figure 5.20: Front Elevation – St Giles High Street

Existing Structure / Condition

5.9.3 The existing building is steel framed with concrete filler joist floors and masonry infill within the frame. The building has filler joist floors that span between the facade on St Giles High Street, a central steel spine beam, and the party wall to 27 Denmark Street. The central spine beam is supported by a steel column in the Denmark Street facade and it is believed a similar column exists in the party wall to 59 St Giles High Street. The lower ground floor has a ground bearing concrete slab and the building is founded on mass concrete footings that have been proved to extend at least 0.8m below the existing floor level.

5.9.4 The filler joist slab is of an unknown depth, and is observed to be in a poor condition at underside of ground floor slab level. The general condition of the building elsewhere was good. Local corrosion of the steelwork within the floor was noticeable adjacent to water sources.

5.10 No 59 St Giles High Street

Description of structure

5.10.1 The property is a four storey masonry building with mansard roof to the rear, which the Camden listed building register dates from the early 19th Century. The top floor of the front facade is of slightly later masonry construction than the floors below. There are two windows in the front facade. The original masonry front facade has been removed at ground floor level and replaced with steel beam and column.

5.10.2 Modern floor finishes on the upper floors meant that it was not possible to confirm the direction of the span of the floor, however from the deflected shape of the floor it is likely that the first floor spans between the masonry party walls and is trimmed around the chimney breasts that are retained on the party wall to No. 28 Denmark Street. The mansard roof has a central valley that runs from the front facade to the rear where it drains to a gutter behind a parapet. The timber stud wall around the stairs supports the rear portion of the upper floors and extends down to ground floor level. This wall is removed at lower ground floor level where a masonry wall is provided adjacent to the stairs. At lower ground floor level a masonry spine wall separated the front and rear portions of the building. In front of the building there is a former light-well that has been covered with a concrete slab supported by a steel beam to form the pavement above.

Figure 5.21: Location of No 59 St Giles High Street

Figure 5.22 Front Elevation

Condition and Observed Maintenance issues

5.10.3 There is little sign of movement to the external masonry walls, the main maintenance issue relates to the mansard roof which is in poor condition. The slates to the rear elevation have been replaced with corrugated metal panels, there is a build- up of debris on the roof and behind the rear parapet and the flashings to the adjacent walls are incomplete.

5.10.4 The roof structure was inspected in part from the underside. Water Ingress was evident and appears to have lead to rot. Internally the first floor structure was slightly springy when walked upon and the plaster finishes to the stud wall around the stair have been removed at first floor level to expose the studs. These studs are therefore lacking any fire protection and have inadequate restraint.

5.10.5 The floors span from the front wall to the central spine wall. When opened up they appeared in sound condition.

6 PROPOSED DEVELOPMENT

6.1 Zone 1 Building A:

6.1.1 Building A comprises a 7 storey steel framed structure that houses a mixed use development that includes retail, hotel, office and leisure facilities, see figure 6.1. Steel is used as the framing system to minimise the weight of the structure that is imposed on the transfer structures and the foundations.

6.1.2 The floor structure is formed of composite metal deck slabs which act compositely with steel beams. A main feature of the building is the 4 storey high covered Urban Gallery on the Andrew Borde Street and Charing Cross Road sides of the building.

6.1.3 Above the Urban Gallery is a 3 storey leisure facility that is supported on long span transfer trusses that transfer the gravity loads to a limited number of columns on the building's facade. On the Charing Cross Road facade these columns are supported by the existing Consolidated Piles.

6.1.4 Around the Urban Gallery a moveable facade is provided that enables the area to be screened off from the surrounding streets for certain events. This moveable facade is supported at the top by the structure of the leisure facility and restrained approximately 4m above ground level by a horizontal beam or transom that spans between the main facade columns.

6.1.5 At the corner of Charing Cross Road and Andrew Borde Street a 'dummy column' is provided which is actually hung from the leisure facility above. This dummy column supports and restrains the corner of the moveable facade rail without imposing vertical foundation loads at its base. This is because the dummy column is located too close to the Escalator Box, Crossrail Tunnel and new Tottenham Court Road ticket hall to enable an independent foundation to be constructed.

6.1.6 To the south side of the Plaza is a 4 storey mixed use building which provides vertical circulation and stability to the leisure facility above. Stability is provided by the diaphragm action of the floor plates transferring horizontal loads back to the stability cores where concrete shear walls around the stairs, lifts and risers transfer the horizontal loads to the ground floor slab which is itself restrained by the retaining walls of the basement box.

6.1.7 The positions of the columns at ground floor have been co-ordinated with the below ground infrastructure to avoid the footprint of the Eastbound Crossrail tunnel and the exclusion zone around it identified in the Agreement between Consolidated Developments and the Secretary of State for Transport.

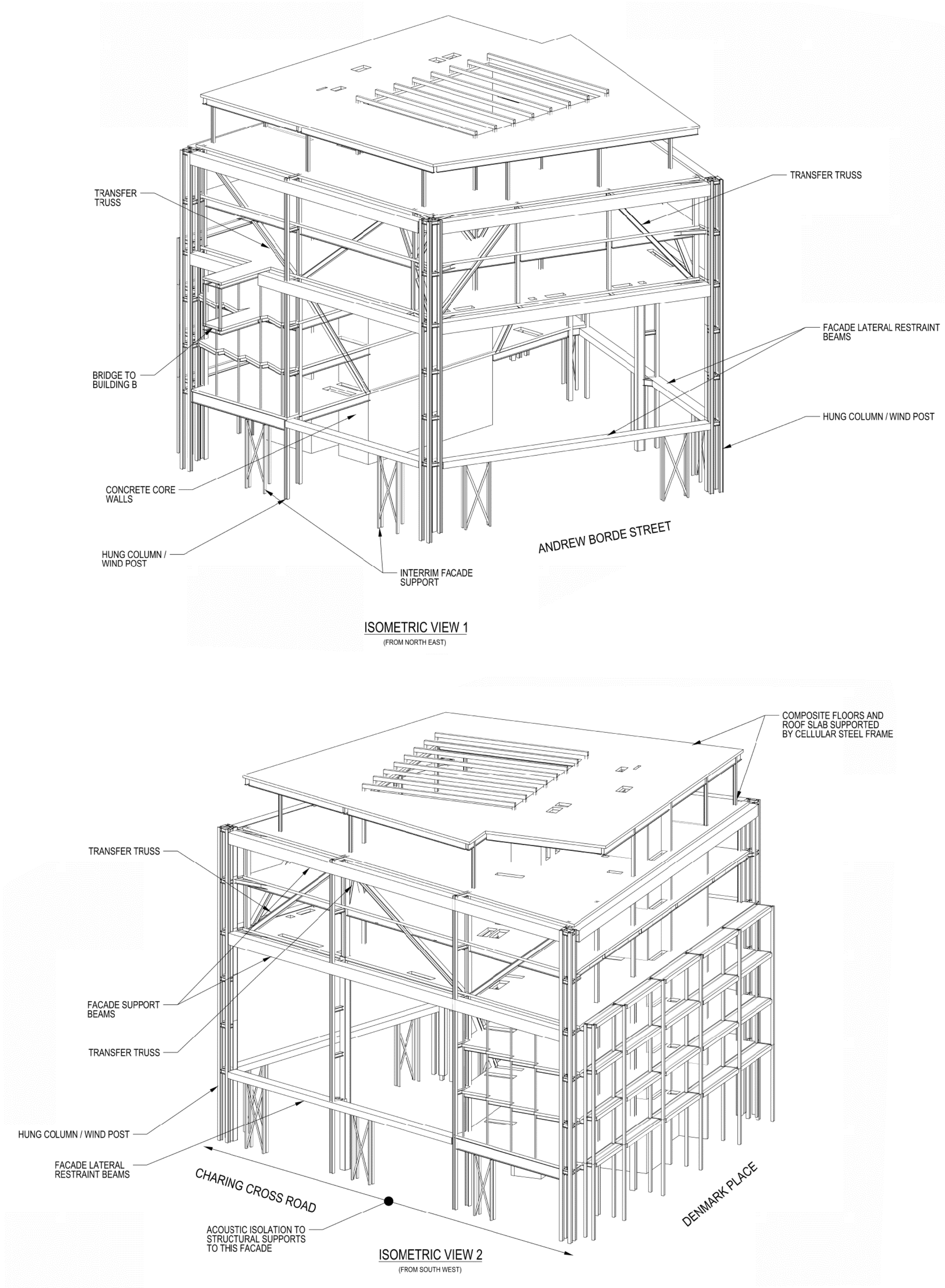

Figure 6.1: Building A Superstructure

6.2 Zone 1 Building B:

6.2.1 Building B is a 5 storey mixed use building that is similar in form and construction to Building A, see figure 6.2. A single storey covered Plaza is formed at ground floor with two stories of office use and two stories of restaurant use above. Steel transfer structures span between the main supporting columns on the west and east sides of the building and also over the basement Events Gallery.

6.2.2 A top hung moveable facade runs along the Andrew Borde Street side of the building and is restrained by a transom approximately 4m above ground level. The transom spans between the superstructure columns.

6.2.3 Stability is provided by concrete shear walls around the lift core. The transfer trusses and superstructure columns on the west side of the Plaza also contribute to the stability system of the building. At ground floor level the horizontal loads are transferred by the ground floor slab to the basement retaining walls.

6.2.4 At the third floor level an interconnecting bridge is provided between buildings A and B a movement joint is provided between the buildings to keep the stability systems separate and control differential movements.

6.2.5 The footprint of the building is clear of the Escalator box, however the Eastbound Crossrail tunnel runs diagonally across the building. Column positions at ground floor level have been planned to avoid landing on the Crossrail tunnels and exclusion zones as far as possible, however some columns land close to the exclusion zone and are transferred around it by the Crossrail heave retention slab at B1 level.

6.3 Zone 1 Building C:

6.3.1 The 4 storey building C provides office accommodation, with plant on the roof structure. The regular arrangement of the structure and spans of up to 8m allow for the use a concrete flat slab structure that minimises the depth of the structural zone and allows for the horizontal distribution of services. See figure 6.3.

6.3.2 Stability is provided by concrete shear walls that go to the ground floor where horizontal loads are transferred by the ground floor slab to the basement retaining walls.

6.3.3 Building C is outside the footprint of the NLEB and London Underground tunnels and is supported by piles.

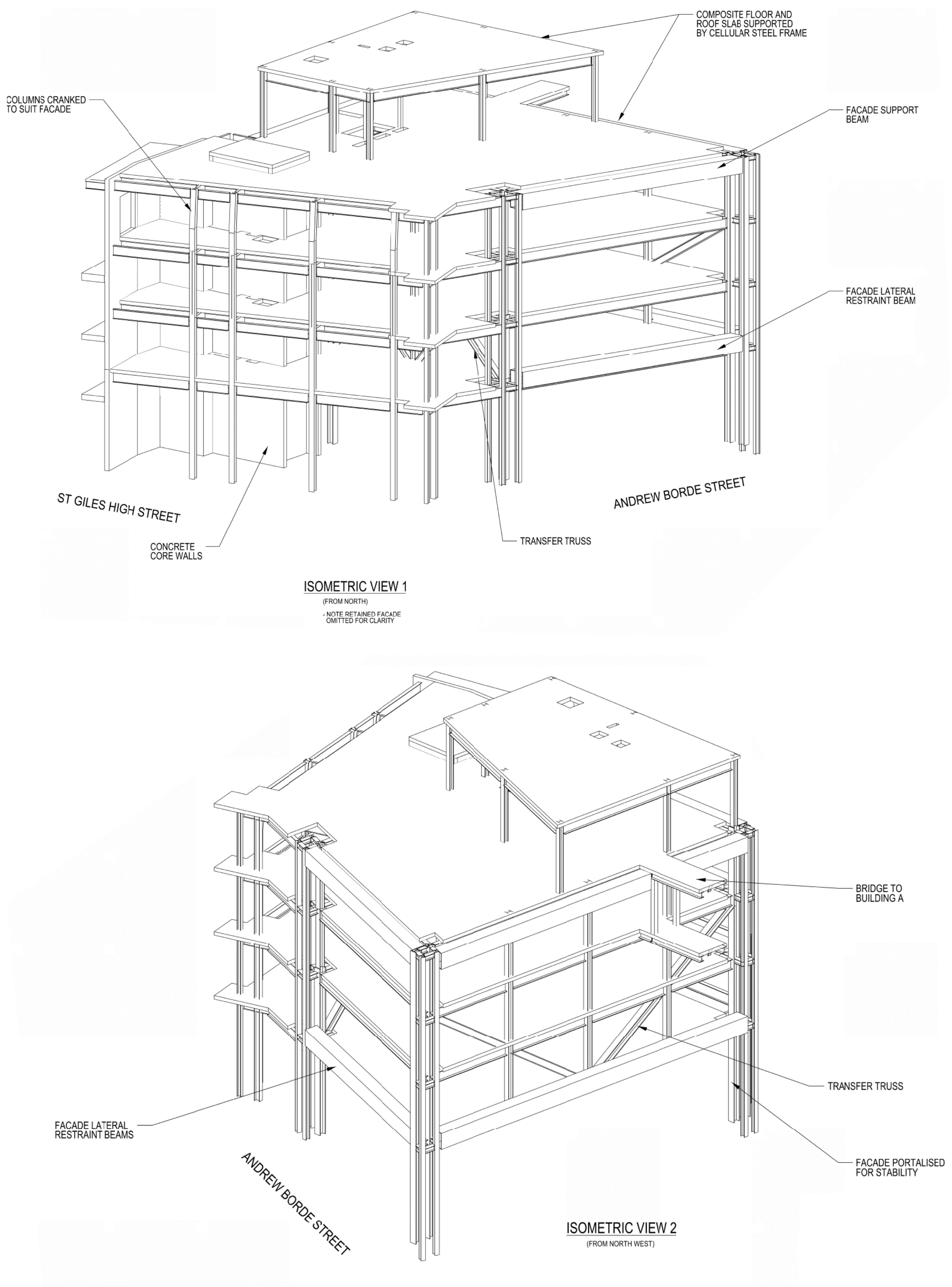

Figure 6.2: Building B Superstructure

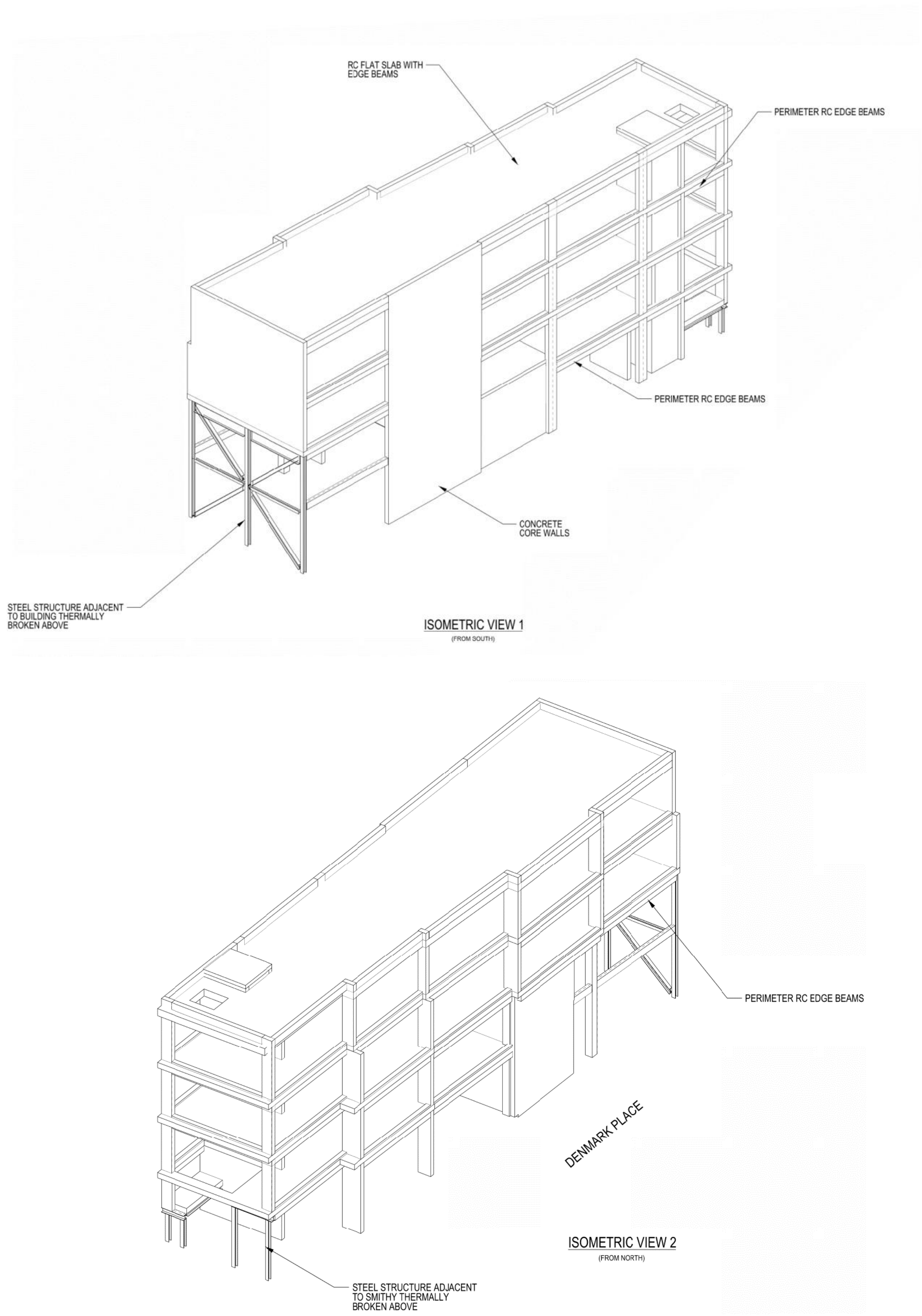

Figure 6.3: Building C Superstructure

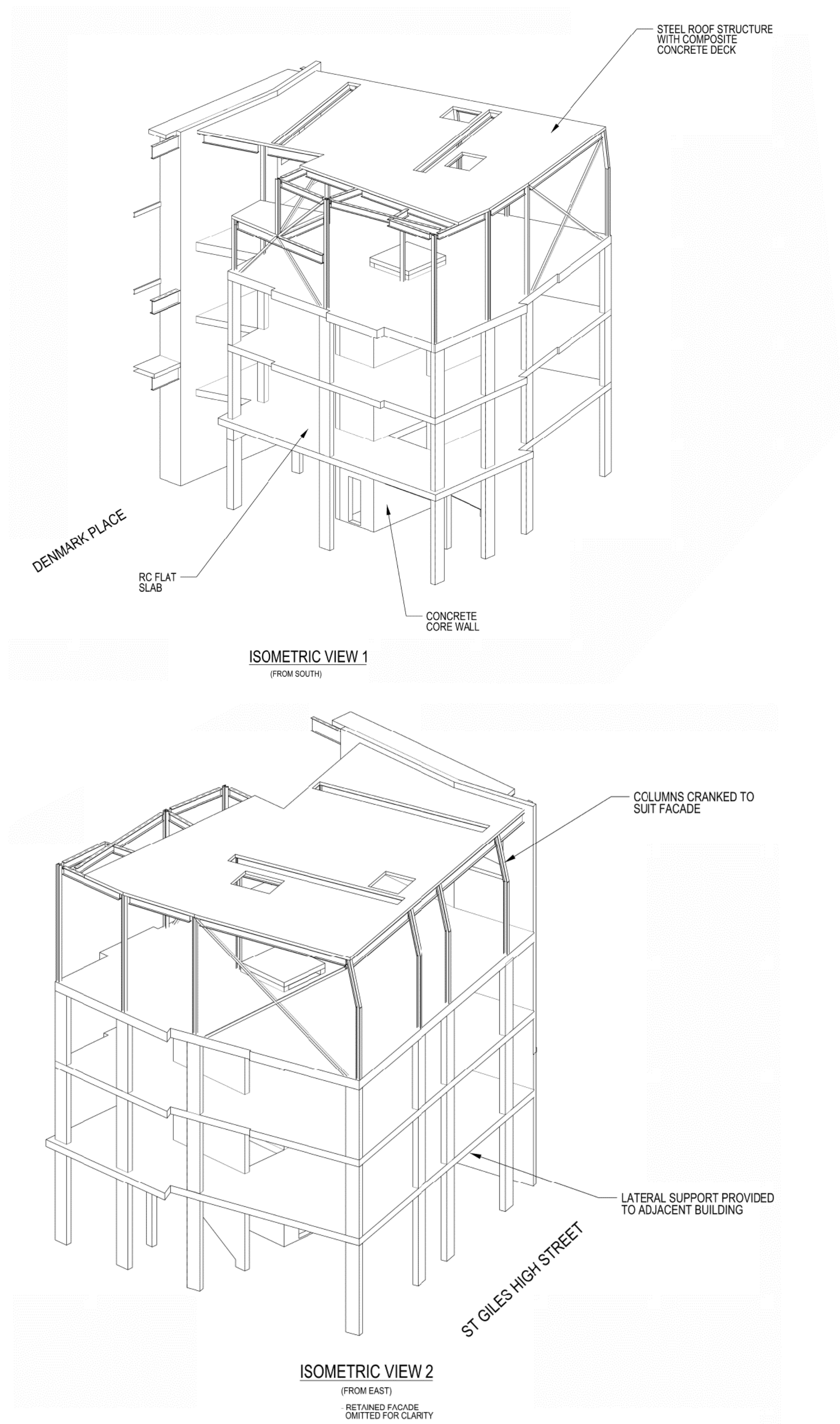

Figure 6.4: Building D Superstructure

6.4 Zone 1 Building D:

6.4.1 Building D is a 4 storey concrete framed structure that houses two stories of residential use and the building services plant that serves the majority of the project. A concrete flat slab structure spanning up to 7m between columns is utilised to provide the maximum clear height for the residences and the services and provide a robust structure with sufficient mass to provide acoustic separation between spaces. See figure 6.4.

6.4.2 The concrete structure also restrains the retained facade on St Giles High Street. Stability is provided by a combination of concrete shear walls around the lift shafts and a concrete shear wall that is shared with the adjacent building B. Closely spaced columns are provided behind the existing facade.

6.4.3 Building D is largely above the Crossrail tunnel and utilises a raft slab to distribute the superstructure loads over the Crossrail tunnel. As the superstructure loads are less than the weight of the overburden removed, a heave retention slab at B1 level and perimeter retaining walls are used to stiffen the basement structure and transfer the net heave forces back to the tension piles either side of the Crossrail tunnel.

6.5 Zone 1 Basement Box:

6.5.1 A new basement is proposed beneath buildings A, B, C and D which will form an Events Gallery, see figure 6.5. The central part of the Events Gallery is a column free space of approximately 18m x30m with the maximum clear height possible. A mezzanine is provided around the Events Gallery to accommodate bars and ancillary activities.

6.5.2 Either side of the Crossrail Tunnel exclusion zone the depth of the basement is increased to accommodate the plant rooms, lift pits and sprinkler tanks. These areas of deeper basement are clear of both Crossrail and the Escalator Box.

6.5.3 The footprint of the basement is constrained by the Escalator Box and Charing Cross Road to the West, Andrew Borde Street to the North, the retained facade on St Giles High Street to the East and retained (some listed) buildings to the South on Denmark Place.

6.5.4 As the Event Gallery is located directly above the Eastbound Crossrail tunnel the depth of the basement is constrained by the exclusion zone around the Tunnel as detailed in the Crossrail Information for Developers (February 2008) which puts a 6.0m clearance between the outside of the tunnel and the development above. The Crossrail Information for Developers also allows for an 'Alignment adjustment zone' of 3.0 m above and to the sides of the tunnel, however at the site location the tunnel is constrained by passing under the Escalator Box so its position is fixed at this location.

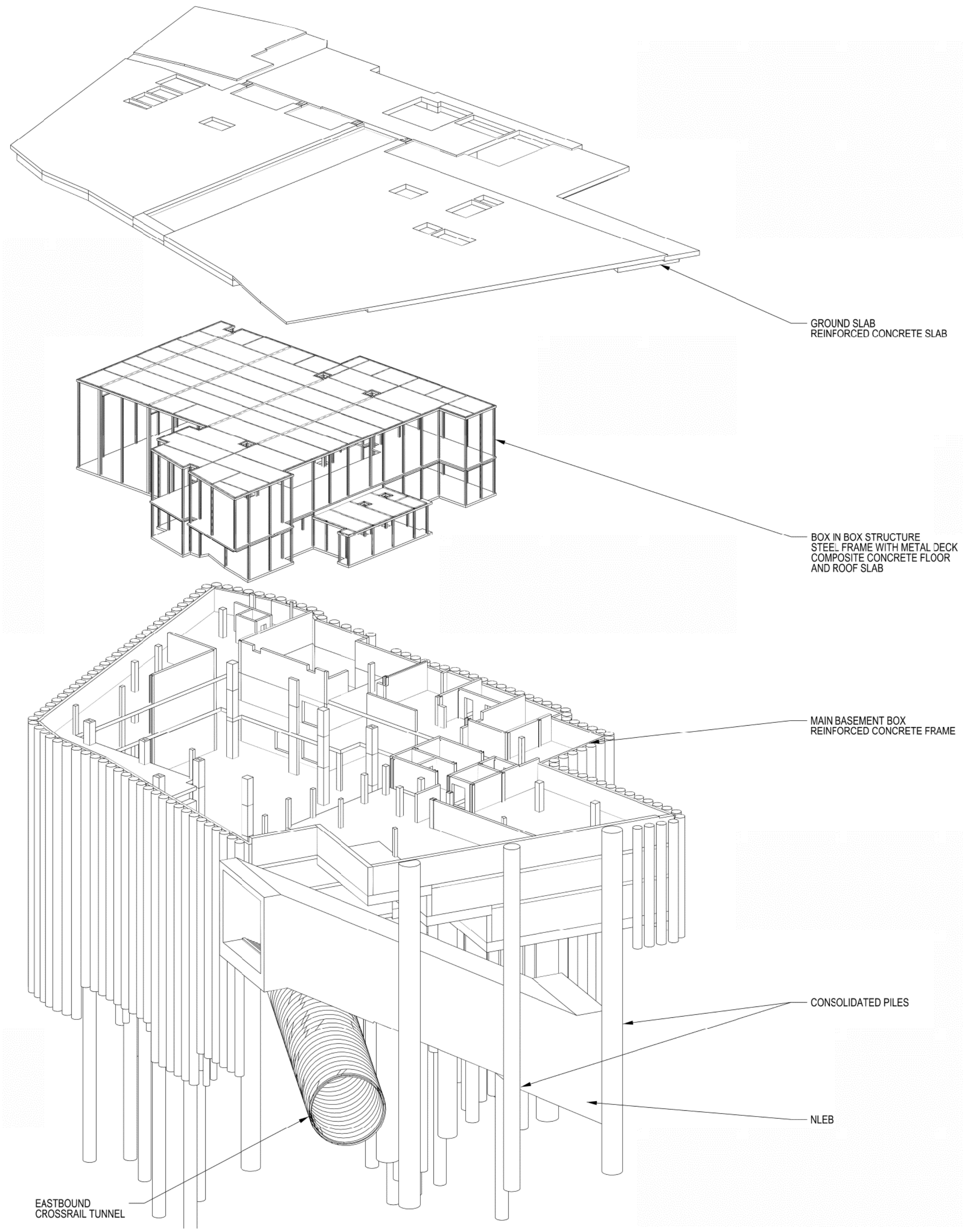

Figure 6.5: Basement Structure

6.5.5 As part of the Agreement between the Secretary of State for Transport and the Project Sponsor, it was agreed that the exclusion zone between the Crossrail tunnel and the oversite development could be reduced to a minimum of 1.0m at the Escalator Box, increasing to 3.0m where the centre of the tunnel alignment crosses the Eastern boundary of the site. Furthermore the drawings in the Agreement note that 'the exclusion zone shown on this drawing allows for the development of the Crossrail alignment to the East of the safeguarding tunnel. Subject to agreement with Crossrail, piling may be permitted in this zone once the alignment is fixed. However, no piles closer than 1.0m clear from outside of tunnel will be allowed, and no piles within the exclusion zone may be closer than the pile diameter from the tunnel.'

6.5.6 The design for the basement has therefore been progressed on the basis that no foundation structures will be allowed closer than 1.0m clear (including allowances for construction tolerances) from the outside of the tunnel, and that the basement structure should be 6m above the tunnel crown. After consideration of the construction method a minimum dimension of 2.0m between the outside of the pile and the outside of the tunnel has been agreed with Crossrail. The minimum dimension allows for pile construction tolerances.

6.5.7 As a significant amount of the existing overburden above the Eastbound Crossrail tunnel will be removed by the basement excavation, a design for the basement structure has been developed that will restrain the ground movements, particularly heave, caused by the removal of the overburden. The design involves the installation of tension piles either side of the Eastbound Crossrail tunnel and the construction of a heave retention slab that spans between the tension piles at B1 level. This system of heave retention slab and tension piles is designed to resist the heave forces generated by the basement excavation and therefore control the movements experienced by the Eastbound Crossrail tunnel. The principle was initially discussed with Crossrail in meetings in 2011 and was presented to them in the Conceptual Design Statement (029-S-REP-001 Revision 01, December 2012). Following review by Arup (original designers of the Crossrail tunnel) and construction methodology input from Skanska the originally proposed adit beams were replaced with a heave retention slab at B1 level. This approach was presented to and accepted in principle by Crossrail in November 2015.

6.5.8 The basement structure above the Escalator Box is supported by the Consolidated Piles so that it does not rely on either the Escalator Box structure or the LUL secant piled wall that was used to enable construction of the escalator. A new basement retaining wall spans between the Consolidated Piles and supports the basement floor slabs.

6.5.9 There is no piling directly above the NLEB or the Northern Line platform tunnels, however the basement above the Northern Line Lower Concourse (NLLC) tunnel is proposed to be constructed within secant piled walls with a toe level no lower than +113.500m (see drawings Z1-S-031 and Z1-S-032 in Appendix N). The top of the extrados of the NLLC tunnel is at approx. +105.5m giving 8.0m clear between the pile toe and the tunnel. This exceeds the 6.0m exclusion zone identified in figure 1 of LUL Standard 1-050. Furthermore these secant piled walls are not designed to support vertical loads, with all column and floor loads supported by the Consolidated piles and other piles shown on drawing Z1-S-031.

6.5.10 The basement and ground floor slabs prop the retaining walls across the footprint of the basement site to resist earth pressures and therefore control lateral movements of the retaining wall and the Escalator Box.

6.5.11 The depth of the basement over the Escalator Box is limited to +114m as part of the Agreement between the Secretary of State for Transport and the Developer. This Agreement also requires at least 2m of overburden to be maintained above the Escalator Box to control heave and uplift, therefore the footprint of the basement structure reduces from Lower Ground Floor Level to Basement Mezzanine Level to Main Basement Level to maintain this clearance.

6.5.12 Given the relative proximity of the Events Gallery to both Crossrail and the Northern Line, an acoustic assessment of the noise from the trains has been made and submitted to Crossrail. This has resulted in the adoption of a 'box in box' structure around the Events Gallery.

6.5.13 The inner structure of the 'box in box' is formed by a braced steel framed structure that sits on acoustic isolation bearings at main basement level. The structure is separated from the surrounding concrete basement structures at all other levels.

6.6 Zone 2 Nos 22 and 23 Denmark Place

6.6.1 No 22 Denmark Place (at the rear of 26 Denmark Street) is a single storey masonry building with a timber framed roof. It is known as the 'Smithy' as it was formerly a forge. Although No 26 Denmark Street is grade II listed this building is not included within the description, but is considered to be locally significant by Camden. Part of the building sits above the Eastbound Crossrail tunnel. Constructing the basement around this building would create a discontinuity in the heave restraint system described above and also results in significant movements due to both the basement construction and the Crossrail tunnelling.

6.6.2 As a result the basement and heave protection system has been extended under No. 22 Denmark Place in order to maintain a consistent heave restraint system. In order to mitigate the effects of movement it is proposed to support the existing building on a concrete raft slab that will itself be ultimately supported on the piled basement structure. As access for piling within the building footprint is difficult it is proposed to temporarily move the Smithy during the piling works so that a consistent interface with the Crossrail Tunnel can be maintained across the basement footprint. Once the piling works are complete the Smithy will be returned to its original location and suppported by the piled foundations over the basement construction. Abbey Pynford have been engaged to develop the methodology for moving the Smithy and propose to cast a raft slab under the building and lift the building and raft slab together.

No 23 Denmark Place was a 3 storey former Victorian warehouse of masonry construction with timber floors. It was in poor condition, has experienced recent movement and would have required extensive repair and underpinning to stabilise and protect it. After consultation with Camden Heritage officers and Historic England it was agreed to dismantle No 23 Denmark Place to facilitate the protection and temporary movement of No 22 Denmark Place.

6.7 Zone 2 Nos. 21 to 25 Denmark Street:

6.7.1 These existing buildings are to be retained and refurbished as part of the development. The principle structural alterations are the addition of a new floor with a mansard roof. In order to minimise the change in foundation loads associated with the new floor it is proposed to replace the existing roof construction with a lightweight steel and timber floor construction and form the mansard roof out of similar lightweight construction.

6.7.2 The existing first floor structure at No. 21 Denmark Street will also be removed to improve access to the development from Denmark Street. Steel frames will be provided between ground and second floor at No. 21 to restrain the party walls and support the lightwell above.

6.8 Zone 2 No 26 Denmark Street:

6.8.1 The rear wall at No 26 Denmark Street has experienced previous movement and has lower foundations than the adjacent chimney (previously underpinned prior to this project) and the party walls to No 25 and No 27 Denmark Street. It is proposed to underpin the rear wall to provide a more consistent formation level, enable the construction of a lower ground floor to 23 Denmark Place and arrest further movement.

6.8.2 Figure 6.6 shows the extent of the proposed works, detailed sketches are shown in Appendix D12 and calculations in Appendix D13. H Smith's underpinning specialist will undertake the works.

6.9 Zone 2 No 28 Denmark Street:

6.9.1 The lower ground floor of No 28 Denmark Street will house the UKPN switch room for the Zone 1 works, as a result the existing floor level will need to be lowered by approximately 400mm in order to achieve the required headroom. A series of trial pits have been dug around the perimeter of No 28 Denmark Street to establish the existing footing and formation levels, these have revealed that the majority of the existing walls have been previously underpinned to a depth that is sufficient for lowering the existing floor slab. The exceptions are the partition to the west side of the lower ground floor (adjacent to 27 Denmark Street) and the vaults below Denmark Street.

6.9.2 The impact of underpinning these walls has been assessed (refer to Appendix M2), detailed sketches of the construction sequence are shown in Appendix D12 and calculations (including stability of the masonry retaining walls) in Appendix D13. H Smith's underpinning specialist will undertake the works.

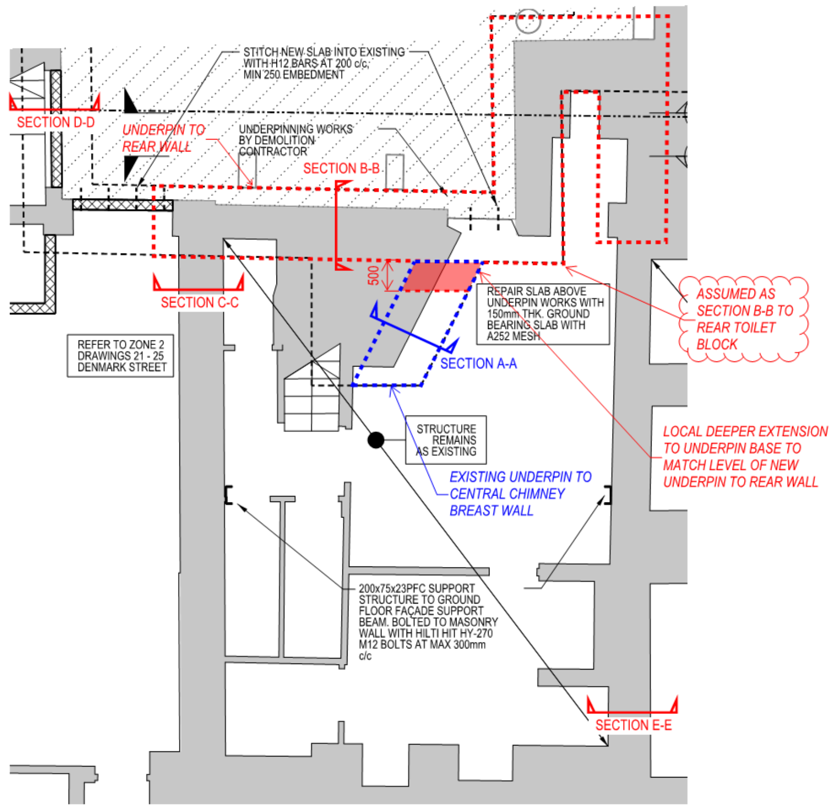

Figure 6.6: Underpinning works to 26 Denmark Street

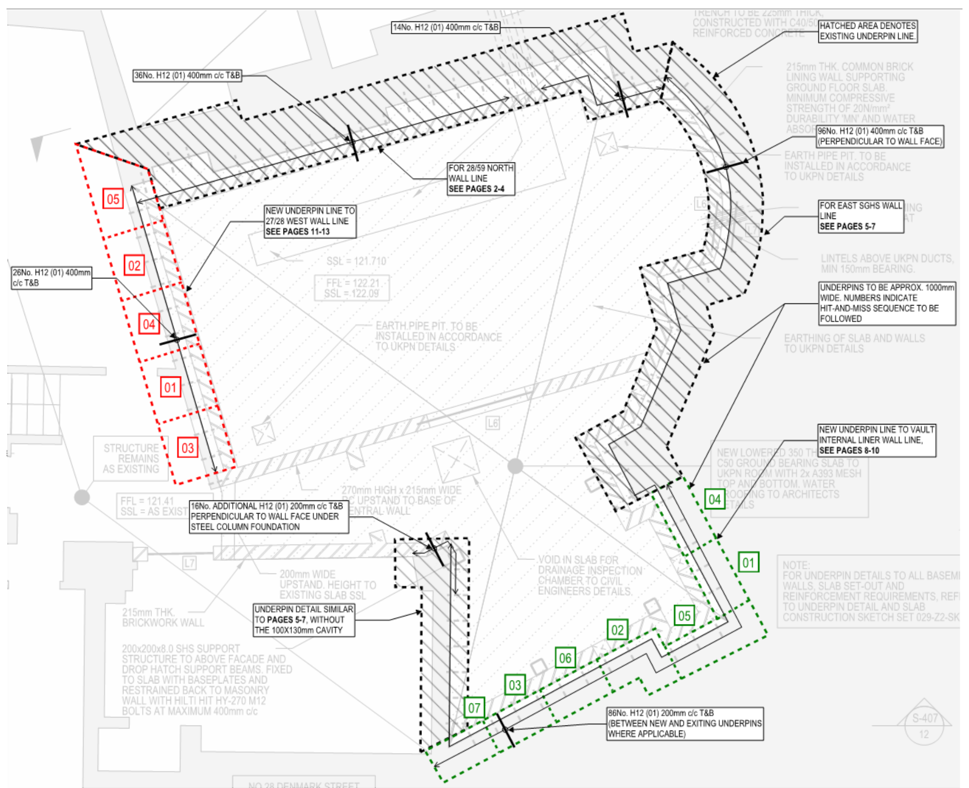

Figure 6.7: Underpinning works to 28 Denmark Street

7 REQUIREMENTS OF THE BASEMENT CONSTRUCTION PLAN

7.1 Overview

7.1.1 The following Section addresses point by point the requirements of the Basement Construction Plan as detailed within Section 3.2 of the Section 106 agreement for St Giles Circus.

7.2 Definitions

7.2.1 Taken from the Section 106 Agreement:

3.2.1 "the Burland Category of Damage"	an industry recognised category of structural damage as specified at para 2.30 of Camden Planning Guidance 4: Basements and lightwells (as may be amended) and shown in the First Schedule annexed hereto
3.2.2 "Neighbouring Properties"	the neighbouring properties known as 25, 27 and 28 Denmark St London WC2H; and the following demolished properties 54-59 St Giles High St London WC2H 8LH and 1-6 Denmark Place London WC2H in the event these are replaced prior to the basement works being completed
3.2.3 "Detailed Basement Construction Plan"	a plan setting out detailed information relating to the design and construction of the basement forming part of the Development with a view to minimising any or all impacts of the Development on Neighbouring Properties and the water environment and to provide a programme of detailed mitigating measures to be undertaken and put in place by the Owner with the objective of maintaining the structural stability of the Property and Neighbouring Properties as described in the Basement Impact Assessment by Engenuiti Limited dated 30 November 2015 submitted with the Planning Application and to include the following key stages:-

7.3 Requirements

7.3.1 Taken from the Section 106 Agreement:

Requirements for Basement Construction Plan given in S106 3.2.2	How this has been addressed
(a) that the design plans have been undertaken in strict accordance with the terms of this Agreement incorporating proper design and review input into the detailed design phase of the Development and ensuring that appropriately conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties have been incorporated into the final design taking into account the Basement Impact Assessment and intrusive Site Investigation Report submitted and approved under planning reference 2015/3072/P; and	The Basement Impact Assessment (BIA) and intrusive site investigation reports (Appendices S1 and S2) are the key documents in all assessments made by the Basement Design Engineer in relation to the design of all permanent and temporary works for the formation of the proposed basement. The structural condition of the Neighbouring Properties has been assessment by Engenuiti and reviewed by the Basement Design Engineer – (Appendices S4, S5 and S6). The Engenuiti design for the permanent basement works has been reviewed by the Basement Design Engineer and refined accordingly. Relevant Design documents are given in (Appendices D1 to D13). The temporary works and pile design calculations and sequencing prepared by the main contractor and specialist contractors are given in (Appendices C1 to C6). The Basement Design Engineer has reviewed the calculations and proposed sequences. The main contractor and specialist contractors have revised their calculations accordingly.
(b) that the result of these appropriately conservative figures ensure that that the Development will be undertaken without any impact on the structural integrity of the Neighbouring Properties beyond "Slight" with reference to the Burland Category of Damage; and	The Basement Design Engineer has made an assessment of the Neighbouring Properties and incorporated the design and temporary works conditions into an assessment of the impact of construction on the Neighbouring Properties that has been prepared by A-Squared Studio. The Basement Design Engineer has reviewed the damage assessment prepared by A-Squared Studio and can confirm that the assessment incorporates conservative modelling relating to the local ground conditions and local water environment and structural condition of properties. The damage assessment concludes

	that the impact on the structural integrity of the Neighbouring Properties is no worse than " Very Slight" with the majority of Neighbouring Properties experiencing "Negligable" damage according to the Burland Category. Refer to Appendix M2.
(c) that the Basement Design Engineer having confirmed that the design plans have been undertaken in strict accordance with this Agreement and includes a letter of professional certification confirming this and that the detailed measures set out in sub-clauses (i)-(vii) below have been incorporated correctly and appropriately and are sufficient in order to achieve the objectives of the Detailed Basement Construction Plan;	A letter of professional certification will be written by the Basement Design Engineer to accompany this report.
(c) (i) reasonable endeavours to access and prepare a detailed structural appraisal and conditions survey of all the Neighbouring Properties to be undertaken by an independent suitably qualified and experienced chartered surveyor (and for details to be offered if this is not undertaken in full or part);	This is addressed in Appendices S3, S4, S5 and S6. Appendix S3 is survey drawings of Neighbouring Buildings. Appendix S4 is a structural appraisal of the Neighbouring Buildings. Appendix S5 is trial pits to Neighbouring Buildings and Appendix S6 is condition survey reports prepared by an independent and suitably qualified chartered surveyor as part of the Party Wall award.
(c) (ii) a method statement detailing the proposed method of ensuring the safety and stability of Neighbouring Properties throughout the Construction Phase including temporary works sequence drawings and assumptions with appropriate monitoring control risk assessment contingency measures and any other methodologies associated with the basement and the basement temporary works;	The Construction Methodology is summarized in Sections 8 and 9. Construction sequences proposed by the Basement Design Engineer are given in Appendices D5 for Zone 1 and D12 for Zone 2. A construction methodology prepared by the main contractor is given in Appendix C1 for Zone 1 – this is in line with Engenuiti proposals. Temporary works drawings are given in Appendices D8 and C4. The Basement Design Engineer has reviewed the above information prepared by the main and specialist sub-contractors. The monitoring regime and methodology proposed by the Basement Design Engineer is given in Appendix M3 and baseline results are given in Appendix M4. Construction risk assessment and control measures are given in Appendix M5. The contingency plan in Appendix M7 highlights the actions to be taken if the monitoring shows that the movements are greater than the trigger levels. The amber trigger levels are set at the predicted movements. The requirements of Appendix M7 are included in the piling specification.
(c) (iii) detailed design drawings incorporating conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties prepared by the Basement Design Engineer for all elements of the groundworks and basement authorised by the Planning Permission together with specifications and supporting calculations for both the temporary and permanent basement construction works;	The following Appendices are given: Appendix D1 Engenuiti Design Philosophy & Criteria Report Appendix D2 Donaldson Geotechnical Interpretative Report Appendix D3 Engenuiti Piling Specification Appendix D4 Engenuiti Zone 1 Drawings & IFC Model Appendix D6 Engenuiti Zone 1 Load Take Down Appendix D7 Engenuiti Zone 1 Basement Permanent Works Calculations Appendix D8 Engenuiti Zone 1 Temporary Works Drawings Appendix D9 Engenuiti Zone 1 Temporary Works Vertical Loading Calculations Appendix D10 Engenuiti Zone 1 Horizontal Temporary Works Loads on Concrete Structure Appendix D11 Engenuiti Zone 2 Drawings Appendix D13 Engenuiti Zone 2 Basement Permanent Works Calculations Appendix C1 Skanska Construction Methodology Appendix C2 Cementation Pile Design Drawings Appendix C3 Cementation Pile Design Calculations Appendix C4 RKD Zone 1 Horizontal Temporary Works Drawings Appendix C5 RKD Zone 1 Horizontal Temporary Works Design Calculations The Basement Design Engineer has either prepared or reviewed the above documents to ensure that they incorporate conservative modelling relating to the local ground conditions and local water environment and structural condition of Neighbouring Properties.
(c) (iv) the Basement Design Engineer to be retained at the	This is addressed in Section 9.

Property throughout the Construction Phase to inspect approve and undertaking regular monitoring of both permanent and temporary basement construction works throughout their duration and to ensure compliance with the plans and drawings as approved by the building control body;	The Basement Design Engineer shall act as an external independent reviewer of the monitoring reports. The Basement Design Engineer will maintain a specific role on site during basement construction and will have a representative based on site 2-3 days each week to monitor the construction process of the basement. They will feedback any concerns to the main contractor and employer so that all concerns are addressed.
(c) (v) measures to ensure the on-going maintenance and upkeep of the basement forming part of the Development and any and all associated drainage and/or ground water diversion measures order to maintain structural stability of the Property the Neighbouring Properties and the local water environment (surface and groundwater);	This is addressed in Section 9 and Appendices D5 and C1. Following construction there are no ongoing maintenance requirements for the basement.
(c) (vi) measures to ensure ground water monitoring equipment shall be installed prior to Implementation and retained with monitoring continuing during the Construction Phase and not to terminate monitoring until the issue of the Certificate of Practical Completion (or other time agreed by the Council in writing); and,	All monitoring will continue until issue of the Certificate of Practical Completion. A series of three ground water monitoring wells have been specified in or adjacent to the Neighbouring Properties and will be installed prior to implementation.
(c) (viii) a refined ground movement analysis/building damage assessment with all the construction activities analysed including specific details s that actual movements can be compared with predicted values during the construction process in order to minimise potential damage	This is given in Appendix M2 and has been reviewed by the Basement Design Engineer.
(c) (ix) detailed underpinning proposals for 28 Denmark Street and detailed proposals for the monitoring of ground movements on surrounding properties	This is given in Appendix D12 and D13. Proposals for the monitoring of ground movements are presented in Appendix M3.

8 DEMOLITION SEQUENCE & METHOD STATEMENT

8.1 Previous Demolition Works

8.1.1 As part of the Tottenham Court Road Station Upgrade works the north part of the site that is currently occupied by LUL has already had the existing buildings demolished in advance of the NLEB construction. These buildings have been demolished down to basement level and outside the footprint of the NLEB they have been backfilled.

8.1.2 A temporary road (bus diversion D3) has been formed across the site which is to be removed as part of the demolition package.

8.2 Demolition Works

8.2.1 The site encompasses a range of different buildings with varying levels of demolition required (see figure 8.1), these include:

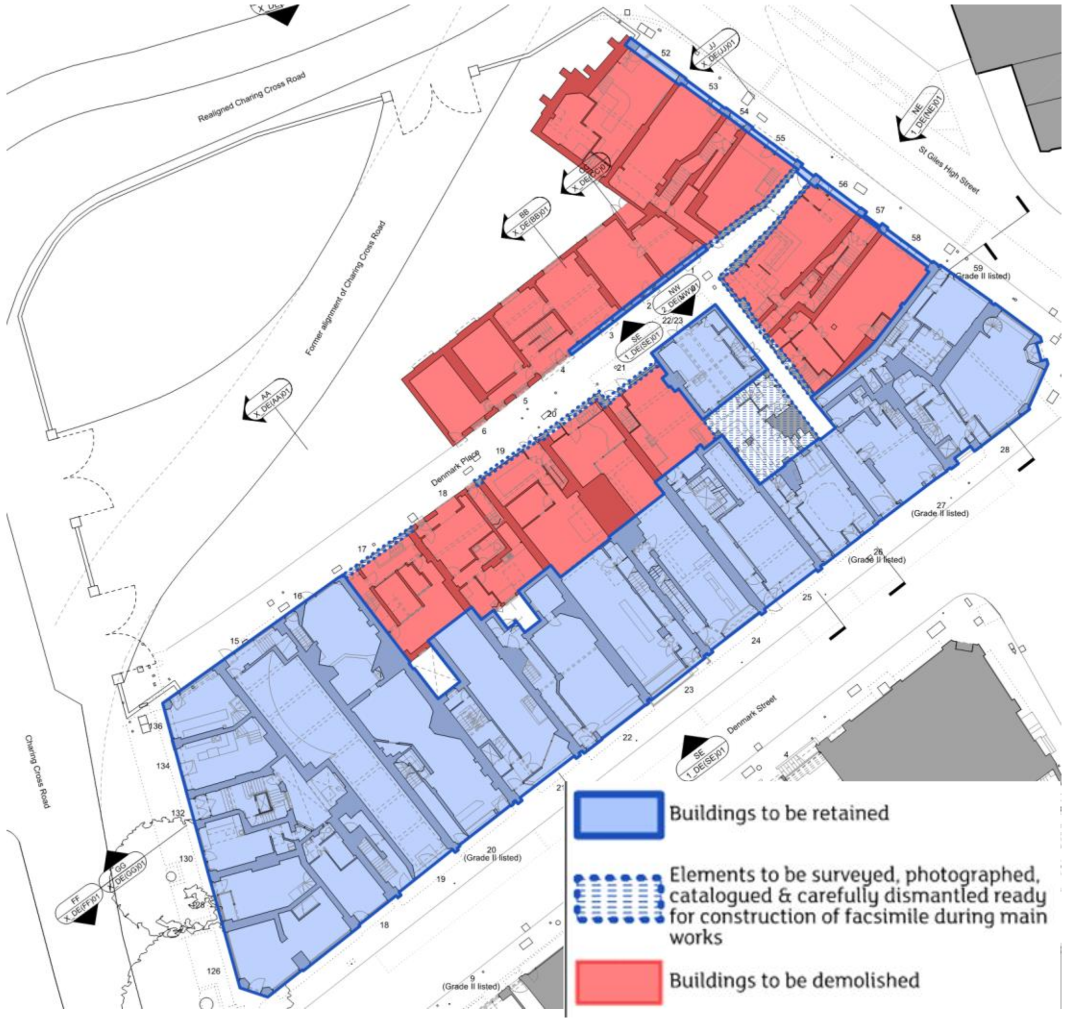

Figure 8.1: Extent of demolitions.

Denmark Street

8.2.2 Removal of the rear sections of the building facing onto Denmark Place to No. 21, 22, 23, 24 & 25 (which form No.'s 17, 18, 19, 20 & 21 Denmark Place respectively).

St Giles High Street

8.2.3 Façade retention to the York & Clifton mansions elevation from No. 52 to 58 and the demolition of the 5 storey building over basement behind.

Denmark Place

8.2.4 Removal of buildings No. 1, 2, 3, 4, 5 & 6 and 23.

8.2.5 The front facade of buildings No. 1, 2 & 3 are to be dismantled and replaced with a facsimile restrained by the new building B.

8.2.6 The elevations of buildings No. 17, 19, 20 & 21 are to be carefully recorded and dismantled to allow for future reinstatement.

8.3 Sequence of Works

The following sequence of works is being followed:

8.3.1 Inspect and survey façades that are to be retained as part of the works.

8.3.2 Divert existing services to the occupied and adjoining properties that cross the areas for demolition.

8.3.3 Install dividing walls as per drawings between the occupied properties and the portion of the buildings to be demolished.

8.3.4 Disable all incoming services to the properties that are to be demolished and cap redundant drainage runs.

8.3.5 Undertake a soft strip of the properties that are to be demolished.

8.3.6 Fill the vaults under the street at 52 to 58 St Giles High Street in accordance with the drawings.

8.3.7 Install façade retention system.

8.3.8 Demolish the buildings to existing ground level using rubble from masonry and concrete structures to fill existing basements to a level 1.0m below existing ground level.

8.3.9 Remove other demolition rubble/debris from site to a licenced waste disposal facility.

8.3.10 ARCHAEOLGICAL INVESTIGATION to be undertaken by others, excavating areas outside basement footprints to a depth of approximately 2.5m below existing ground level.

8.3.11 Upon release of the site from the Archaeological Investigation breakout remaining basement structures including retaining walls, footings, concrete or masonry ground slabs and drainage runs.

8.3.12 Rubble from concrete and masonry structures to be used to level the site to approximately 24.0mAOD

8.3.13 Remove other demolition rubble/debris from site to a licensed waste disposal facility.

8.4 Movement and Storage of Materials during demolition

8.4.1 In order to control the effect on ground movements that the demolitions could have, it is proposed to use the masonry and concrete rubble from the demolished buildings to fill the existing basements below the buildings. As figure 8.2 shows this will be done in a sequential manner so that the only material removed from the site during the demolition is the soft strip material and organic matter such as the timber floor structures.

8.4.2 Any surplus rubble that results from the demolition of the above ground floor structures will be stored on the northern area of the site so that it is away from the archaeological investigations that are required by the planners. Stock piles of demolition rubble or other materials are limited to a maximum height of 2.0m above surrounding ground level so that the loading from the stored materials does not exceed 40kPa. This is within the 50kPa allowance above existing ground level that the Crossrail tunnels are designed for. The demolition specification prohibits the storage of materials above the NLEB. A minimum clear distance of 1.0m must be maintained between the outside of the NLEB and the material storage area as identified on demolition drawing Z1-D-404

8.4.3 Once the archaeological investigations are completed the remaining basement walls, basement slabs and footings will be broken out. This will require the temporary excavation of the rubble fill to the basements. So that the effect of this temporary excavation on the Crossrail tunnel below is limited, the demolition specification requires the excavation of rubble and basement material to be under taken in "hit and miss" areas of no more than 100m2 prior to backfill. See figure 8.3.

8.4.4 The footprint of the basements are then backfilled to 24mAOD (124mATD to LUL datum) using the compacted rubble from the site so that the enabling works conclude with a level site that is approximately 1.0m below existing ground level.

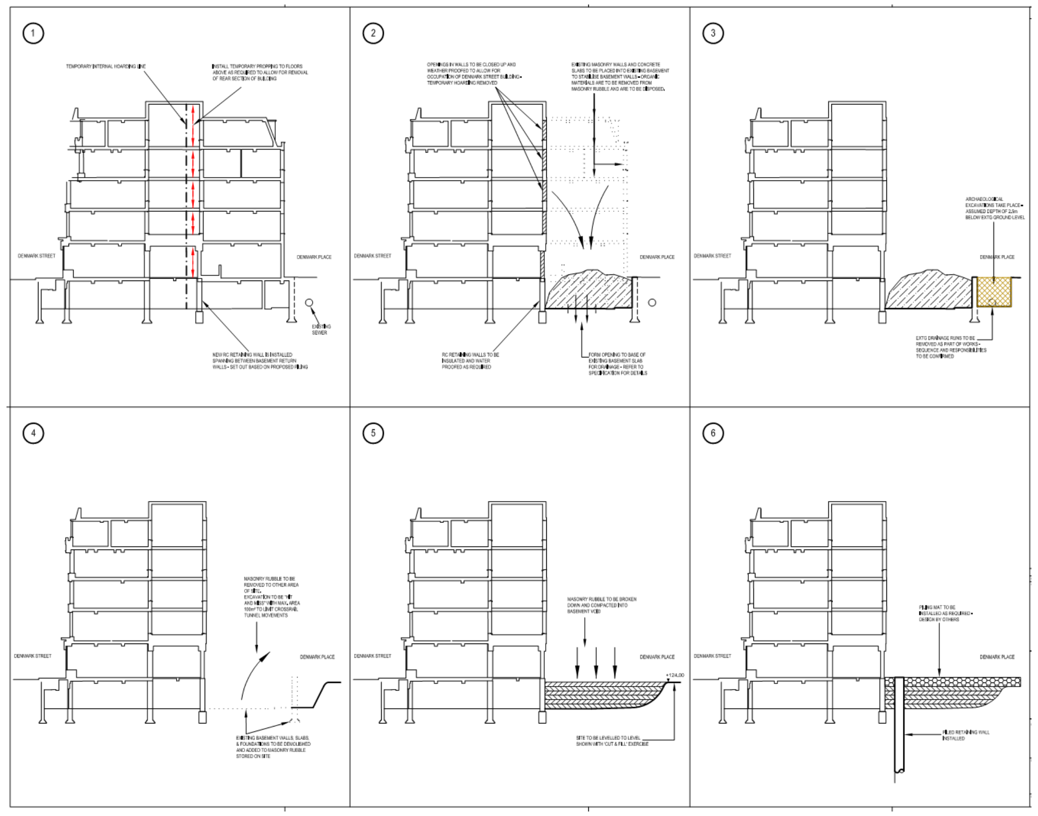

Figure 8.2: Sequence of demolition to control ground movements.

Figure 8.3: Breaking out of basements to be conducted in hit and miss arrangement.

9 CONSTRUCTION SEQUENCE & METHOD STATEMENT

9.1 Zone 1 Main Basement above Eastbound Crossrail Tunnel

9.1.1 The following description outlines the Construction Method Statement for the purposes of identifying the modelling strategy for the basement construction.

9.1.2 The basement construction methodology has been reviewed and developed by Skanska and is shown in more detail in Appendix D12. The principle change to the basement construction methodology relates to the heave retention system for Crossrail Tunnel.

9.1.3 The overall construction sequence can be described as follows:

On Handover from demolition contractor:

- Site is clear and level. All services and buildings have been removed.
- The facade retention to St Giles High Street will be in place.
- No. 22 Denmark Place (the Smithy) will have been relocated.
- The temporary works “Lego” block retaining wall (Lower Ground Floor to top of piling Mat) to the rear of Denmark Street will be in place.

Piling:

- Install Piling Mat.
- Site set up and installation of bentonite plant.
- Construct guide wall.
- Commence piling - retaining walls to south and east of NLEB constructed first, then other retaining walls, tension piles, plunge columns.
- Pile testing actioned and completed.
- Return No. 22 Denmark Place (the Smithy) to original position.

During pile installation commence basement construction over NLEB

- Prop existing NLEB piled walls between capping beams below road slab.
- Remove road slab.
- Construct new capping beam on Charing Cross Road frontage, supported by Consolidated piles.
- Construct new Ground Floor slab between capping beam on Charing Cross Road frontage and new retaining walls to south and east of NLEB.
- Remove props between NLEB capping beams once new Ground Floor slab over NLEB has achieved design strength. At this point ground floor construction can commence to the east of NLEB.
- Excavate between NLEB and new retaining walls to south and east of NLEB to Basement Mezzanine level (approximately coincidental with existing backfill level below NLEB).
- Construct Basement Mezzanine slab and lining wall above NLEB. Fix to Consolidated piles.
- Construct Lower Ground Floor slab and lining wall above NLEB. Fix to Consolidated piles.

Install Ground Floor Slab to the east of NLEB:

- Install capping beams.
- Cast Lower Ground walls / lift pits to link plunge columns.
- Layout long span beams to plunge column or temporary support points.
- Layout transfer structures for buildings over until excavation beneath allows final columns installed over Crossrail.
- Connect to Smithy support structure.
- Cast Ground Floor slab leaving mole holes.

Superstructure construction (detailed bottom) can commence at this point.
Excavate Basement to the east of NLEB: Note this may only commence once BM and LGF slabs and lining walls over NLEB have been completed.

- Excavate top down through mole holes to Basement Mezzanine level.
- Construct Basement Mezzanine floor slab as permanent whaling/ring beam to prop retaining wall.
- Link Basement Mezzanine slab above NLEB to remaining slab at this level.
- Complete ring beam at Basement Mezzanine level with insertion of steel struts to north side of excavation.
- Excavate top down through mole holes to Basement B1 level. Note this includes the B1 basement above the NLEB
- Construct Basement B1 floor slab as permanent propping to retaining wall.
- Install reinforced concrete walls and Lower Ground Floor slab as access becomes available.
- Excavate top down through mole holes to Basement B2 level.
- Construct Basement B2 floor slab as permanent propping to retaining wall.
- Complete basement lining walls, core walls and slab at lower ground floor.
- Remove temporary plunge columns and temporary props.

Superstructure construction (can commence once ground floor complete):
Building A Superstructure:

- Cast Cores Building A
- Install steel structure to floor plates and rentrant steel deck up to level 4 on south of building fixing back to core.
- Cast floors.
- Install trusses all round on temporary supports at 4th floor level.
- Insall longspan steel structure to remaining floor plates and rentrant steel deck to top floors of building.
- Cast floors.
- Install steel structure to roof level bar.

Building B Superstructure:

- Cast Cores Building B
- Install first floor truss on Grid B2. Found on central temporary support point.
- Install truss to west facade. Found on temporary support point to south.
- Install longspan steel structure to floor plates and rentrant steel deck.
- Cast floors, connect to retained facade as construction progresses.
- Continue to roof level.
- Install steel structure to roof level bar and steel portal frame to roof behind St Giles High Street.

Building D Superstructure:

- Cast reinforced concrete walls and columns then construct reinforced concrete floor above.
- Repeat until top floor is reached.
- Connect to retained facade as construction progresses.
- Install large containerised plant units.
- Install steel portal frame structure to roof.
- Once the superstructure for Buildings B and D is complete and connected to the retained façade the temporary façade retention to St Giles High Street may be removed.

Building C Superstructure

- Cast reinforced concrete walls and columns then construct reinforced concrete floor above.
- Repeat until top floor is reached.
- Install large containerised plant units.
- Install acoustic wall to open plant enclosure.

9.2 Basement Design Engineer role during Construction Phase

9.2.1 The Basement Design Engineer shall act as an external independent reviewer of the monitoring reports.

9.2.2 The Basement Design Engineer will maintain a specific role on site during basement construction and will have a representative on site 2-3 days each week to monitor the construction process of the basement. They will feedback any concerns to the main contractor and employer so that all concerns are addressed.

10 TEMPORARY WORKS

10.1 Top Down Construction

10.1.1 Top down construction has been adopted for the St Giles Circus basement construction in order to speed up the overall construction programme, reduce the movements experienced by the adjacent buildings and infrastructure, and create laydown and working space for the superstructure works.

10.1.2 The sequence of works shown in section 9.0 of this report utilises the ground floor slab to form a prop to the retaining wall in the temporary and permanent cases. Excavation then proceeds down to the Basement Mezzanine slab, which also forms a prop to the retaining wall in the temporary case. With props at two levels it is then possible to excavate down to the main basement B1 slab formation level with the retaining walls over the Crossrail and LUL tunnels (where the toe embedments are minimal) cantilevering below the Basement Mezzanine slab until the main basement B1 slab is cast.

10.1.3 Once the basement B1 slab has been cast, the excavation can proceed to basement B2 level with props at ground floor, basement mezzanine and basement B1 level. Casting the B2 basement slab provides the lowest level of permanent propping and enables the temporary props at Basement Mezzanine level to be removed.

10.1.4 The piled retaining wall detailed design, undertaken by Coffey's on behalf of Cementation, has been reviewed by the Basement Design Engineer to see that it complies with the design criteria and construction sequence for the basement. The piled wall design includes each key stage of construction for the different cross-sections of the retaining wall around the basement perimeter.

10.1.5 Checks have been undertaken to confirm that at the lowest level of excavation the mass of London Clay below the excavation is sufficient to resist the hydrostatic water pressure and prevent the base of the excavation from blowing. This is conservative as the ground water is under-drained with pore water pressures that rarely exceed 100kPa (see figure 4.1).

10.2 Plunge Columns

10.2.1 The ground floor slab is cast in advance of the basement excavation and the subsequent internal structures. As a result a system of plunge columns are installed with the bored piles to prop the ground floor slab in the temporary case during basement excavation and construction. The plunge columns are designed to support the worst case axial loads during both the construction stages and (where appropriate) in the permanent works.

10.2.2 In the construction case the plunge columns are designed for the following loads:

- Self weight of the whole superstructure and sub-structure excluding the B2 slab.
- Self weight of the cladding to the superstructure.
- An imposed construction load of 1.5kPa to the superstructure.
- A 5kPa super imposed dead load on the ground floor slab.
- A 25kPa imposed construction load on the ground floor slab, with localised higher loads for cranes and lifting.
- A 5kPa imposed construction load on the remaining basement slabs.

10.2.3 For the construction load case the following two scenarios were considered for the effective length:

- The basement excavation has proceeded to Basement Mezzanine level, but the slab at Basement Mezzanine is yet to be cast, leaving the column restrained by the ground floor slab and the infill around the column. The effective length in this case is conservatively considered as the length between the ground floor and the B1 slab. In order to allow for construction tolerances and eccentric connections the column is designed for an eccentric load applied at Height/400 plus the distance from the centre of the column to a connection 100mm from the face of the column.
- The basement excavation has proceeded to B1 Basement level, but the slab at this level is yet to be cast and the column under consideration is not connected to the Basement Mezzanine level slab (column passes through box in box structure), leaving the column restrained by the ground floor slab and the infill around the column below B1 level. The effective length in this case is conservatively considered as the length between the ground floor and the B2 slab. As all the columns in this area support beams that bear on the column head, the column is designed for an eccentric load applied at Height/400 plus the distance from the centre of the column to the face of the column.

10.2.4 The above loads were coupled with a 50kN horizontal point load applied at any height to allow for impact during construction.

10.2.5 In the permanent case the plunge columns were designed for the worst case combination of permanent and variable loads over an effective length equivalent to the maximum height between storeys. See Appendix D9 for the plunge column design calculations.

10.3 Temporary Works Steel Beams

10.3.1 At ground floor level the construction sequence requires a system of temporary steel beams to support the slab over the NLEB and the Crossrail tunnel exclusion zone in advance of constructing the B1 basement slab and the columns that are supported by it. The temporary steel beams are supported by the plunge columns and in some cases the perimeter piled wall. Figure 10.1 shows the proposed arrangement of the beams

10.3.2 The ground floor temporary works beams below Building D are also required to support the Basement Mezzanine slab over the Crossrail exclusion zone in the temporary case. To facilitate this a series of steel hangers are dropped from the Ground Floor temporary works steels. The hangers continue down to B1 basement level and after construction of the B1 basement raft slab form the permanent columns that support the Basement Mezzanine slab, Ground Floor slab and Building D superstructure above. Figure 10.2 shows the proposed arrangement of supporting beams and hangers in Building D.

10.3.3 It is important that the concrete lining to the secant piled wall is cast between Basement Mezzanine and Ground Floor slab levels prior to excavating below the Basement Mezzanine slab in Building D. This is because the piled wall has a limited toe depth above the Crossrail tunnel and can only support the weight of the Basement Mezzanine and Ground Floor slabs prior to excavating below Basement Mezzanine level. The lining wall will act as a deep beam that supports the Ground Floor and Basement Mezzanine slabs by spanning between deep piles outside the Crossrail exclusion zone.

10.3.4 The temporary works steels are designed for the construction loads identified in Appendix D1 and the calculations are presented in Appendix D9. Refer to Appendix D8 for the drawings showing the final arrangement of the Temporary Works Steel Beams.

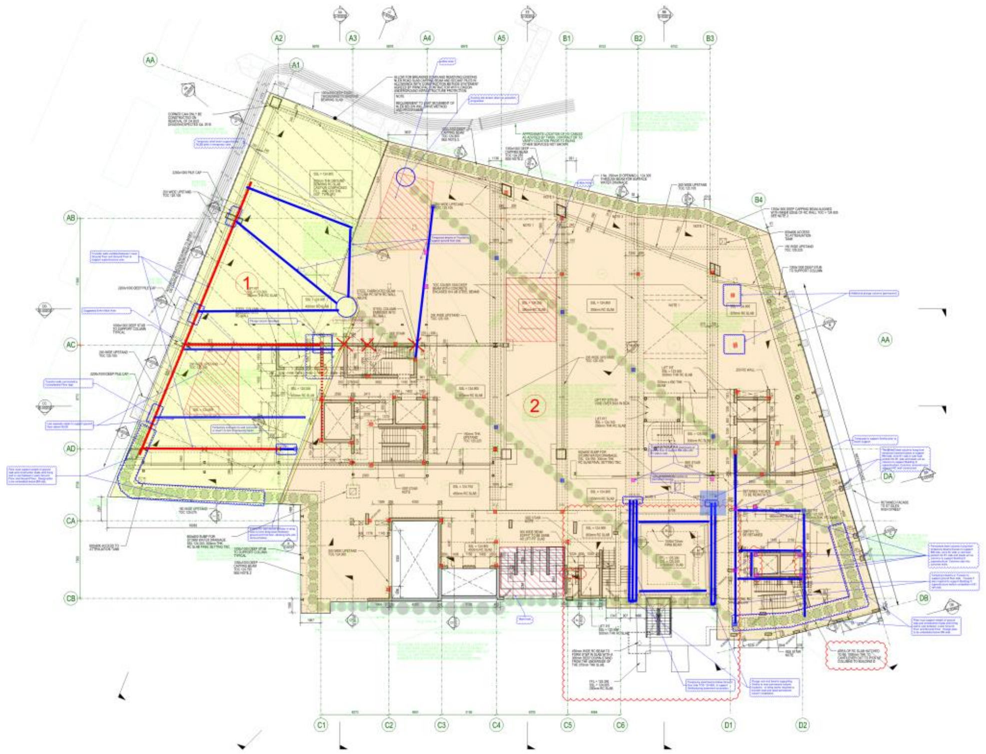

Figure 10.1: Temporary Works steel (shown blue) to support ground floor slab over NLEB and Crossrail exclusion zone.

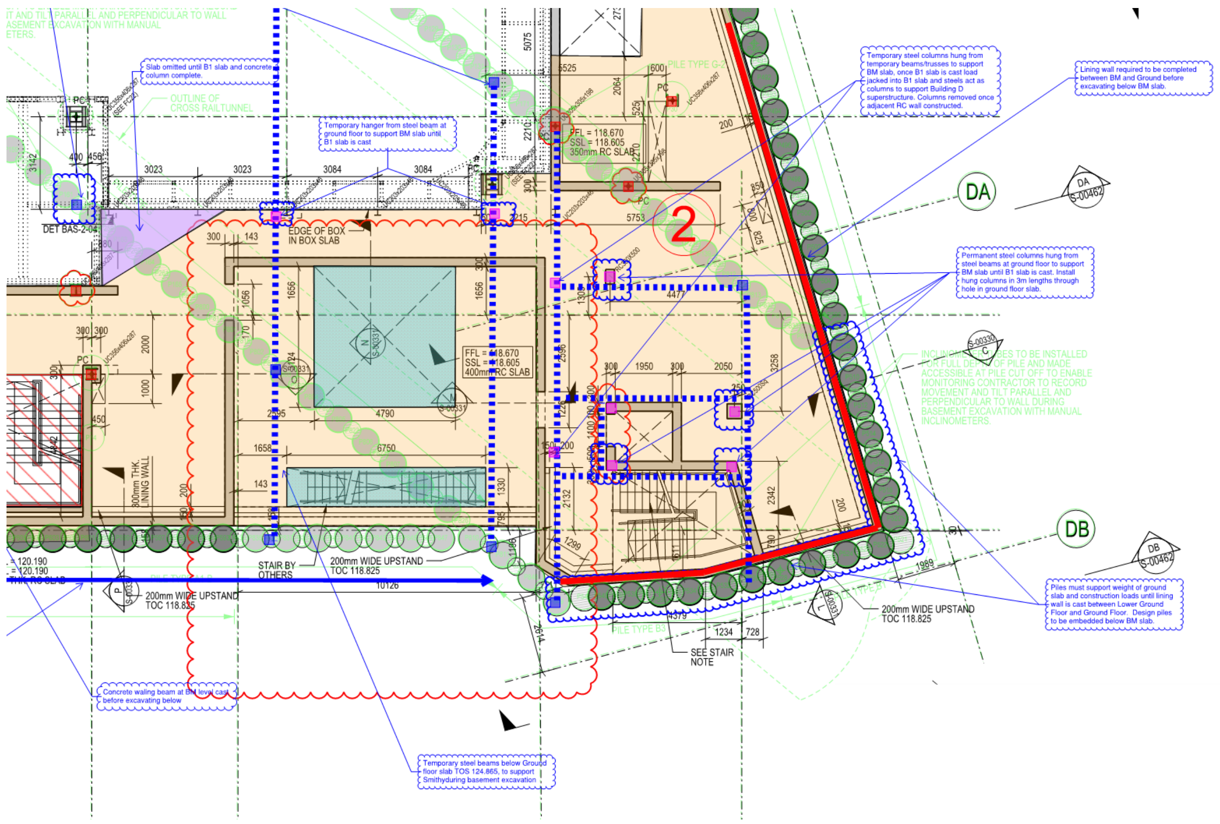

Figure 10.2: Building D steel hangers (shown pink) to support Basement Mezzanine slab over Crossrail exclusion zone.

10.4 Out of Balance Forces

10.4.1 The existing ground level on the north side of the site is at approximately 125.1m ATD. Immediately to the south of the proposed basement the existing ground level is approximately 122.0m ATD due to the lower ground floor in the existing adjacent properties.

10.4.2 As a result there will be a net horizontal earth pressure applied to the upper parts of the basement. In the permanent condition this earth pressure will be balanced by increased passive pressures on the south side of the basement and shear forces generated in the lining walls, perimeter piled walls and load bearing piles. The out of balance forces will be at their most critical during the early stages of construction when the basement has been excavated down to Lower Ground Floor or Basement Mezzanine level.

10.4.3 In these cases there are two principle systems for resisting the out of balance forces:

- The ground floor slab acts as a deep beam that spans between the hard-firm secant piled walls to the west and east of the basement with lateral forces taken by shear between the ground floor slab and the piled wall and then through the piled wall itself.
- The ground floor slab is propped on the south side next to the adjacent buildings by concrete shear walls cast between the lower ground floor capping beam and the ground floor slab, with the shear walls supported by plunge columns and the earth pressures from the north side resisted by increased passive pressures behind the piled wall on the south side.

10.4.4 For the temporary works design the second system has been used to verify the stability of the basement during construction, with preliminary checks on the first system providing an enhanced factor of safety. Refer to Appendix D10 for detailed calculations.

10.4.5 Prior to constructing the shear walls between the lower ground floor capping beam and the ground floor slab the out of balance forces will be resisted by the piled retaining wall on the north side of the site acting as a cantilevered retaining wall above the formation of the lower ground floor slab. The design of the piled retaining wall considers this construction stage. Refer to Appendix C3 for further details.

10.4.6 The magnitude of the net out of balance force compared to the total force on the retaining walls is considered to be small. In the temporary construction case it has been shown that the Southern retaining wall has capacity to resist this (ref passive checks in appendix D10). In the long term this is further enhanced by the lining walls that will add stiffness to the basement box (mobilising the secant piled walls on the East and to a lesser extent the West sides, transferring out of balance forces from the ground floor slab to the base slab and then to the load bearing piles) to control sway in the basement structure. In terms of the effect on neighbouring building movements, it is noted that it will be of benefit as it will reduce the movement of the Southern retaining wall during excavation. Neither the 3d Plaxis ground movement model, nor the XDisp model (reference Appendix M2) has taken this into account, so the overall assessment of movement of the neighbouring buildings remains conservative.

10.5 Horizontal Propping

10.5.1 The top down construction sequence requires props to the basement retaining wall at ground floor, basement mezzanine, B1 basement and B2 basement levels. Props at ground floor, B1 basement and

B2 basement levels are formed by casting the permanent works slabs over the footprint of the basement in advance of excavation below these levels. At basement mezzanine level the arrangement of the box in box structure for the Events Gallery prevents casting a permanent slab over the whole footprint of the basement or against the basement retaining wall on the north side of the basement.

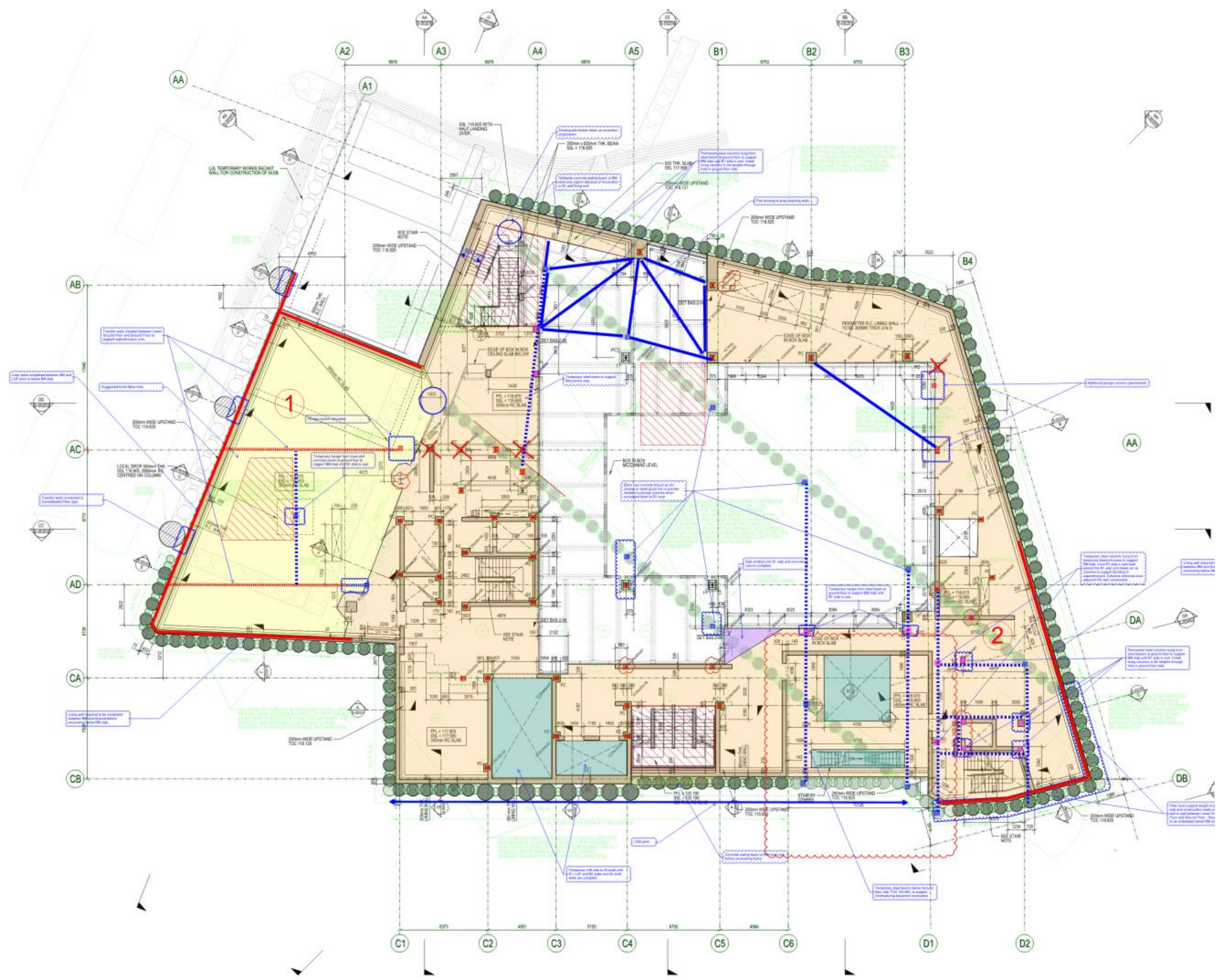

Figure 10.3: Basement Mezzanine and Temporary Works steel (shown blue) form ring beam to prop retaining wall.

10.5.2 In order to form an effective prop at this level during construction the basement mezzanine slab is supplemented with some temporary works steel props and whalings that work with the basement mezzanine slab to form a stiff ring beam around the perimeter of the basement, see figure 10.3.

10.5.3 The estimated stiffness of the propping system has been provided to the retaining wall designers and the retaining wall designers have provided the predicted prop reactions at each level. The propping forces provided by the retaining wall designers (see Appendix C3) have been checked against the propping forces that the concrete slabs have been designed for (Appendix D10) and used to design the steel temporary propping (see Appendix C5).

10.6 Temporary Works to Adjacent Buildings

10.6.1 Prior to basement construction commencing a demolition and enabling works package has been let to H Smith. This includes installation of the façade retention steelwork at 52 to 58 St Giles High Street, filling of the existing pavement vaults at 52 to 58 St Giles High Street with foamed concrete and installing temporary bracing within 59 St Giles High Street to retain the party wall.

10.6.2 Prior to lowering the existing ground floor within 28 Denmark Street a system of temporary props will be installed at the base of the retaining wall to replace the propping action of the existing lower ground floor slab until the new slab is competed.

10.6.3 As 26 Denmark Street is in a poor condition the internal structure has been propped at ground floor level to relieve the load on the beam supporting the spine wall at first floor level and the gable wall facing 27 Denmark Street has been propped.

11 MONITORING REGIME DURING CONSTRUCTION

11.1 Adjacent Buildings

11.1.1 A system of monitoring has been installed by Site Engineering Surveys Limited (SES) on the front and rear of the adjacent buildings to the south of the proposed buildings and also to the retained façade on St Giles High Street. The system comprises of prisms that are fixed to the building facades and read by Automatic Total Stations (ATS). The ATS are positioned to sight a series of control points on buildings that are away from the development so that movements of any ATS fixed to the adjacent buildings that could be affected by the development are taken account of.

11.1.2 Figure 11.1 shows a plan of the facades that will be monitored as part of the development, although those south of Denmark Street (Zone 3) are yet to be installed.

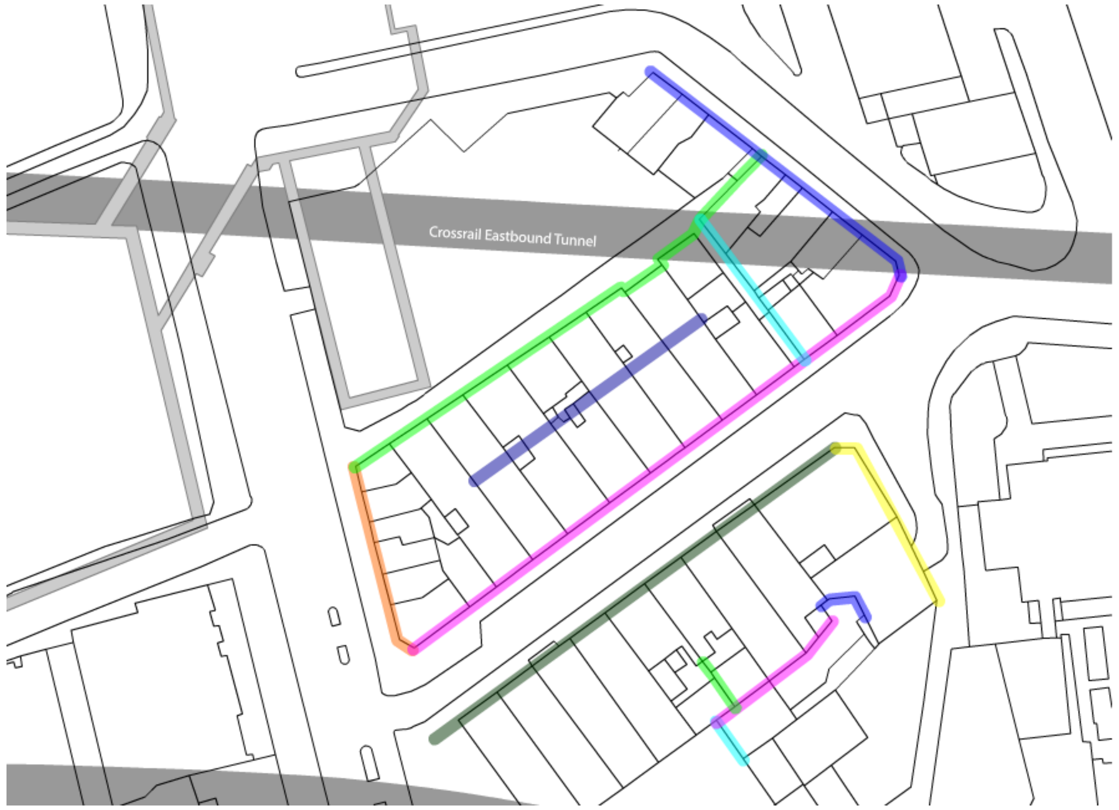

Figure 11.1: Plan of monitored facades at St Giles Circus Development (from SES website)

11.1.3 The majority of the prisms and ATS support brackets were originally installed for LUL/Crossrail as part of the Tottenham Court Road Station Upgrade Works, these were then purchased by the client and new ATS installed to commence monitoring in February 2015. Additional prisms have been installed on the rear façade of the Denmark Street properties (shown purple in figure 11.1). Initially it was not possible to sight these prisms from the ATS due to the mews buildings on Denmark Place so manual surveying was required during the demolition works, but now that these have been demolished these prisms will be added to the automatically monitored system. Figure 11.2 shows the prisms installed on the adjacent building elevations.

Figure 11.2: Denmark Street (north) and St Giles High Street façade monitoring (from SES website)

11.1.4 The amber trigger is intended to reflect the predicted movements, with the red trigger reflecting movements that would cause concern for damage to the building, usually at 1.5 times the amber trigger plus 2mm tolerance for the monitoring system. During pile installation, the monitoring points on the adjacent buildings have an amber trigger set at 5mm movement and a red trigger set at ~~10~~ 8mm movement in any direction. These figures take account of the 2mm accuracy of the monitoring system plus a H/1000 tilt over a typical 3.0m storey height before triggering an amber warning. During basement excavation the amber trigger level is set at 15mm and the red trigger level is set at 25mm, both of these triggers include the cumulative effect of pile installation and basement excavation and are based on the movements predicted in Appendix M2. For further detail on the monitoring plan and baseline results refer to Appendices M3 and M4. Further detail on the derivation of the trigger levels and the actions to be taken if the trigger levels are breached are presented in Appendix M7. Figure 11.3 summarises the monitoring points and trigger levels for the Adjacent Buildings

11.2 LUL Infrastructure

11.2.1 The LUL Monitoring Plan is also presented in Appendix M3. As the enabling and demolition works commenced in advance of the final submission for the permanent works, the Monitoring Plan has been designed to cover both the enabling and permanent works. A Monitoring Action Plan (MAP) with trigger levels for the escalators and underground structures has been agreed with LUL.

11.2.2 Site Engineering Services Ltd (SES) are also undertaking the monitoring within the LUL Infrastructure for the St Giles Circus project. Method Statements for installation of the submitted to and approved by LUL.

11.3 Crossrail Infrastructure

The Crossrail Monitoring plan is also presented in Appendix M3, has been agreed with Crossrail and is installed in the Eastbound Crossrail tunnel.

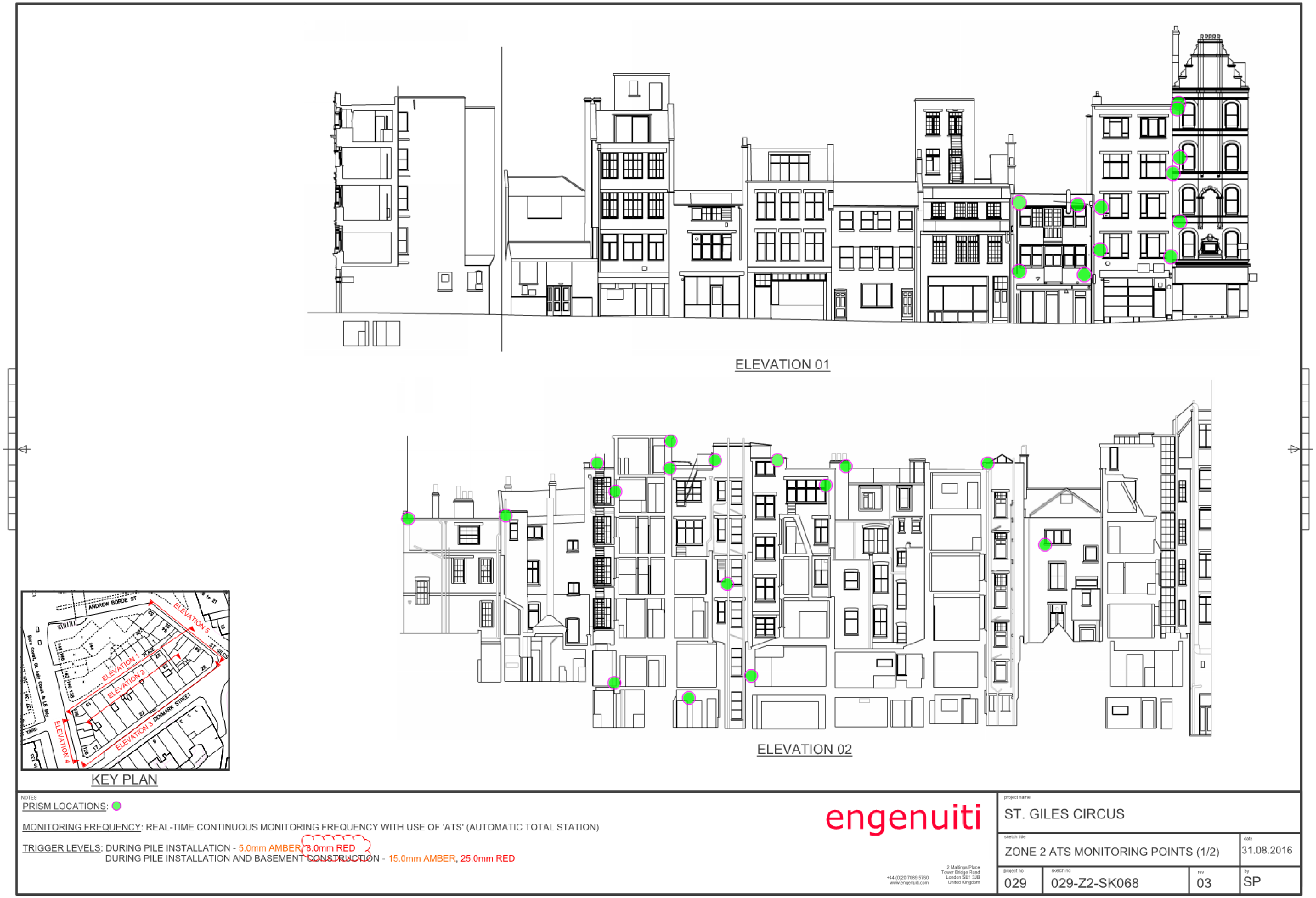

Figure 11.3: Adjacent Building Monitoring Points and Trigger Levels, part 1 of 2.

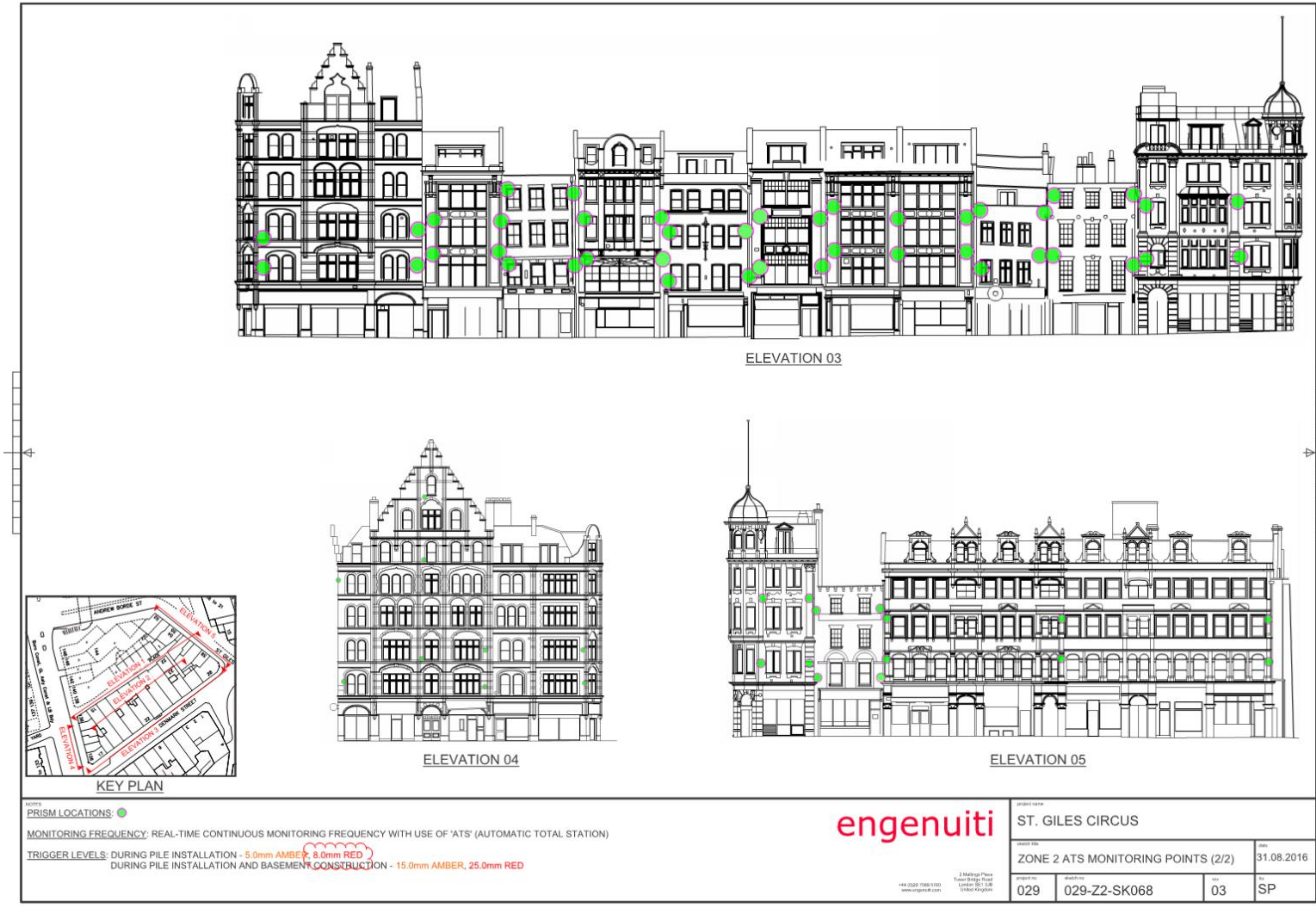

Figure 11.3: Adjacent Building Monitoring Points and Trigger Levels, part 2 of 2.