Abacus Belsize Primary School

Stage 3 Structural Report

BLUE ENGINEERING

May 2019

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REV 1 - 30/10/2018

REV 2 - 7/3/2019

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BLUE ENGINEERING

1.0 INTRODUCTION

This report has been produced by Blue Engineering on behalf of the Department for Education, for the proposed redevelopment of Abacus Belsize Primary School. This document covers the work undertaken during the Stage 3 (Scheme or Developed Design) stage of the project, a description of the main elements of the structure is given plus the design criteria and parameters to which the detail design of the project will be completed. Information has also been provided to allow the Cost Consultant develop the project cost plan.

It should be noted that this is preliminary and subject to refinement and amendment during the following stages of design. A suitable cost contingency should thus be made to allow for ongoing design development plus the unknowns and associated risks to the project.

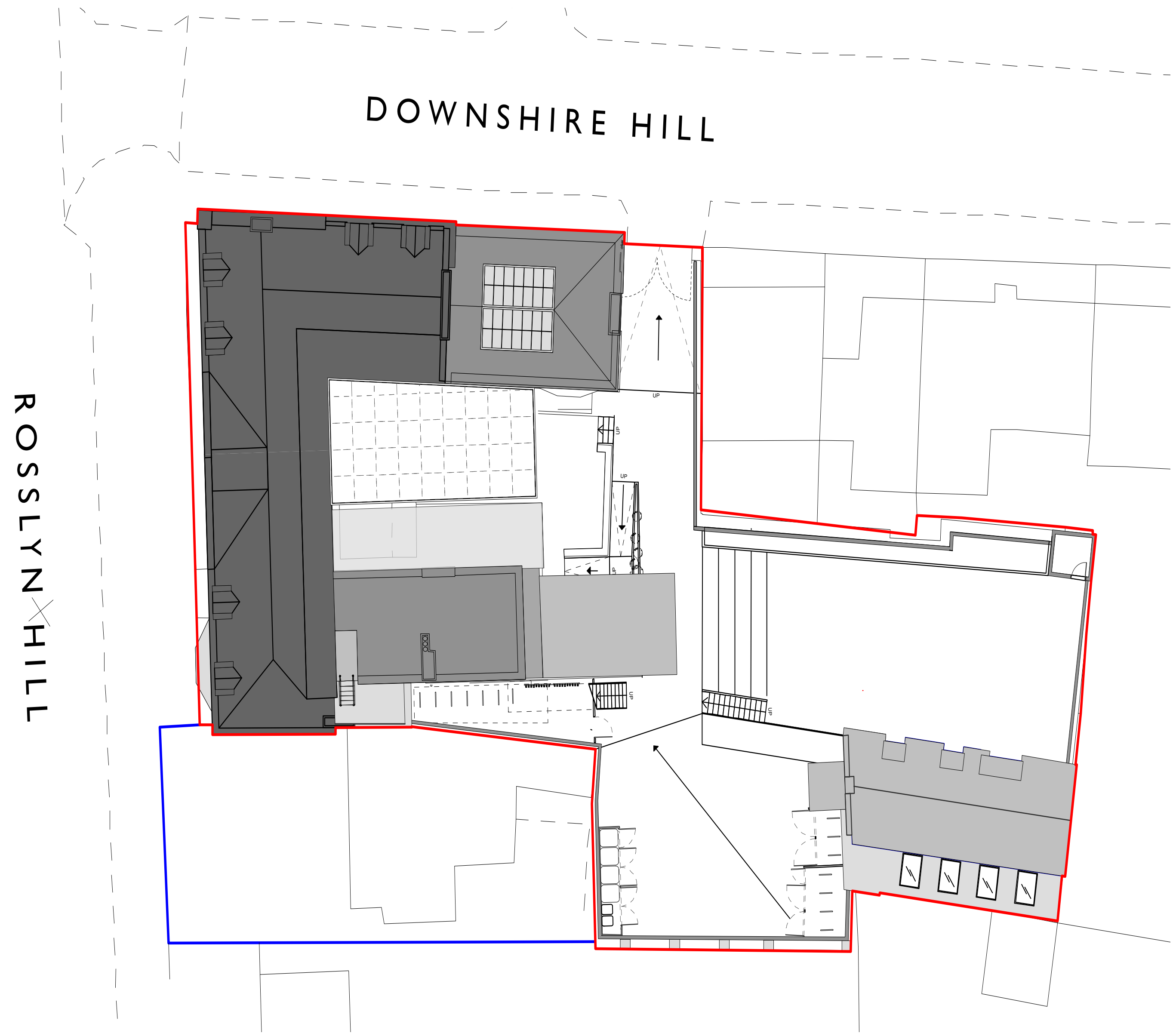


Fig 1 - Site Boundary

Fig 2 - Side Elevation

2.0 THE PROJECT

It is proposed to create a new site for the Abacus Belsize Primary School through the conversion of the former Magistrates Court and Police station, a Grade 2 Listed building, into a single form entry primary School and also Business and Enterprise Space (B1 use class). The project will retain all existing exterior features whilst creating appropriate spaces internally to suit the new uses.

The proposals, whilst generally aiming to minimise intrusive works to the structure, involve alterations which remove loadbearing walls and require new structure to replace their function. Principal of these is the creation of an open-plan School hall at ground floor with two floors of existing construction retained above, and consequently requiring transfer beams and associated columns and foundations. Other alterations generally throughout the site require steel beams and, in some cases, new columns and foundations. These works also include opening up the ground floor of the stable block to form a new classroom.

Full access to the site will be provided by creating some discrete interventions. These consist of installing a lightweight open floored entrance ramp above the lightwell on Rosslyn Hill, modifying slightly the entrance levels on Downshire Hill, and the insertion of a passenger lift within the building. Playground and internal floor levels are also being modified to ensure full access to the rear.

Fig 3 - Main Elevation

3.0 THE SITE

3.1 SITE LOCATION

The site is located in the London Borough of Camden, adjacent to 26 Rosslyn Hill, NW3 1PD, to the south of Hampstead village and in proximity to Hampstead Heath. National Grid reference is TQ 26852 85550.
The main building faces onto streets on two elevations, and the space to the rear backs onto garden walls to a number of different properties. The building also shares a wall with the neighbouring house at 26 Rosslyn Hill.

The surrounding area is primarily residential, with retail and restaurant provision close by in Hampstead village.

3.2 EXISTING BUILDINGS

The existing buildings were constructed in 1913, designed by the Architect John Dixon Butler, and designated Grade II listed in 1998. It has several distinct parts:

- A magistrate's court which comprises an open space at first floor level, offices at ground floor and cells at lower ground. This has different floor levels than the main building.
- The main police station building on 4 levels with pitched roof.
- The attached rear wing to the south, again on 4 levels but with flat roof and cells at lower ground floor.
- The annex building within the rear courtyard, a separate domestic scale 2-storey building possibly originally a stable.

The main building has been altered in a number of ways in the past to accommodate its former use. These alterations include external corridors and walkways (some of these caged for the purposes of moving inmates around), an external lift shaft, and mechanical plant located in the grounds at grade and elsewhere. The annex building has also had alterations to construct a concrete first floor and roof.
The structure has masonry walls, mass concrete strip foundations, proprietary joist and pot floors with concrete topping, and a trussed pitched roof constructed in timber. The main staircase is of cantilever stone or precast concrete construction.
The main building has a lightwell on the Rosslyn Hill elevation, enabling daylight into the Lower Ground level. The return elevation on Downshire Hill has no lightwell and the external wall at Lower Ground retains the footpath.

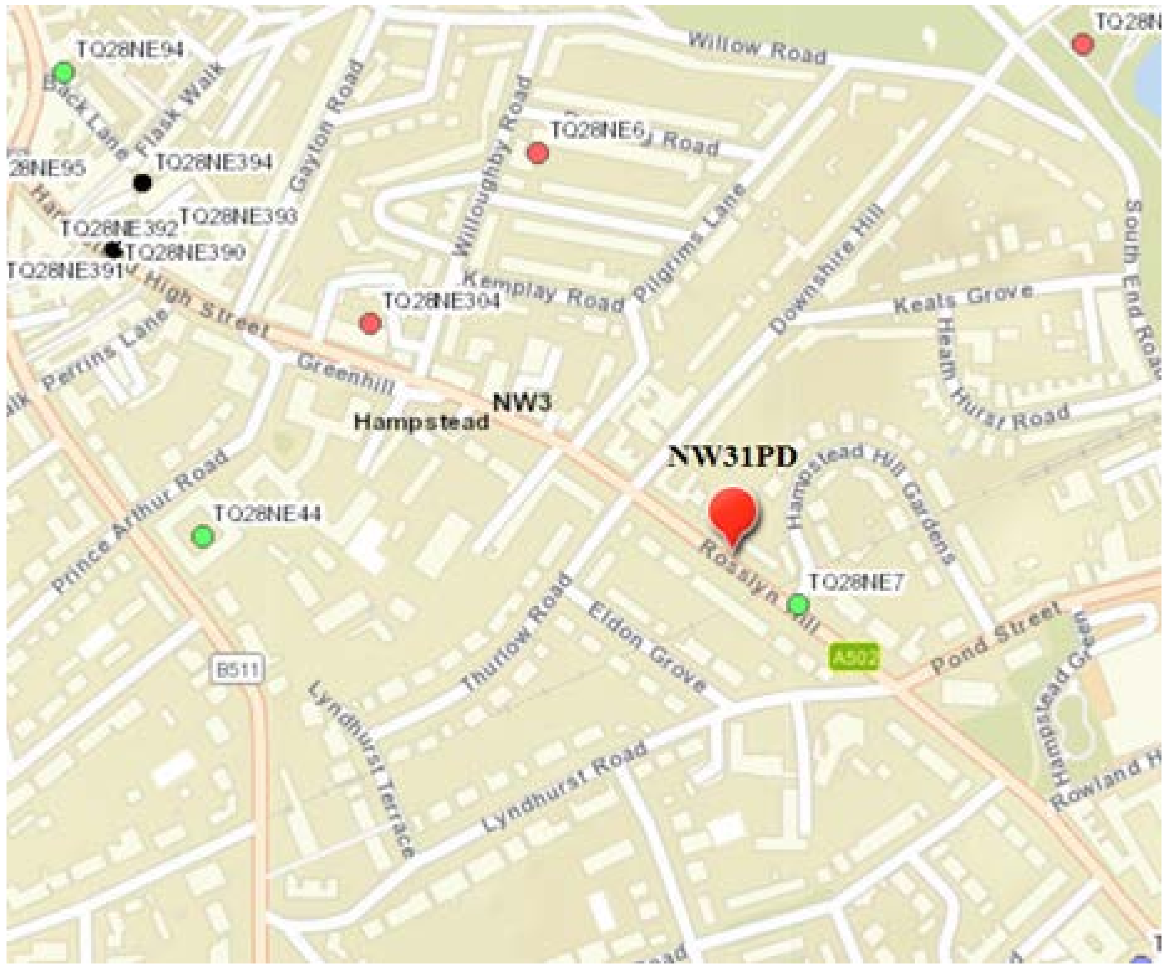


Fig 4 - Street plan

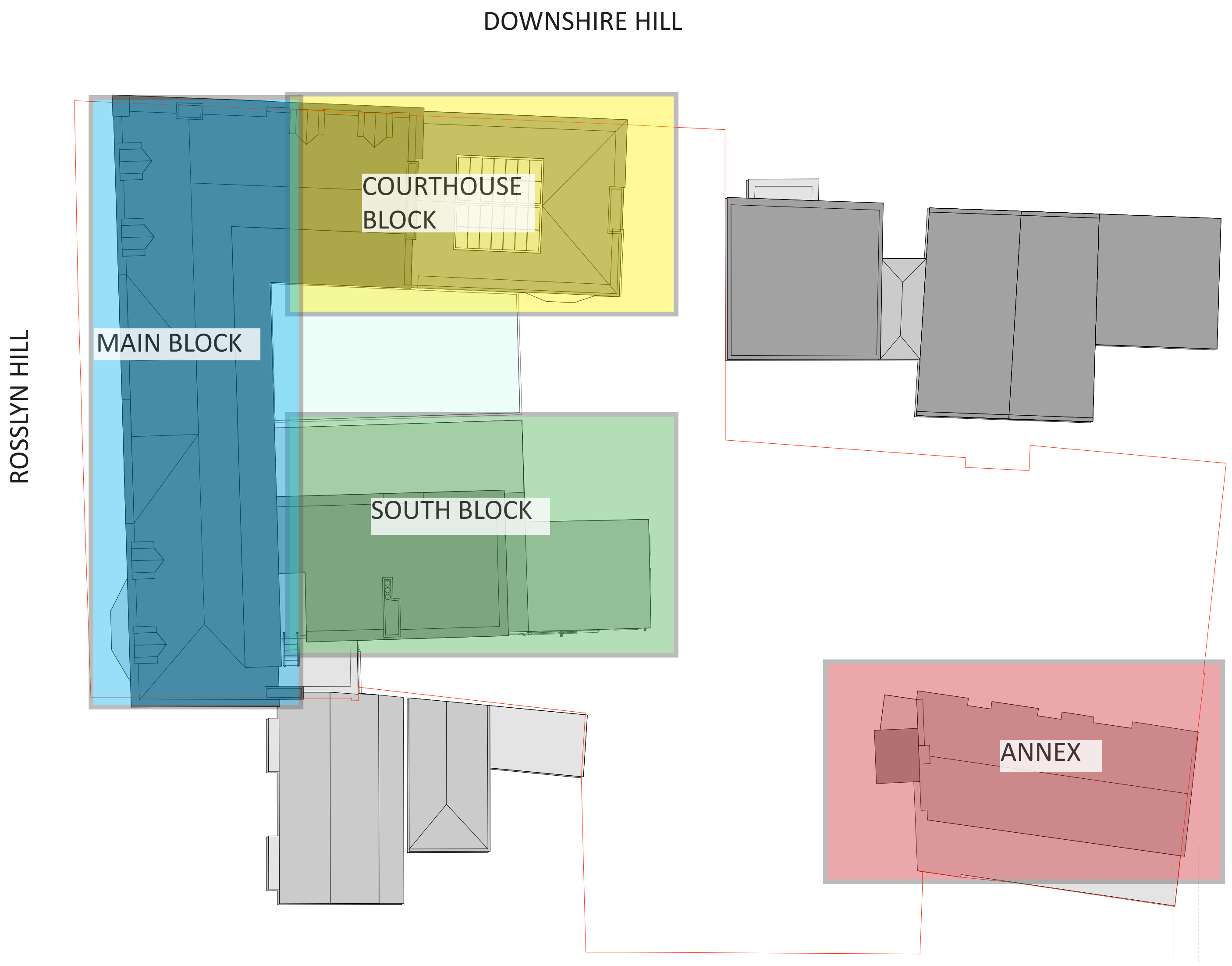


Fig 5 - Block layout

3.3 GROUND CONDITIONS

3.3.1 SOIL STRATA

In this vicinity soil conditions are alluvium overlying either the claygate member (clay, silt and sand) or London Clay. Publically available records available from the British Geological Society indicate the site is located on or near the boundary between these two zones.
The nearest publically available borehole records (1900 and 1963) indicate Clay and varied conditions ranging from fine sand with silt to laminated grey sandy clay.
We understand a full Soil Investigation was undertaken in 2015 during a previous scheme, by 'geosphere environmental ltd'. However this report has not been seen by Blue Engineering.
Limited information is available from three internal trial pits excavated at Lower Ground level. These indicate orange brown/grey sandy Clay approximately 300mm below floor level, with existing mass concrete footings founded approximately 1.25m below floor levels.

3.3.2 GROUNDWATER

The topography of the site suggests there may be a risk of a perched groundwater table. Records of internal trial pits excavated at Lower Ground level indicated no groundwater was found.

3.4 UNDERGROUND SERVICES AND FEATURES

Given the previous and current site uses, it is unlikely that there will be any major utilities crossing the site – although this should be confirmed by a full utilities search. The current structural proposals do not involve significant excavations that might disturb buried services. Works within the footpath that might require services alterations include alterations to two entrances (adjustments of steps to the main entrance and raising of pavement levels to the side entrance. No pavement vaults were seen beneath the pavement within the lightwell.
It is anticipated that Thames Water sewers run down Rosslyn Hill and Downshire Hill, together with other mains services. However it is not anticipated that a Build-over Agreement will be required. It is assumed that the below ground drainage design (to be carried out by others) will re-use existing connections to the main sewers and consequently no new connections will be required.
The London Underground Northern Line is located approximately on the line of Rosslyn Hill. However it is at depth and Hampstead station at 58.5m below street level is the deepest station on the network The depth of the tunnels is such that the proposed works will have no influence.

Fig 6 - Local subsurface Geology

Fig 7 - Underground railway map

3.5 SURVEYS AND INVESTIGATIONS

The structure of the existing main building was investigated, to a limited extent, during a previous scheme. A Condition Survey was prepared by Gleeds in 2015, which included the following sections:
- Condition Survey (Building Fabric)
- Condition Survey (M & E)
- Structural Engineers Investigations and Report
- Timber and Damp Survey Report (Timberwise)

The section Structural Investigations and Report, written by hsp consulting, highlights several defects - principally where timber roof structures are subject to damp and decay - and also describes in general terms the floor construction. Generally no major defects have been identified to masonry although the report highlights a number of areas where hairline cracking has occurred, which is principally a cosmetic issue rather than one requiring structural repair.
The timber and damp survey report by Timberwise identifies a number of areas where timber has decayed due to damp penetration, and due allowance should be made for repairs to structural timbers.
Investigations during this phase have added more important detail to the understanding of the structural make-up of the floors. An intrusive investigation determined floor construction, depth and span direction in a number of locations and this is summarised in Appendix B. The floor is constructed from steel joists at close centres, with infill between the joists being provided by two differnt systems. In some cases clay hollow 'pots' (extruded terracota blocks with voids formed in them) bear on the bottom flanges, supporting a loose 'clinker' concrete between and over the joists to make what would have been classified as a 'fire-proof' floor at that time. In other areas the floor appears to have no clay 'pots' and infill concrete appearsto be full depth - this is the more normal 'filler-joist' floor construction.
It was possible to establish the historical BSB sizes of joists from the survey and thus confirm their structural properties. This is discussed further in section 4.

Fig 8 - Courthouse building staircase at 1st floor

Fig 9 - Courthouse building underside of 2nd floor

Fig 10 - Main building roof interior

4.0 EXISTING STRUCTURE

4.1 MAGISTRATE'S COURT BLOCK

The Courtroom roof comprises a single span from side to side with a central pitched roof-light. The form appears to be collar - jointed trusses, likely in timber, with purlins and ridge members spanning between the trusses. The higher roof to the west uses the same construction as for the Main Block (described below).
The lower floors use filler-joist or joist and pot construction supported on load-bearing walls. For the area below the courtroom the floors are supported on a central load-bearing masonry support wall. At Lower-Ground level the wall configuration appears to have been altered by the building of cells for the Court using more recent masonry and these are assumed to be load-bearing also. There may be steelwork to support the central wall above, although it was not possible to established during survey. The staircase at the east end of the court building is supported at high level lower ground on beams.
The entrance/staircase area has differing floor spans, using the same form of construction. At high level first floor there are areas of secondary floors (approximately 1.2m below second floor) each side of the staircase and supported on the staircase walls. These staircase walls run down to basement level.

4.2 MAIN BLOCK

The main building has a pitched timber roof with dormers on the front and side elevations and a flat section to the rear. The structure is supported on timber beams at ceiling level spanning between steel beams which in turn sit on front and rear walls. In a number of locations the front beam, in line with the top of the dormers, is propped down to the second floor level with a series of timber posts, and these coincide with scarf joints within the timber beams. The roof also contains a small water tank platform supported on steel beams.
The intermediate floors are filler-joist or joist and pot construction, generally spanning front-to-back with intermediate support provided by the internal corridor wall. The span varies from floor to floor within the large room located behind the bay window.
The main staircase is a cantilever stair supported from the external wall in a style similar to a classic Georgian staircase (acting in torsion with loads transferred to the floor through interlocking treads). It is suspected the individual treads are concrete rather than stone. There were no significant signs of movement.
There is a stack of flues from lower level fireplaces which finds it way to a chimney stack at roof level. At first floor this stack offsets within the corridor at high level with three cross-walls supporting this offset.

Trial pits excavated under a previous investigation showed walls are founded on mass concrete strips at approx. 1.25m below floor level on orange brown/grey sandy Clay.

4.3 SOUTH BLOCK.

This part of the building has flat roof structures which appear to be filler-joist or joist and pot construction, the same as the floors. In some locations the line of the RSJ's was clearly visible from beneath: possibly indicating a breakdown of the waterproofing and subsequent corrosion.
The span direction and support wall arrangement in this block was not as determinate as in the main block, with wall locations varying from floor to floor. In addition the kitchen area at First Floor level had clearly been altered in the past although it was not possible to view above the false ceiling to determine the presence of any steelwork.
At high level at Ground Floor there is a previous alteration in the form of a long-span beam, presumably replacing a masonry wall. The form of floor construction is visible at this beam location, where finishes (and fire protection to steelwork) has been locally damaged.
In the rear area at Lower Ground level there is a small area of recently installed steelwork at high level. This was, presumably, installed to replace load-bearing walls that were supporting the floor over.

4.4 EXISTING FLOORS GENERALLY

The floor construction was found to consist of small section RSJ's at close centres with clay 'pot' infills and clinker concrete topping. The joist size varied from 50 x 100mm to 100 x 200mm, generally spaced at 650mm centres with overall floor depths of between 215 and 260mm. This structural depth was a reflection of the span of the floor. The floors are generally supported on load-bearing masonry walls of at least 215mm thickness.
Whilst the floor is not as heavy as insitu concrete it has good mass and would therefore be expected to perform reasonably in terms of acoustics.

4.5 ANNEX/STABLE BLOCK

The annex/stable block building is a standalone structure within the grounds. The pitched roof to this building appears to be a domestic scale timber structure with purlins and ridge beams supported on cross-walls, and dormer windows to the front elevation.
The first floor is partially timber joists, and partially contemporary beam and block construction.
Supports at ground floor level comprise masonry walls and a beam supporting the float roof and upper wall. It was not possible to confirm the construction – potentially either reinforced concrete or concrete encased steelwork.

Fig 11 - Interior of Courtroom

Fig 12 - Top floor main building

Fig 13 - South block

Fig 14 - Annex building

A section of the suspended timber ground floor and staircase had suffered significant decay and collapsed.

4.6 LATERAL STABILITY

The main buildings are robust masonry structures with an inherently stable rectangular form and a floor structure that gives good diaphragm actions in terms of transmitting horizontal forces to walls.

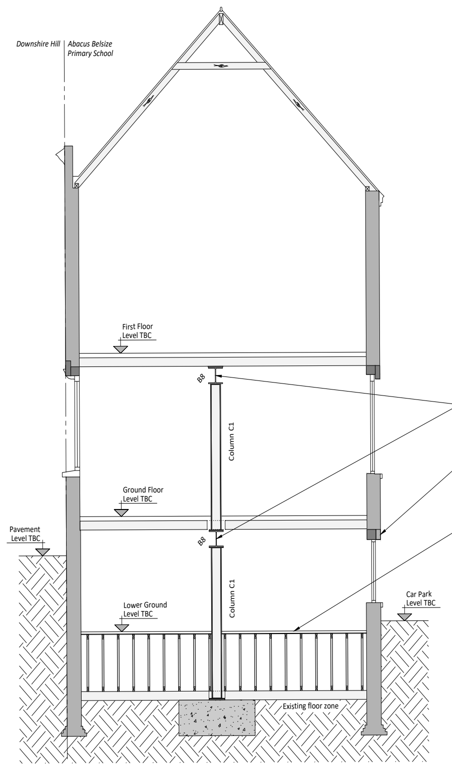


Fig 15 - Proposed section through Courthouse

5.0 PROPOSED STRUCTURAL WORKS

5.1 MAGISTRATES COURT BLOCK

The courtroom and roof are not being altered and, other then making any repairs that are necessary due to damp and decay, there are no structural works at the upper level.

At Ground floor and Lower Ground it is proposed to remove internal load-bearing walls, and a central steel beam and column structure is being introduced to replace them. Due to the long span it is proposed to introduce two intermediate columns, to permit a shallower/lighter section to be used, and these will require new foundations. As noted above the current cell layout suggests there may be additional structure to remove at high level Lower Ground, and further investigation should be carried out to determine this at the next stage and confirm the proposed structural arrangement.

It is proposed to raise the floor level at Lower Ground level to improve access. This is specified as a lightweight timber structure for reasons of economy. Suitably treated timber would be required, and dpc's and ventilation should be designed in to maintain a dry environment. In addition door and window openings will be altered to allow for adequate headroom.

The existing staircase will have limited headroom beneath, after raising the floor, and so this space could be designated for storage.

The floor investigation yielded the result that the Business and Enterprise Space at ground floor level may have insufficient load capacity to offer a full range of uses. Thus, consideration should be given to a more specific assessment of the proposed usage in order to avoid the need to strengthen this section of floor.

5.2 MAIN BLOCK

At roof level the intrusive support posts are to be removed by insertion of some carefully placed cranked steel beams supported on the external walls and wedged up to the underside of the roof beams. The new lift shaft over-run is planned to fit below the existing roof with no alterations required.

In a number of locations masonry support walls are to be locally removed to open up rooms and, here, isolated steel beams are specified - dry-packed up to the underside of the floor over on the line of the wall. Suitable temporary works will be required to allow the removal of the wall and insertion of the steelwork.

At Ground Floor level it is proposed to remove the main masonry wall dividing the main block from the Magistrates Court block -substantial steelwork is required to support the heavy loads in this wall.

Within the staircase area at Ground Floor it is proposed to remove sections of the main corridor support wall to open up the area for circulation. Steel beams and columns are required to support the floors and walls above and transmit the loads back into the support walls below.

A new circulation staircase is to be inserted at the south end of the block. This will be supported on masonry walls, which will also re-support the existing floors at some levels (depending on floor-span directions). New mass concrete strip foundations are required for this.

For alterations to the floors formation of small openings, where located between RSJ's, would be straightforward, requiring insitu concrete to fill in the over-break. Larger openings requiring cutting RSJ's would require the insertion of steel trimmer beams below floor level. One internal chimney flue, on the Downshire Hill side, is being removed and this will require the floor to be re-supported locally with steelwork and the voids created in the floor to be infilled with insitu concrete. All chimney stacks are to be retained at roof level to maintain the roofscape.

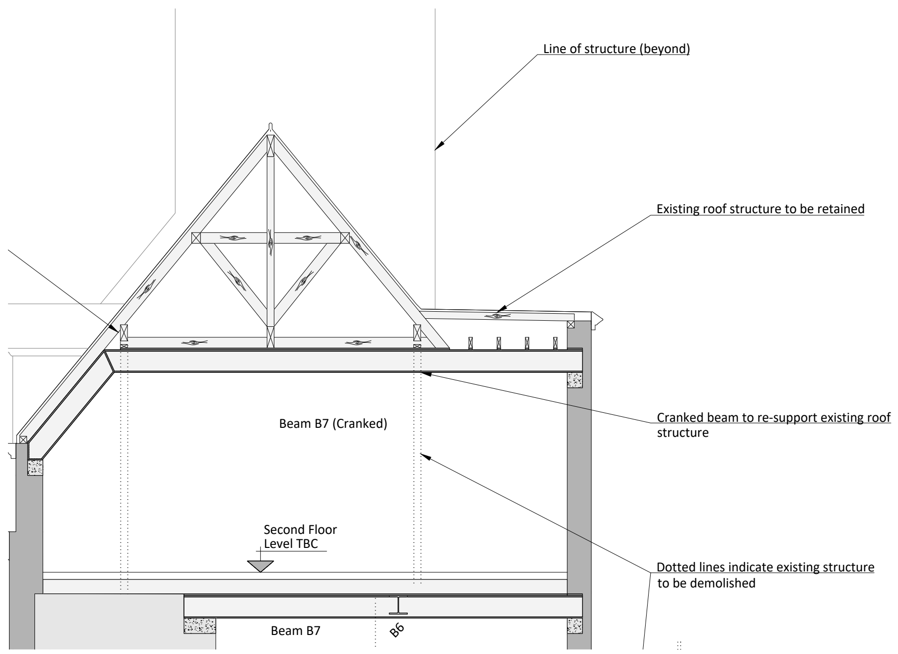


Fig 16 - Proposed section through Main building

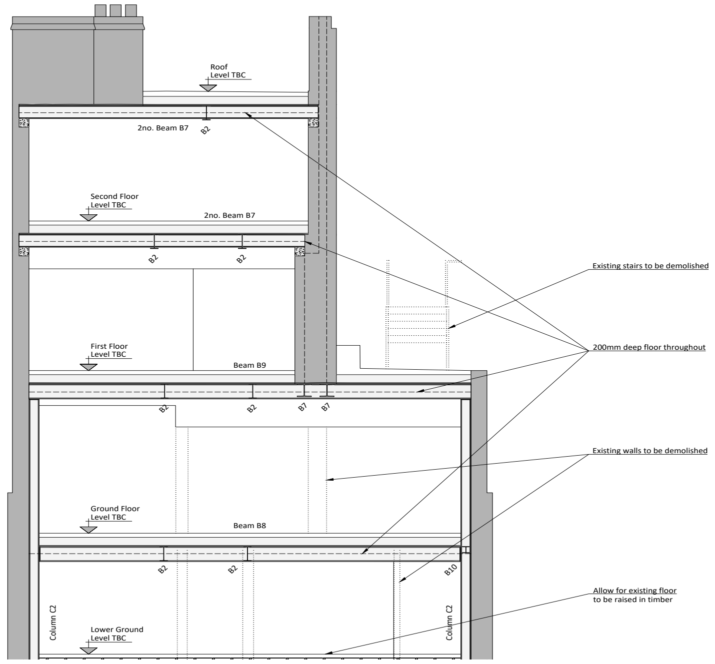


Fig 17 - Proposed section through South block

5.3 SOUTH WING

5.3.1 School HALL

The proposed location of the School hall is at Ground Floor level. By its nature the hall requires an open space without vertical structure, where currently there are a number of load-bearing walls. Because this wing steps in above, at first floor level, there is a heavy external wall to be supported. The chosen solution is to use a series of steel transfer beams within the ceiling of the hall, supported on two-storey columns on new foundations. The span of these beams, some 9.5m, means that the governing design criteria is deflection – too high a beam deflection would lead to undesirable cracking above and noticeable sloping in the floors. In keeping the depth of the beams to a minimum, to maximise space within the hall, we have chosen to use compact UC sections – these need to be heavy, at 467 kg/m, to meet the deflection limits. The more economical alternatives, of using deeper UB sections, or introducing internal vertical structure, were explored and ruled out due to their negative impact on the usability of the space during this design stage.
The footprint of the Ground Floor is being extended into what is currently external space, to create a rectangular hall. The floor is formed in concrete on metal deck, supported on steelwork. The roof is to be constructed using timber joists - the option of using concrete on metal deck, as the new floor below, was ruled out on grounds of economy.
At Lower Ground level similar steel framing is required, although the sections are less heavy here as they do not need to transfer masonry loads from above.

5.3.2 OTHER ALTERATIONS

A number of internal load-bearing walls are proposed to be removed and isolated steels are proposed, supported on external walls. In addition it is proposed to remove the internal flue stack up to second floor level (all chimney stacks are being retained above roof level). This is to remove as much of the dead weight of masonry as possible and thus reduce the weight of steel required at lower levels. This will create a void in the floors where the flue stack is removed, and this can be infilled with insitu concrete.
It is proposed to raise the floor level at Lower Ground level to improve access. This is specified as a lightweight timber structure for reasons of economy. Suitably treated timber would be required, and dpc's and ventilation should be designed in to maintain a dry environment. Door and window openings will be altered to allow for adequate headroom, highlighted on the drawings.

5.4 ANNEX BUILDING

Supporting walls are to be removed to allow the opening-up of the lowest level to form a classroom space. New steel framing is required to support the floor and beams over. To maintain lateral stability a sway-frame is to be provided with moment connections between the beam and columns. In addition extensive repair and/or replacement of timbers affected by decay will be required.

5.5 ENTRANCE RAMP AND STAIRS

In order to provide an accessible main entrance a new pedestrian ramp is to be installed above the light-well area between the footpath and the building. This will be a lightweight steel structure with an open mesh deck to maximise daylight to the spaces at Lower Ground. Structural hollow section steel sections are proposed, which would be galvanised for durability. To avoid fixing structure into the facade of the existing building, new columns and foundations, as well as the existing masonry bracing walls, are to be used for vertical support. In addition the existing stone entrance steps and landing will be rebuilt further way from the building to provide a level platform for the ramp.

5.6 COURTYARD CANOPY

A glazed canopy is proposed to be installed between the Court building and the South wing. This will be a single-glazed construction (glazing designed by a specialist contractor) supported on lightweight structural hollow sections, which would be galvanised for durability. To avoid fixing structure into the facade of the existing building, columns and foundations are proposed to support this structure. The perimeter will need to incorporate movement provision between the canopy and the masonry to accommodate lateral sway movements as well as construction tolerances.

5.7 EXTERNAL WORKS

The current external levels vary significantly across the site. It is proposed to rationalise these to create a more level playing surface.
In order to achieve this regrading will require construction of retaining structures in reinforced concrete and a certain amount of regrading. It is also propose to adjust levels by small amounts at the site boundary, and this will be done with the aim of maintaining or reducing the retained height of soil where boundary walls currently provide a retaining function. At the Annex building it is proposed to raise ground levels by a substantial amount (1.5-2.0m) and this will require a new retaining structure to be built to avoid surcharging the masonry. The annex wall would also require treating to prevent the ingress of moisture.

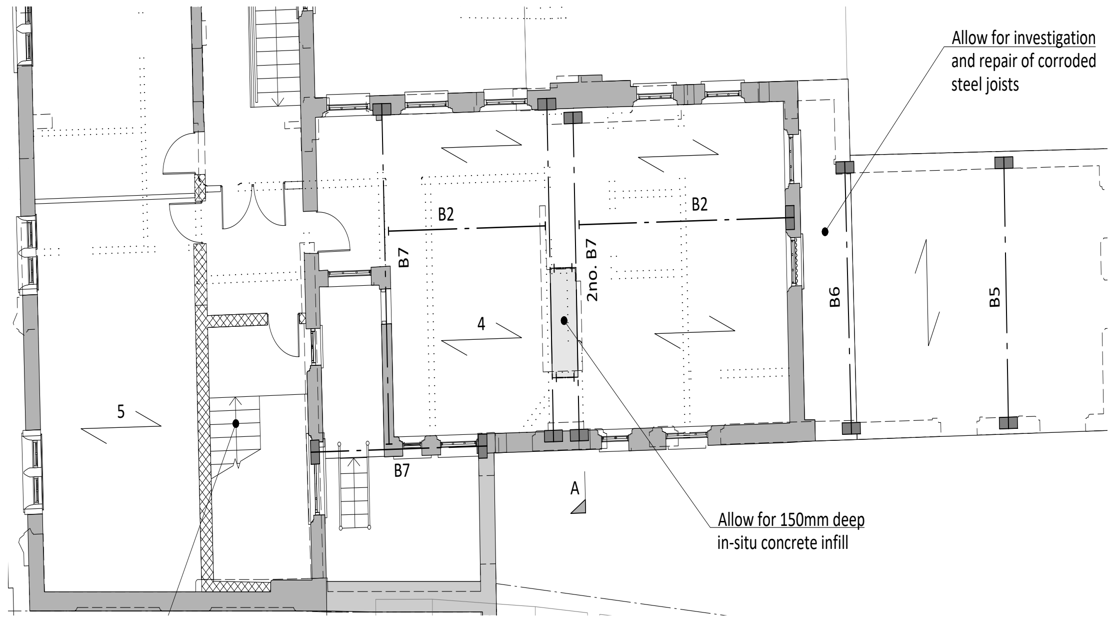


Fig 18 - Proposed plan South block

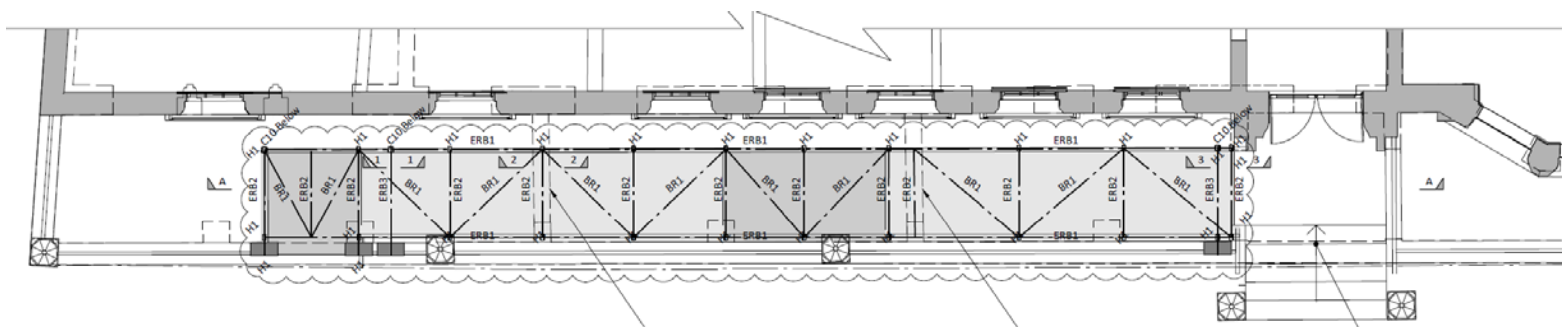


Fig 19 - Proposed plan Entrance ramp

6.0 FOUNDATIONS

The existing building is traditionally constructed on spread foundations. Our understanding of the site soil conditions is based on desk study described in section 3.3, and the trial pit record included in the information supplied to us during our briefing. This latter piece of information, by 'geosphere environmental ltd', includes three trial pit logs describing the subsoils as orange silty sandy Clay. No density or stiffness descriptions are given nor any insitu soil property testing.

Based on the above we have made a reasonable assumption of an allowable bearing pressure of 100 kN/m2, a value which would conservatively be applicable to this sort of subsoil. This may, however, be conservative, and savings could be made on the basis of a detailed investigation. We propose new foundations to be mass concrete spread foundations (pads or strips) and we do not believe it necessary to allow for piled foundations.

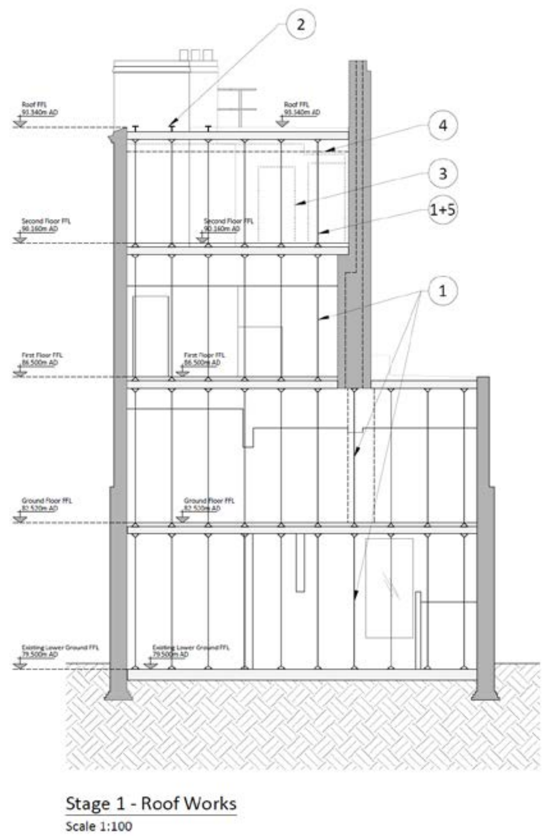
It is important that final foundations design is based on an accurate knowledge of the site soil conditions, either through release of the previous full Soil Investigation or by undertaking a new one.

7.0 DEMOLITION / TEMPORARY WORKS/CONSTRUCTION SEQUENCE

The works require demolition of a number of loadbearing walls and resupport of floors and walls onto new steelwork. This will use normal temporary works methodology of needles and props, with appropriate bracing, and designed by the contractor. New steelwork will be inserted and dry-packed up to the underside of the existing, and the steelwork has been designed to limit deflections to a maximum of 15mm but generally less than span/360 to minimise the movement of the superstructure and consequent risk of cracking. The area of works that is, perhaps, the most involved is where the new School hall is being created in the South block and a combination of long-span beams and transfers are being inserted below the first floor. Here we have developed an outline construction sequence demonstrating a safe methodology for propping and erection of new structure.

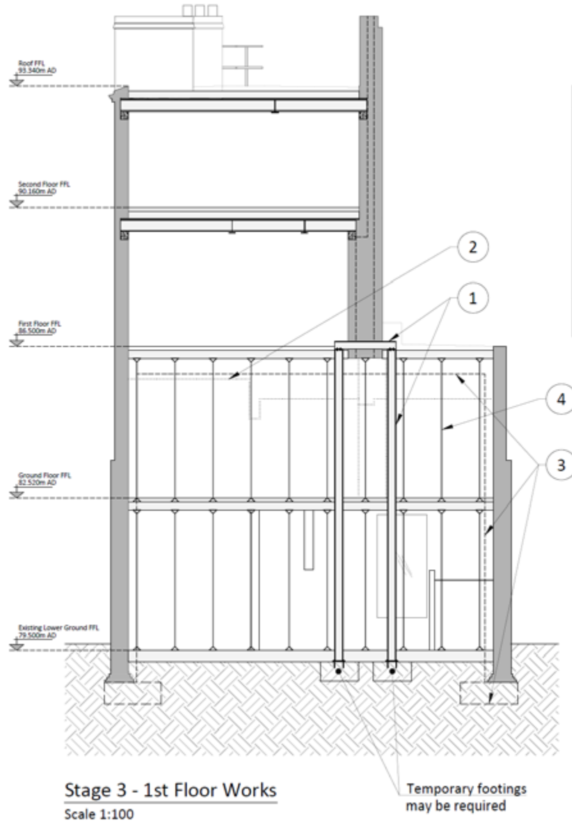
8.0 BASEMENT WATERPROOFING

The existing building has a number of areas where the internal Lower Ground floor levels are below ground and the masonry walls act as retaining walls. In addition the site groundwater levels are not known and there is a risk that basement floors could be subject to damp. Whilst there is not a structurally integral solution proposed (e.g. application of watertight concrete) consideration should be given to methods of enhancing the performance of the elements described above through tanking or other means. This could commonly be dealt with through a performance specification from the Architect.



	Sequence
1	Through prop from roof to lower-ground
2	Install needles to support chimney stack
3	Demolish walls and flue stack at 2nd floor level
4	Insert beams tight to underside of roof and dry-pack
5	Remove needles and top level of props

Fig 20.1 - Outline construction sequence South block



	Sequence
1	Install additional props and needles to support external wall
2	Demolish walls to ground floor level
3	Construct foundations and erect columns up to underside of 1st floor. Insert beams tight to underside of 1st floor and dry pack
4	Remove props at ground floor level

Fig 20.2 - Outline construction sequence South block

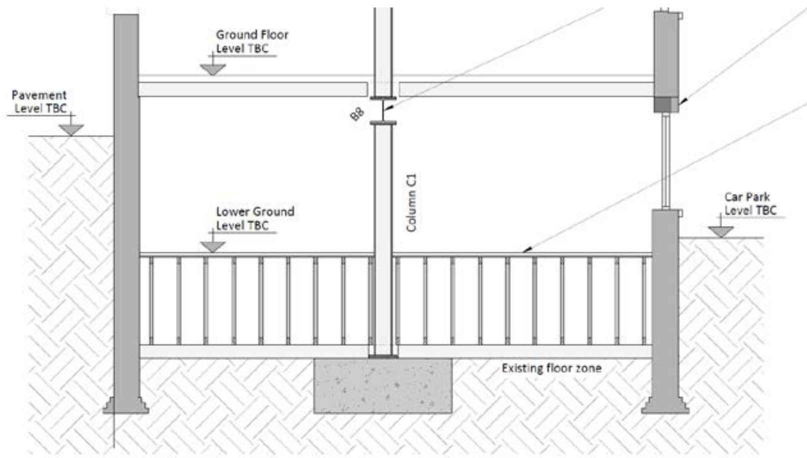


Fig 21 - Proposed raised floor construction

9.0 LOADS AND DESIGN CRITERIA

9.1 DEFLECTION

The structure has been designed such that deflections are limited to the following values.
Vertical Deflections
Slabs and beams generally
Deflection under total load = span/250
Deflection under imposed load = span/360 (or 20mm, whichever is lesser)
Cantilevers
Deflection under total load = span125
Deflection under imposed load = span/175 (or 20mm, whichever is lesser)
Horizontal Deflection
Deflection under total load = H/500
Note:
Horizontal deflection of vertical elements occurring under wind will be limited to the value above, where H is the height of the building above ground level.
All finishes, cladding and services, etc will need to be detailed to accommodate the movements indicated above.

9.2 SETTLEMENTS

For the purposes of preliminary design differential settlement between column locations will be limited to distance/500 with an absolute limit of 20mm (Reference: CIRIA SP27 pp.69). Total settlement will be limited to 25mm. All cladding, finishes and services must be designed and detailed to accommodate the above settlements.

9.3 DURABILITY AND CORROSION PROTECTION

Corrosion protection of the steel structure will generally be achieved by means of a suitable paint system, which will usually be specified to provide a life to first major maintenance of 15 years. The choice of protection will be influenced by location and aesthetics. Where steelwork is exposed to the external environment, such as canopy structures, a galvanized coating will improve durability and increase the periods between maintenance.

9.4 FIRE PROTECTION

The structure is required to have 90 minutes of fire protection for all primary elements. Generally the inherent fire resistance of concrete means that no additional fire protection will be required for concrete elements through suitable cover to reinforcement and minimum concrete section sizes. Fire protection for any steel structure is to be specified by the Architect, but could be any one of the following: encasement with fire-resistant board, spray applied mineral fibre, or intumescent paint coatings. Some elements may not require fire-protection, subject to verification by Building Control (for example the proposed external ramp structure). The existing joist and pot floor was probably designed and marketed as fire-resistant when it was constructed in 1914. However it is recommended that a Fire Engineer is consulted to verify its performance under fire and to specify any enhancements that may be recommended.

9.5 ACOUSTICS

The existing joist and pot floor is of reasonably robust construction and generally has finishes applied above it to isolate from impact sound. However it is recommended that an Acoustic Engineer is consulted to verify its performance under fire and to specify any enhancements that may be recommended. Where new floor structures are specified these may also need enhancement to provide adequate acoustic performance.

9.6 DESIGN STANDARDS

Since March 2010 Eurocodes and their associated National Annexes (providing country-specific design parameters), have superseded British Standards as the principle design codes for structural elements in the United Kingdom. Reference will be made to British Standards and other technical guidance where topics are not adequately addressed in the Eurocodes.
It is of note that while no longer current, the superseded British Standards generally remain cited within UK Building Regulations. The following codes and design guides will be used principally in preparing the structural design for the project. For the sake of brevity National Annexes are not listed:

•• Eurocode 0: Basis of structural design:
BS EN 1990:2002
•• Eurocode 1: Actions on structures:
BS EN 1991-1-1:2002, BS EN 1991-1-2:2002, BS EN 1991-1-3:2003, BS EN 1991-1-4:2005, BS EN 1991-1-5:2003, BS EN 1991-1-6:2005, BS EN 1991-1-7:2006
•• Eurocode 2: Design of concrete structures:
BS EN 1992-1-1:2004, BS EN 1992-1-2:2004
•• Eurocode 3: Design of steel structures:
BS EN 1993-1-1:2005, BS EN 1993-1-2:2005
•• Eurocode 7: Geotechnical design:
BS EN 1997-1-1:2004
Building Regulations: all relevant sections, including Approved documents A & B concerning structure and fire safety.

9.7 DESIGN LOADS

9.7.1 VERTICAL LOADS

In accordance with the requirements of BS EN 1990 and the building brief the following design loads have been adopted.

Dead loads
All structure dead loads are calculated based on the proposed material densities as per BS EN 1991-1
- Finishes and Services 2.00 kN/m2
- Cladding (average inc glazing) 3.50 kN/m2

Imposed loads
New structure has been designed to comply with the following imposed loading requirements as per BS EN 1991-1:

Usage	Imposed Load kN/m2	Partitions kN/m2
Entrance and Foyer	3.00	
Corridors and hallways	4.00	
Teachers rooms/offices	3.00	1.00
Classrooms	3.00	1.00
Community spaces *	5.00	
Halls	5.00	
Roofs	0.75	
Plant Areas (Various)	N/A	
* subject to specific usages		

Construction loads
The permanent structure is to be designed for the loads outlined above. Where the Contractor proposes to support construction loads on the permanent structure he will be responsible for verifying that such loads do not exceed the capacity of the structure. Where additional load capacity is required from the to support construction loads, the Contractor will be required to design and install temporary works to support these loads.

9.7.2 LATERAL LOADS

In assessing the lateral load on the building, the critical design case is the greater of either the notional horizontal forces or wind loading. Wind loads are calculated in accordance with EN 1991-1-4. The proposed structure has been designed for a wind load of 0.8 kN/m2. Notional horizontal forces, which account for lack of fit and eccentricities caused by construction tolerances, are calculated in accordance with the relevant material design code.

Steelwork EN 1993-1 cl 5.3.2:
0.5 % of total design (factored) dead and imposed load applied at that level

Concrete EN 1992-1cl.5.2:
0.5 of total design (factored) dead and imposed load applied at that level

9.7.3 MATERIAL GRADES

In-Situ Concrete:
- Reinforced Concrete to EN 206-1 C35/45
- Steel Reinforcement to EN 10080 fyk = 500/mm2

Structural Steelwork to EN 10025-2:
- General internal steelwork S355J0, S355 J0H
- General external steelwork S355J2, S355 J2H

All bolts to be grade 8.8 in accordance with EN 1338-1-8

10.0 RISKS UNKNOWNS & OPPORTUNITIES

These items should be addressed during the following stages of design with the goal of minimising or removing them where possible. The main risks related to structure identified during the preparation of the Stage 3 design are as follows.

Risk/unknown/opportunity	Mitigation
Water ingress at lower ground level	Ensure site ground-water level is confirmed in advance. Make allowance made for keeping excavations clear of groundwater during construction. Develop strategy for waterproofing below ground spaces.
Existing floor construction span direction varies from that assumed, requiring changes to the structural layout.	Confirm in advance of works all floor construction and span directions where alterations proposed, and check floor capacity
Predicted foundation settlements higher than anticipated once SI information obtained	Review new foundation sizes once SI information obtained
Corrosion of existing joists embedded within floors, particularly those located in vulnerable locations (e.g. flat roofs)	Localised further exposure of floor joists to confirm the extent of any corrosion and confirm if repair or replacement is the best option.
Timber decay due to moisture ingress (principally at roof level)	Review timber report previously carried out and undertake further investigations to confirm the extent of necessary repair or replacement
Roof coverings at the end of their life, with subsequent failure and water ingress.	Allow for replacement of all existing roof coverings, subject to survey.
Unanticipated discoveries during construction	Incude suitable allowance for investigations at start of construction, and suitable cost and progarmme contingencies commensurate with building of this nature and history

11.0 CDM

Under the CDM (2015) regulations designers have key duties including:

- When carrying out design work, avoiding foreseeable risks to those involved in this construction and future use of structure.
- Eliminating hazards and reducing risk associated with the hazards that remain.
- Providing information about significant residual risks associated with the design

Designers need to consider the hazards and risks to those who:

- Carry out construction of the design
- Are affected by the construction
- Clean and maintain the structure
- Occupy and use the structure
- Demolish the design at end of life

A preliminary hazard identification and risk assessment has been carried out for this project and is included in Appendix C. This assessment focuses on those risks specific to the project and which may not be immediately obvious to those using the design. Where possible, mitigation measures are suggested. A brief explanation is provided where these mitigation measures have already been implemented in the design to date. Further assessment and review will be carried out in detail during subsequent stages of the design. Key items identified during this stage of work that present significant risks to health and safety include:

APPENDICES:

Appendix A Structural Drawings

Appendix B Floor construction investigation

Appendix C CDM Designer's Risk assessment

Appendix A

Structural Drawings

Date	06.08.18	29.10.18	07.03.19	03.04.19	01.05.19												
Issue	1	2	3	4	5												

Drawing Number	Document Title	Scale	Paper Size	Revision																
100	Lower Ground Floor Plan	1:100	A1	P1	P2	P3	P4	P4												
101	Ground Floor Plan	1:100	A1	P1	P2	P3	P4	P5												
102	First Floor Plan	1:100	A1	P1	P2	P3	P4	P4												
103	Second Floor Plan	1:100	A1	P1	P2	P3	P4	P4												
104	Roof Plan	1:100	A1	P1	P2	P3	P4	P4												
300	Sections A and B	1:50	A1	P1	P2	P3	P4	P4												
301	Section C	1:50	A1	P1	P2	P3	P4	P4												
500	Structural Details (Sheet 1 of 1)	1:20	A1		P1	P2	P4	P4												
501	Proposed Entrance Ramp Plan and Sections	Varies	A1		P1	P2	P4	P4												
502	Proposed Canopy Plans and Sections	Varies	A1		P1	P2	P4	P4												
700	Temporary Works: Stages 1 - 4	1:100	A1		P1	P2	P4	P4												
-	Structural Specification	-	A4	A	-	-	-	-												

Distribution	Issue (E denotes electronic issue)																
Ridge and Partners LLP	E	E	E	E	E												
Satellite Architects	E	E	E	E	E												

Revision prefixes: P — Preliminary T — Tender C — Construction R — Record

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Title: Document Register

Issue: 5

Project: Abacus Belsize Primary School

Job No: 4343

By: ES

Sheet: 1 of 1

Date: 01.05.19

Stage 3 Drawing

NOTES:

This scheme is based on limited opening up works of the existing structure. All assumptions subject to confirmation during next stage.

Founding material assumed to be sandy clay with allowable bearing pressure 150kN/m^2. To be confirmed by geotechnical investigation (not seen)

Proposed Column Schedule	
Ref.	Serial Size
C1	254x254x107 UKC 2 x 2 x 1m deep mass concrete foundation
C2	203x203x86 UKC 1.5 x 1.5 x 1m deep mass concrete foundation
C3	203x203x46 UKC 1 x 1 x 1m deep mass concrete foundation
C4	152x152x30 UKC 1 x 1 x 1m deep mass concrete foundation
C5	150x150x10 SHS 1 x 1 x 1m deep mass concrete foundation
C10	100x100x10 SHS 600x600x750mm deep mass concrete foundation

All Pad foundation dimensions to be as shown in column schedule. Constructed from FND2 concrete mix or other approved by building control officer - depth of foundations to be minimum 1000mm below ground level and as agreed with Building Control

Unless dimensioned otherwise, new wide trench filled foundations to extend to existing foundations with FND2 concrete mix or other approved by building control officer - depth of foundations to be minimum 1000mm below ground level and as agreed with Building Control

Key:

Indicates new brickwork to Architect's specification with class (iii) mortar. Brickwork with F2 designation to be used below DPC

Indicates 3.6N/mm^2 blockwork with class (iii) mortar. Engineering bricks or F2 designation blockwork to be used below DPC

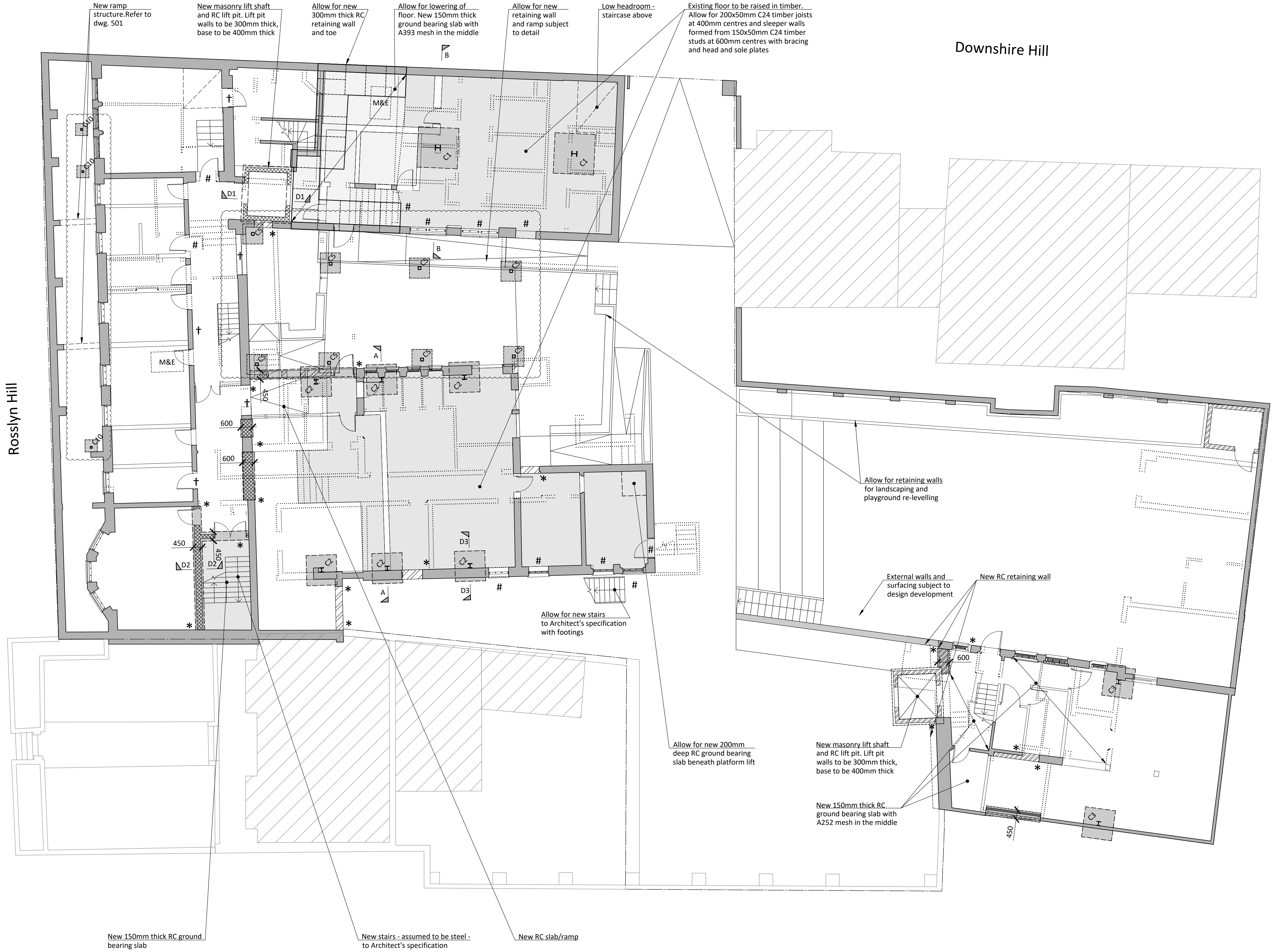
Indicates existing structure to be demolished. Where existing walls are being demolished, foundations are to be retained to provide support to new floor structure

* Indicates junction between new and old masonry walls use Ancon Staifix Universal wall starter kit

# Indicates lintels over openings to be raised. Allow for precast builders work lintels internally and reforming arches on exterior elevations

† Indicates new opening. Precast concrete lintels and exterior detailing to Architect's specification

M&E Allow for new steelwork at high level to support mechanical plant. Allow 200kg. Make allowance for openings for air ducts including lintels



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SCALE 1:100

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Drawing History

Rev	Date	Description	Drawn	Checked
P1	06.08.18	For Comment	RS	CG
P2	29.10.18	For Comment	RS	CG
P3	07.03.19	For Comment	ES	CG
P4	05.04.19	Updated	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Lower Ground Floor Structural Engineering Plan

Project
Abacus Belsize Primary School, NW3

Client
ESFA

Job No.
4343

Drawing No.
100

Revision
P4

Scale
1:100 at A1

A1

Stage 3 Drawing

NOTES:

This scheme is based on limited opening up works of the existing structure. All assumptions subject to confirmation during next stage

Proposed Beam Schedule	
Ref.	Serial Size
B1	203x133x25 UKB
B2	356x171x45 UKB
B3	457x191x74 UKB
B4	533x210x92 UKB
B5	203x203x46 UKC
B6	254x254x89 UKC
B7	305x305x118 UKC
B8	356x368x177 UKC
B9	356x406x467 UKC
B10	152x152x30 UKC
B11	200x90x30 PFC

Proposed Column Schedule	
Ref.	Serial Size
C1	254x254x107 UKC
C2	203x203x86 UKC
C3	203x203x46 UKC
C4	152x152x30 UKC

Key:

Indicates new brickwork to Architect's specification with class (iii) mortar. Brickwork with F2 designation to be used below DPC

Indicates 3.6N/mm² blockwork with class (iii) mortar. Engineering bricks or F2 designation blockwork to be used below DPC

Indicates line of structure under

Indicates existing structure to be demolished. Where existing walls are being demolished, foundations are to be retained to provide support to new floor structure

*Indicates junction between new and old masonry walls use Ancon Staifix Universal wall starter kit

# Indicates lintels over openings to be raised. Allow for precast builders work lintels internally and reforming arches on exterior elevations

† Indicates new opening. Precast concrete lintels and exterior detailing to Architect's specification

Indicates assumed span of existing floor. Number/letter reference where build-up has been confirmed, see dwg. 500

Typically, joists are at 650mm centres, with 100mm deep clay pot and clinker concrete infill and topping

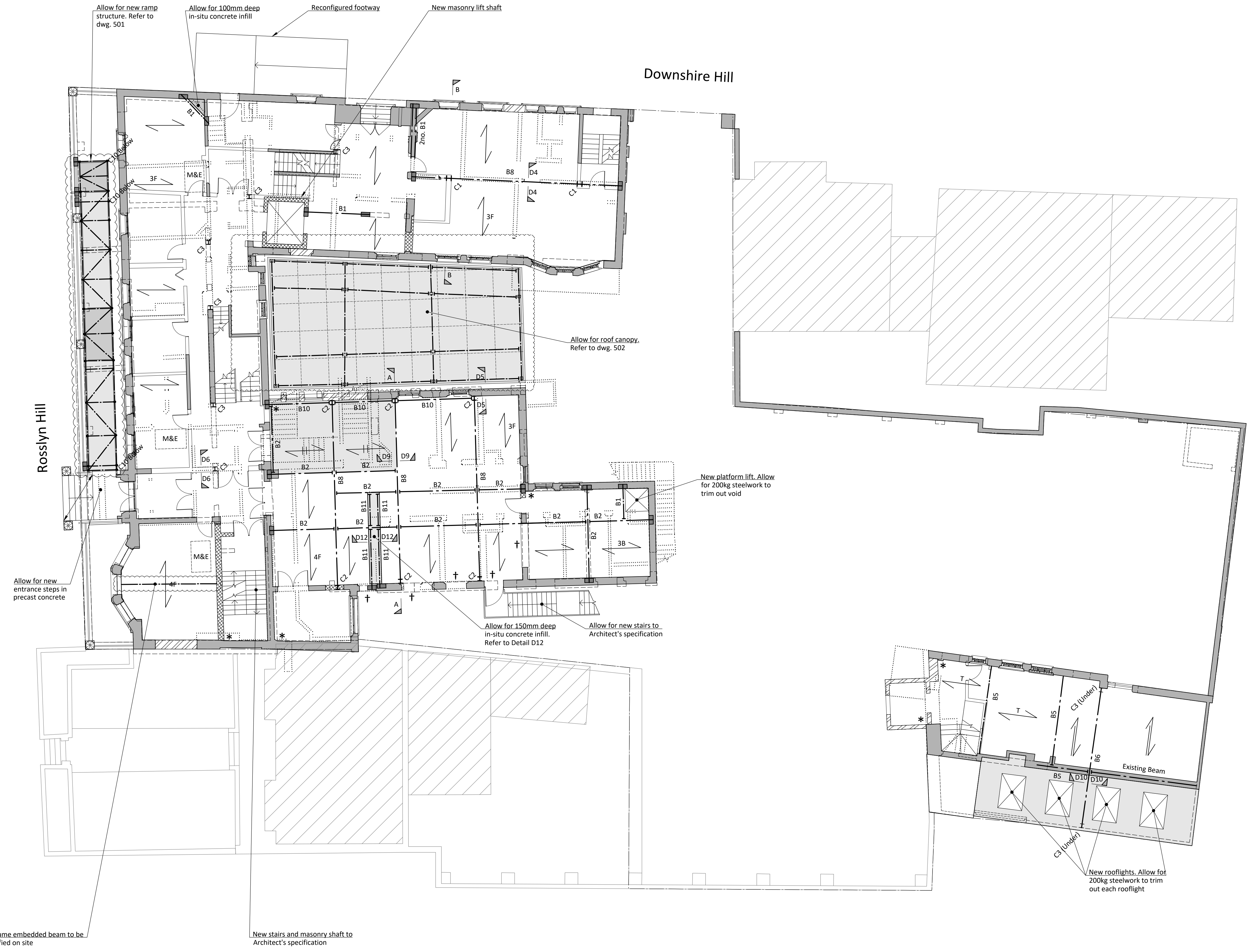
Indicates existing beam and block floor

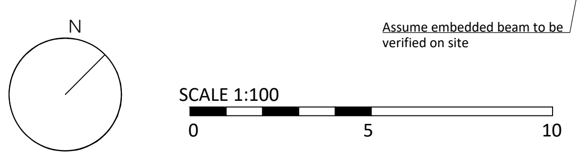
Indicates new 150mm deep concrete floor on metal deck

Indicates new 200x50mm C24 timber joists at 400mm centres

Unless noted otherwise, allow for 450x215x215mm deep mass concrete padstones under all beams

M&E Allow for new steelwork at high level to support mechanical plant. Allow 200kg. Make allowance for openings for air ducts including lintels





A1

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Rev	Date	Description	Drawn	Checked
P1	06.08.18	For Comment	RS	CG
P2	29.10.18	For Comment	RS	CG
P3	07.03.19	For Comment	ES	CG
P4	05.04.19	Updated	ES	CG
P5	01.05.19	Updated	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Ground Floor Structural Engineering Plan

Project
Abacus Belsize Primary School, NW3

Client
ESFA

Job No.
4343

Drawing No.
101

Revision
P4

Scale
1:100 at A1

Stage 3 Drawing

NOTES:

This scheme is based on limited opening up works of the existing structure. All assumptions subject to confirmation during next stage

Proposed Beam Schedule	
Ref.	Serial Size
B1	203x133x25 UKB
B2	356x171x45 UKB
B3	457x191x74 UKB
B4	533x210x92 UKB
B5	203x203x46 UKC
B6	254x254x89 UKC
B7	305x305x118 UKC
B8	356x368x177 UKC
B9	356x406x467 UKC
B10	152x152x30 UKC
B11	200x90x30 PFC

Proposed Column Schedule	
Ref.	Serial Size
C1	254x254x107 UKC
C2	203x203x86 UKC
C3	203x203x46 UKC
C4	152x152x30 UKC

Key:

Indicates new brickwork to Architect's specification with class (iii) mortar. Brickwork with F2 designation to be used below DPC

Indicates 3.6N/mm² blockwork with class (iii) mortar. Engineering bricks or F2 designation blockwork to be used below DPC

Indicates line of structure under

Indicates existing structure to be demolished

∗ Indicates junction between new and old masonry walls use Ancon Staifix Universal wall starter kit

\# Indicates lintels over openings to be raised. Allow for precast builders work lintels internally and reforming arches on exterior elevations

† Indicates new opening. Precast concrete lintels and exterior detailing to Architect's specification

Indicates assumed span of existing floor. Number/letter reference where build-up has been confirmed, see dwg. 500

Typically, joists are at 650mm centres, with 100mm deep clay pot and clinker concrete infill and topping

Indicates new flat roof formed from 200x50mm C24 timber joists at 400mm centres with 18mm ply over

Unless noted otherwise, allow for 450x215x215mm deep mass concrete padstones under all beams

M&E Allow for new steelwork at high level to support mechanical plant. Allow 200kg. Make allowance for openings for air ducts including lintels

N

SCALE 1:100

0 5 10

A1

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P2	29.10.18	For Comment	RS	CG
P3	07.03.19	For Comment	ES	CG
P4	05.04.19	Updated	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
First Floor Structural Engineering Plan

Project
Abacus Belsize Primary School, NW3

Client
ESFA

Job No.
4343

Drawing No.
102

Revision
P4

Scale
1:100 at A1

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Stage 3 Drawing

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P1	06.08.18	For Comment	RS	CG
P2	29.10.18	For Comment	RS	CG
P3	07.03.19	For Comment	ES	CG
P4	05.04.19	Updated	ES	CG

NOTES:

This scheme is based on limited opening up works of the existing structure. All assumptions subject to confirmation during next stage

Proposed Beam Schedule	
Ref.	Serial Size
B1	203x133x25 UKB
B2	356x171x45 UKB
B3	457x191x74 UKB
B4	533x210x92 UKB
B5	203x203x46 UKC
B6	254x254x89 UKC
B7	305x305x118 UKC
B8	356x368x177 UKC
B9	356x406x467 UKC
B10	152x152x30 UKC
B11	200x90x30 PFC

Proposed Column Schedule	
Ref.	Serial Size
C1	254x254x107 UKC
C2	203x203x86 UKC
C3	203x203x46 UKC
C4	152x152x30 UKC

Key:

Indicates new brickwork to Architect's specification with class (iii) mortar. Brickwork with F2 designation to be used below DPC

Indicates 3.6N/mm² blockwork with class (iii) mortar. Engineering bricks or F2 designation blockwork to be used below DPC

Indicates **10.4N/mm²** blockwork with class (iii) mortar. Engineering bricks or F2 designation blockwork to be used below DPC

Indicates line of structure under

Indicates existing structure to be demolished

* Indicates junction between new and old masonry walls use Ancon Staifix Universal wall starter kit

# Indicates lintels over openings to be raised. Allow for precast builders work lintels internally and reforming arches on exterior elevations

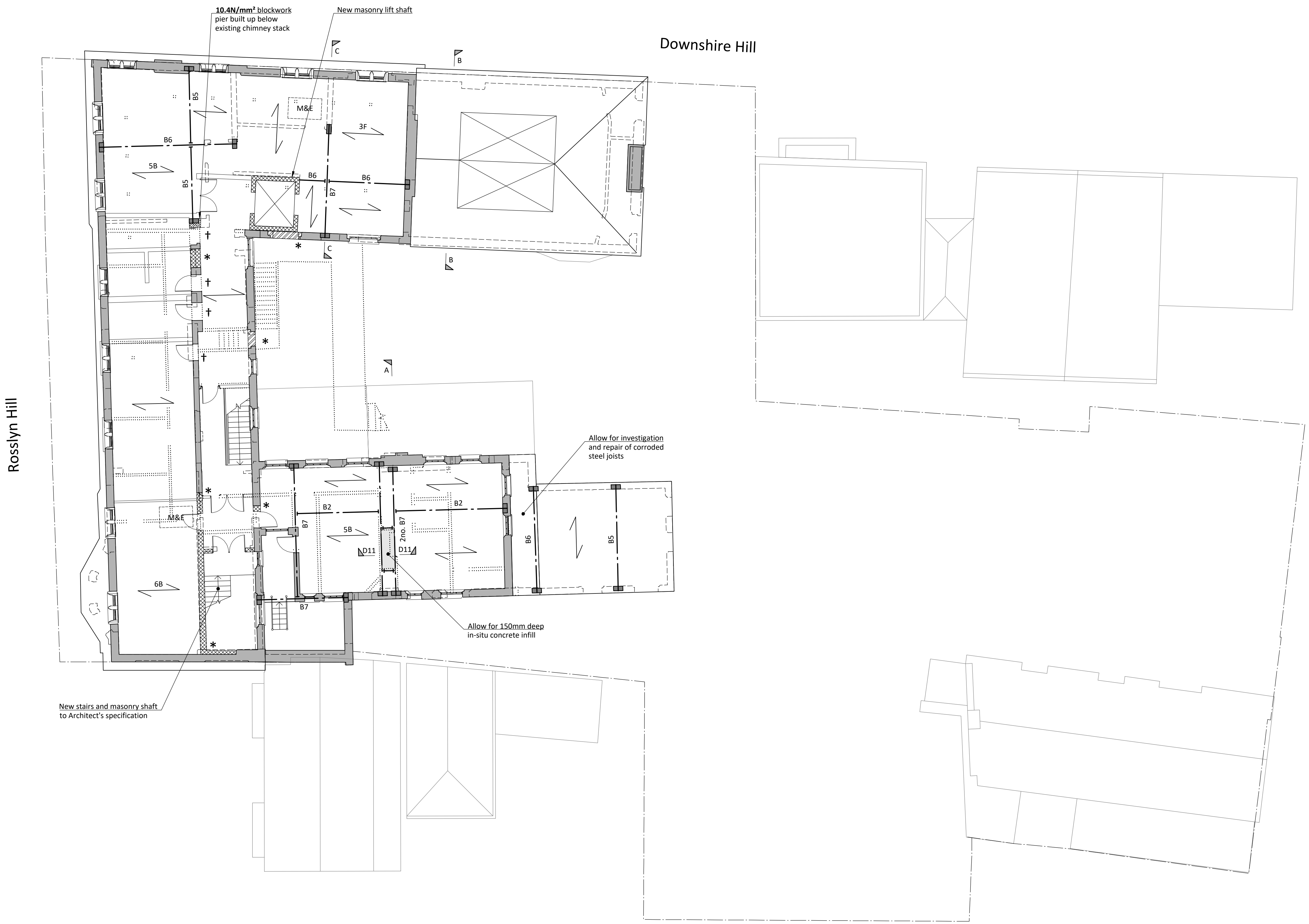
† Indicates new opening. Precast concrete lintels and exterior detailing to Architect's specification

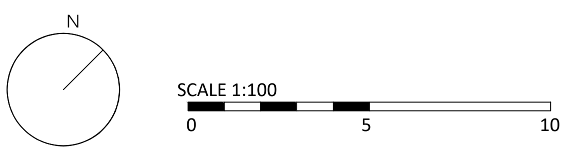
Indicates assumed span of existing floor. Number/letter reference where build-up has been confirmed, see dwg. 500

Typically, joists are at 650mm centres, with 100mm deep clay pot and clinker concrete infill and topping

Unless noted otherwise, allow for 450x215x215mm deep mass concrete padstones under all beams

M&E Allow for new steelwork to support mechanical plant. Allow 200kg. Make allowance for openings for air ducts including lintels





PRELIMINARY
NOT FOR CONSTRUCTION

Title
Second Floor Structural Engineering Plan

Project
Abacus Belsize Primary School, NW3

Client
ESFA

Job No.
4343

Drawing No.
103

Revision
P4

Scale
1:100 at A1

A1

Stage 3 Drawing

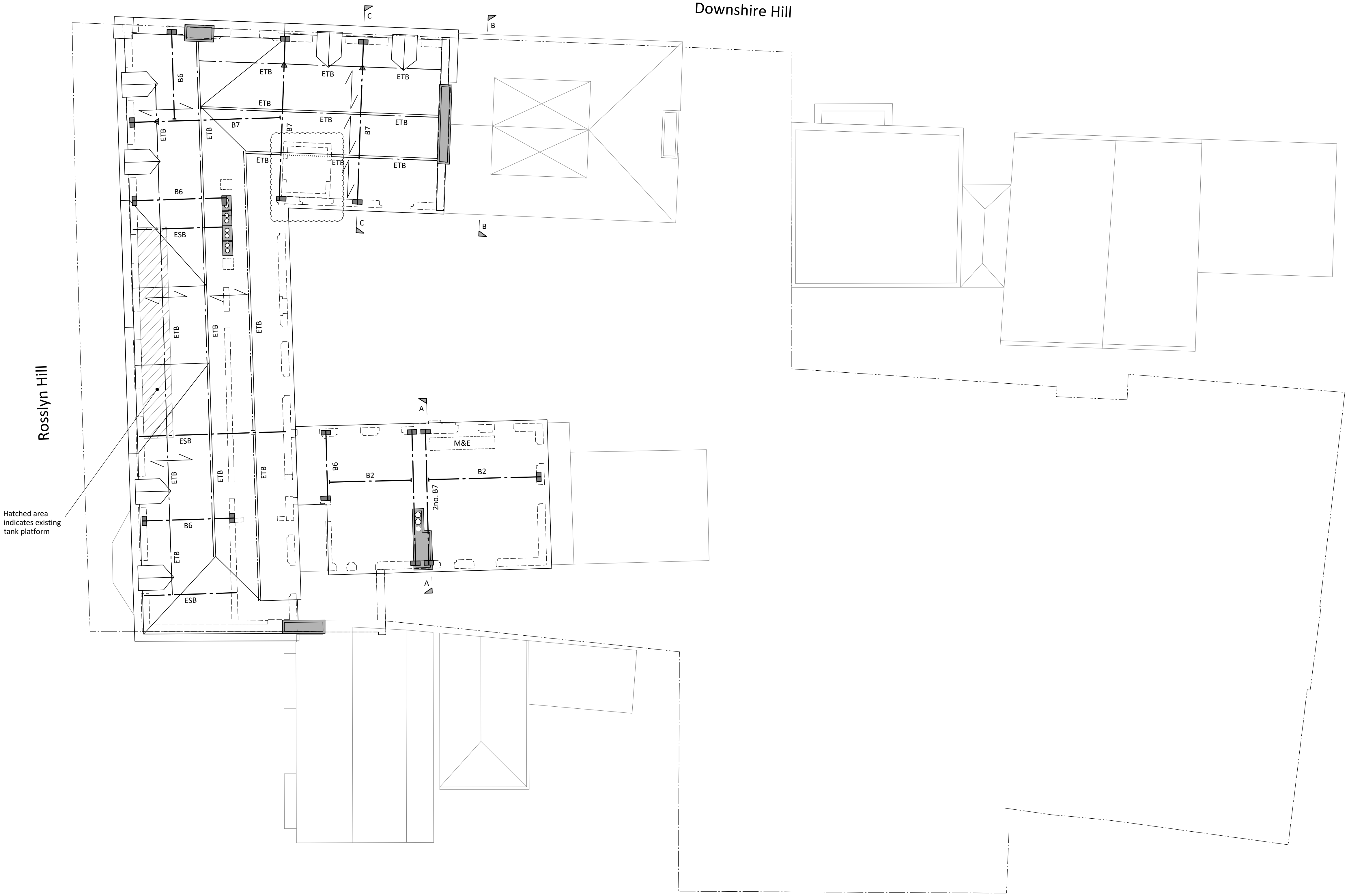
NOTES:

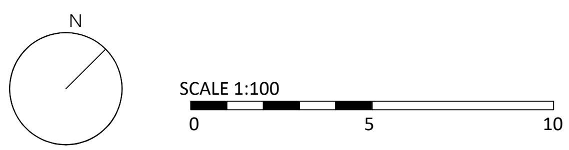
This scheme is based on limited opening up works of the existing structure. All assumptions subject to confirmation during next stage

Proposed Beam Schedule	
Ref.	Serial Size
B1	203x133x25 UKB
B2	356x171x45 UKB
B3	457x191x74 UKB
B4	533x210x92 UKB
B5	203x203x46 UKC
B6	254x254x89 UKC
B7	305x305x118 UKC
B8	356x368x177 UKC
B9	356x406x467 UKC
B10	152x152x30 UKC
B11	200x90x30 PFC

Key:

- Indicates line of structure under
- Indicates approximate position of crank in steelwork
- ESB: Indicates an Existing Steel Beam 381x127 (BSB 25)
- ETB: Indicates an Existing Timber Beam 300x100 centre, 225 x 100 otherwise
- Indicates existing 150x50mm ceiling joists at 355mm centres
- Unless noted otherwise, allow for 450x215x215mm deep mass concrete padstones under all beams
- M&E: Allow for new steelwork to support new mechanical plant on existing roof. Allow 250kg





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Rev	Date	Description	Drawn	Checked
P1	06.08.18	For Comment	RS	CG
P2	29.10.18	For Comment	RS	CG
P3	07.03.19	For Comment	ES	CG
P4	05.04.19	Updated	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Roof Structual Engineering Plan

Project
Abacus Belsize Primary School, NW3

Client
ESFA

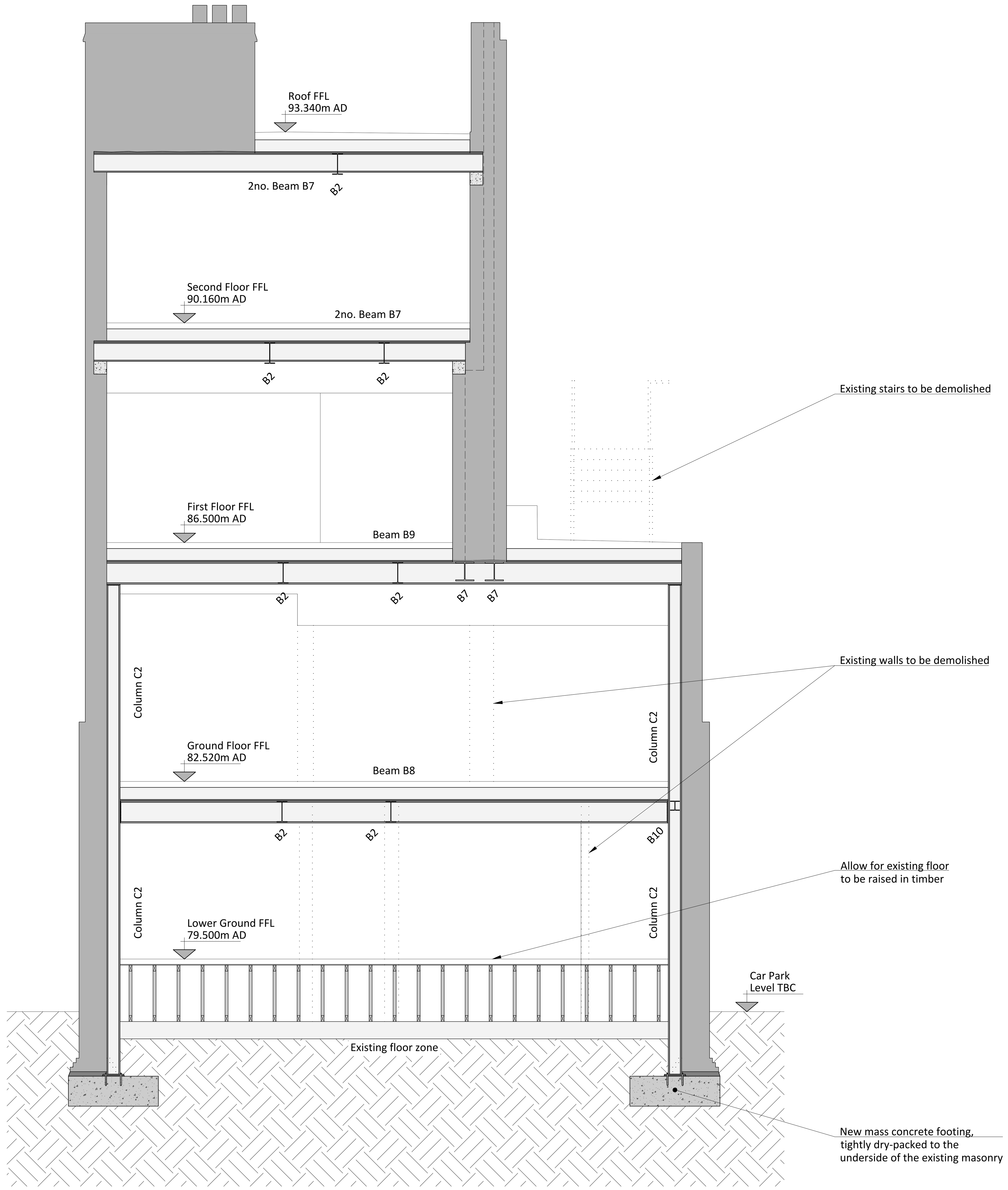
Job No.
4343

Drawing No.
104

Revision
P4

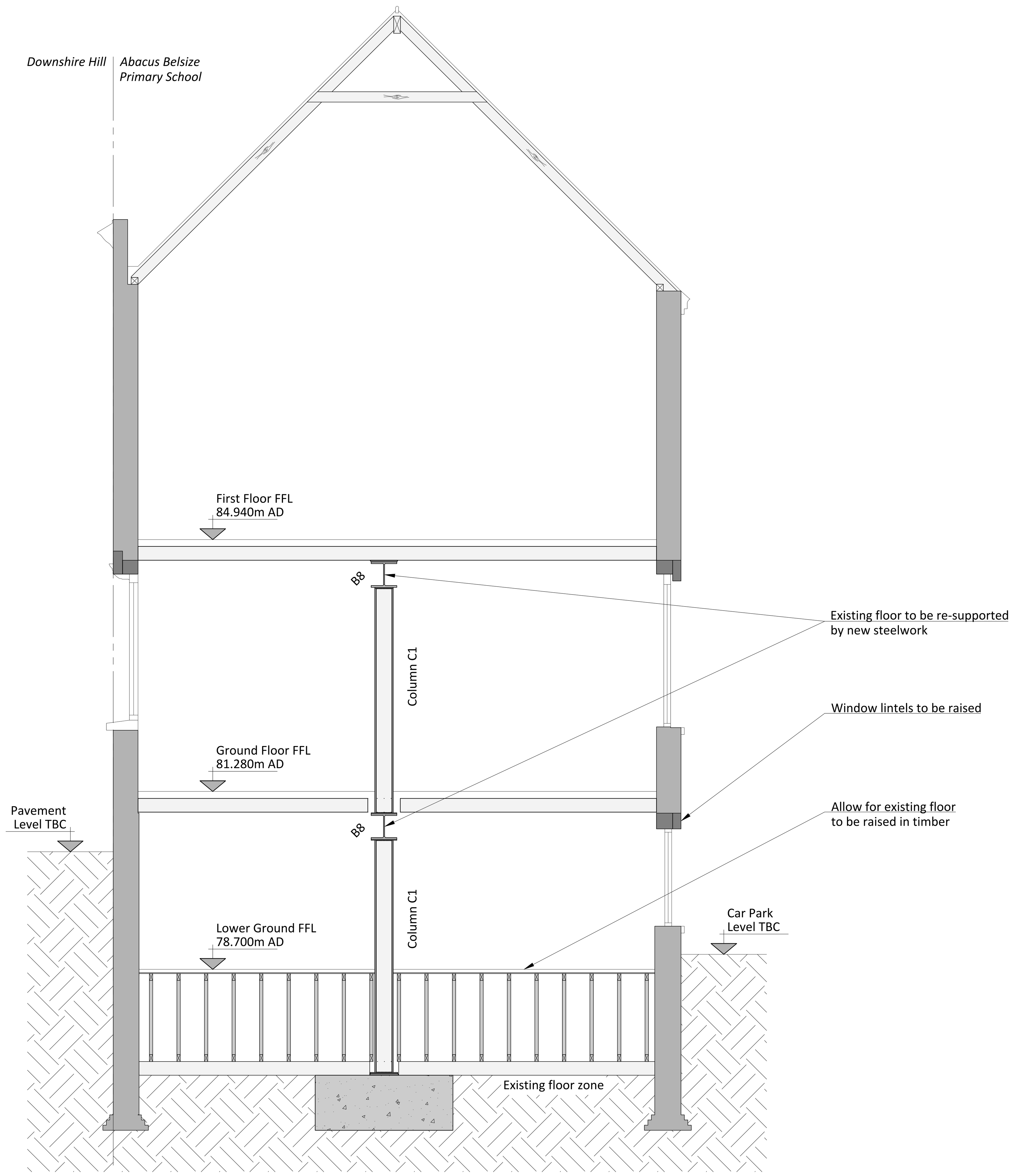
Scale
1:100 at A1

Stage 3 Drawing



Section A
Scale 1:50

Note: Finishes not known



Section B
Scale 1:50

Note: Finishes not known

SCALE 1:50

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A1

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Drawing History

Rev	Date	Description	Drawn	Checked
P1	06.08.18	For Comment	RS	CG
P2	29.10.18	Revised Sections	RS	CG
P3	07.03.19	For Comment	ES	CG
P4	05.04.19	For Comment	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Structural Engineering Sections A and B

Project
Abacus Belsize Primary School, NW3

Client
ESFA

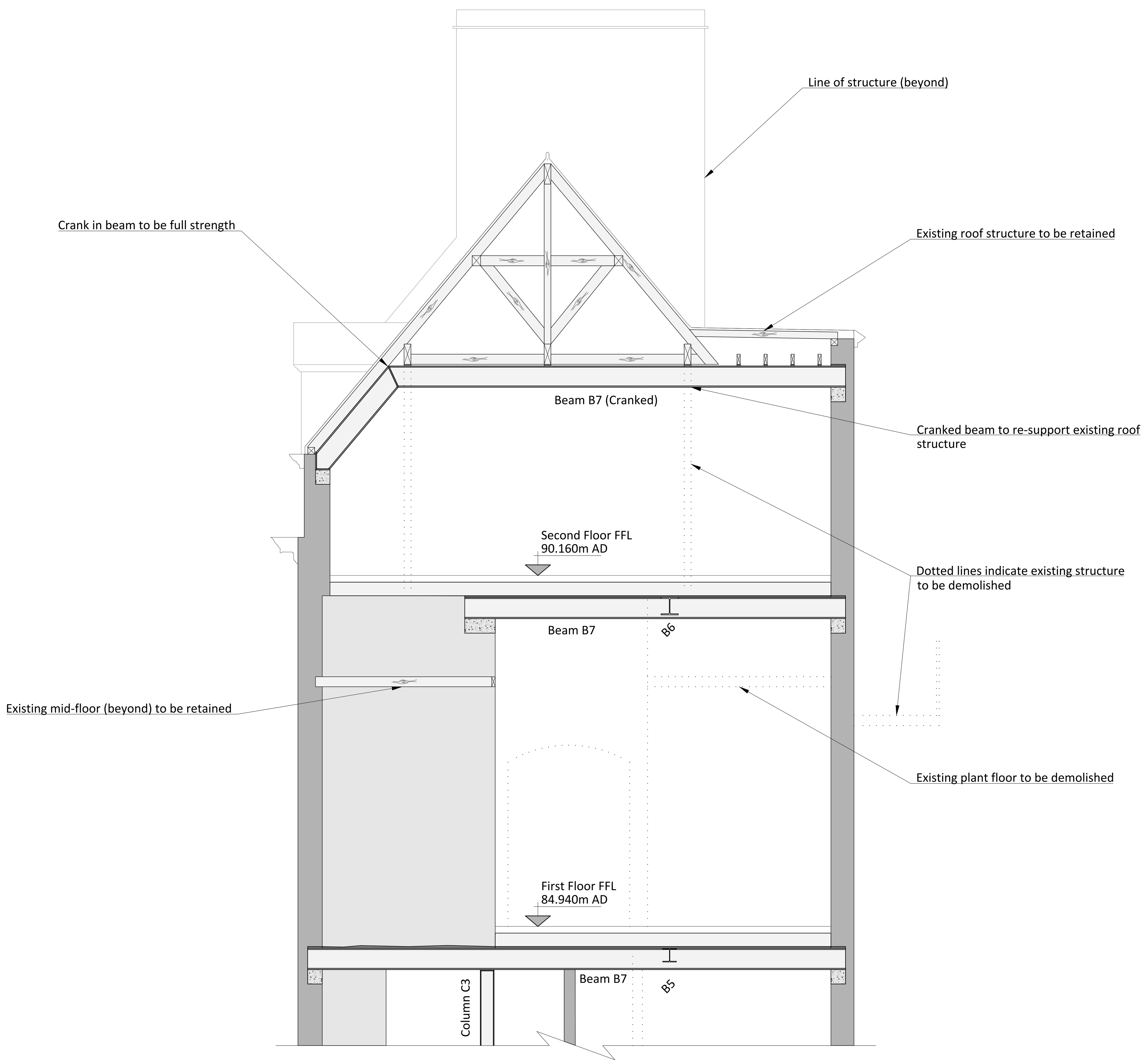
Job No.
4343

Drawing No.
300

Revision
P4

Scale
1:50 at A1

Stage 3 Drawing



Section C
Scale 1:50

Note: Finishes not known

SCALE 1:50
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Drawing History

Rev	Date	Description	Drawn	Checked
P1	06.08.18	For Comment	RS	CG
P2	29.10.18	Added Levels	RS	CG
P3	07.03.19	For Comment	ES	CG
P4	05.04.19	For Comment	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Structural Engineering
Section C

Project
Abacus Belsize
Primary School, NW3

Client
ESFA

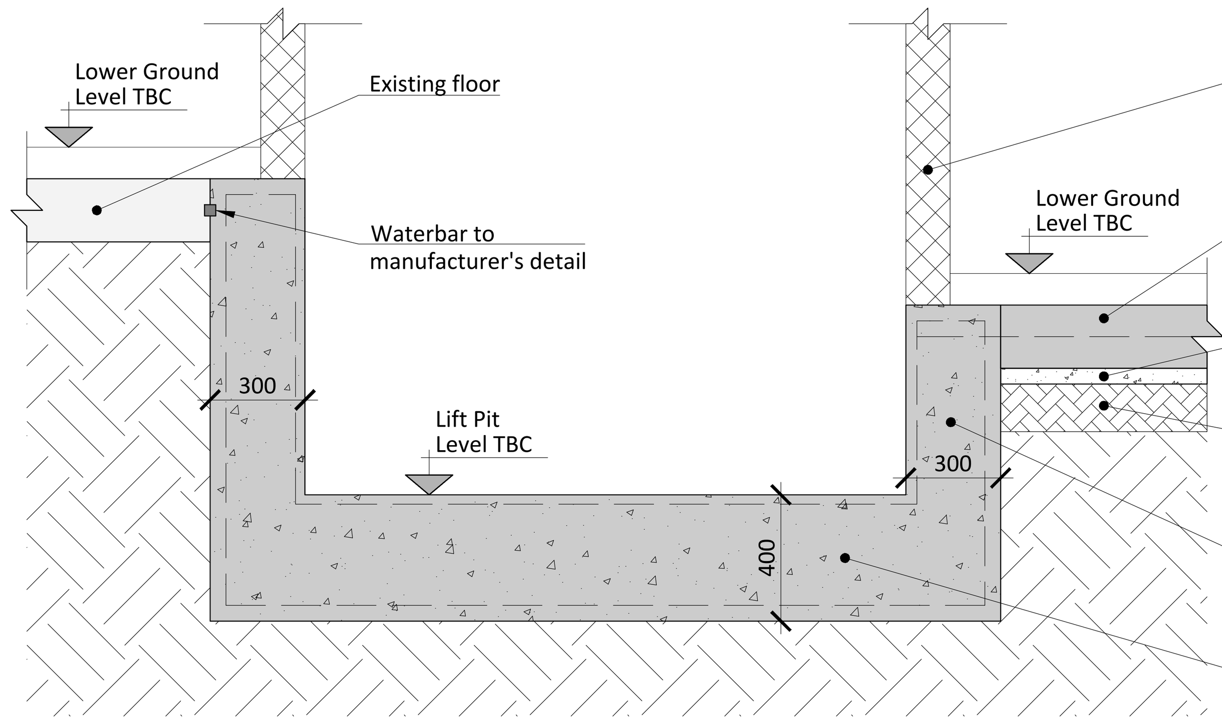
Job No.
4343

Drawing No.
301

Revision
P4

Scale
1:50 at A1

A1



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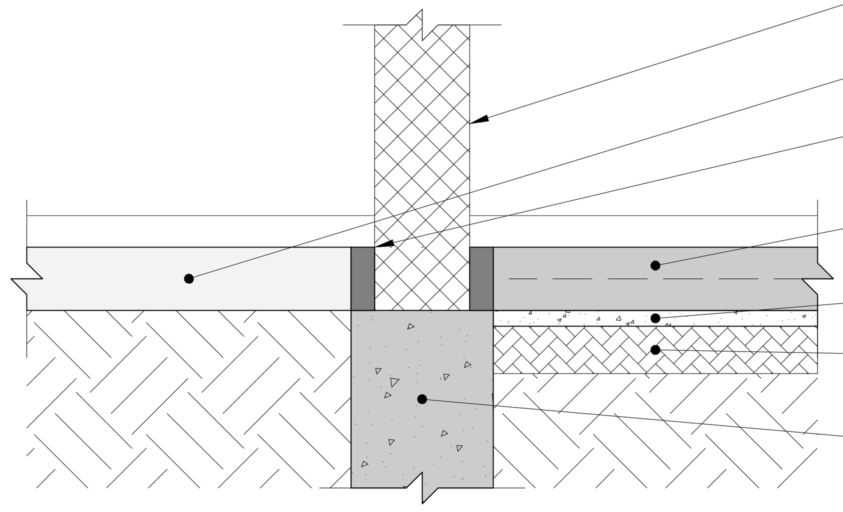
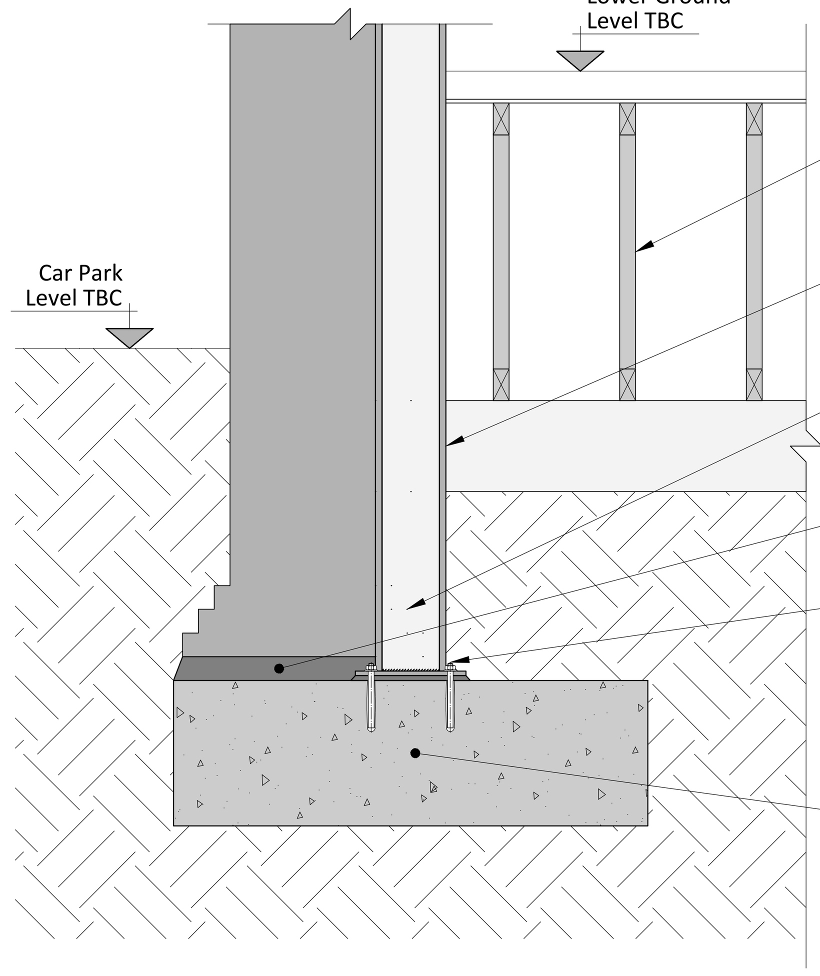
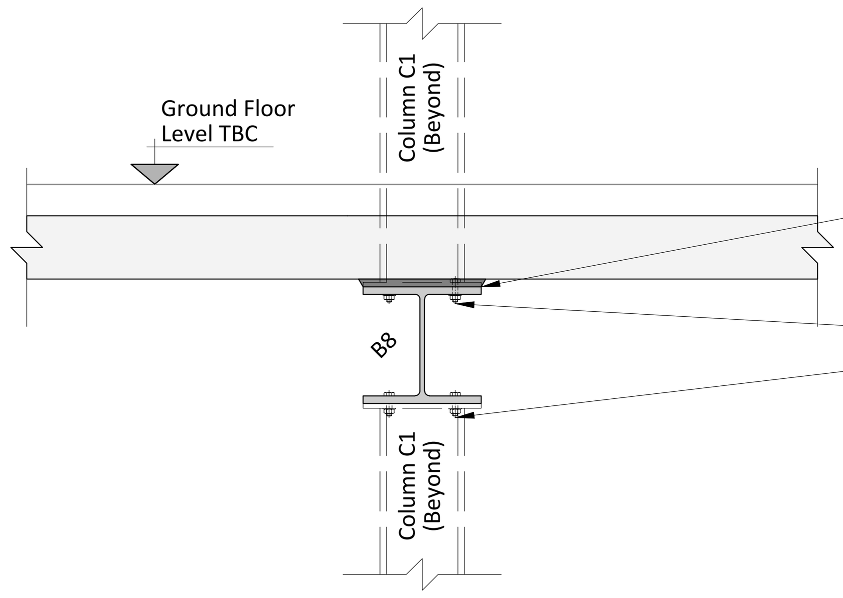
Scale 1:20



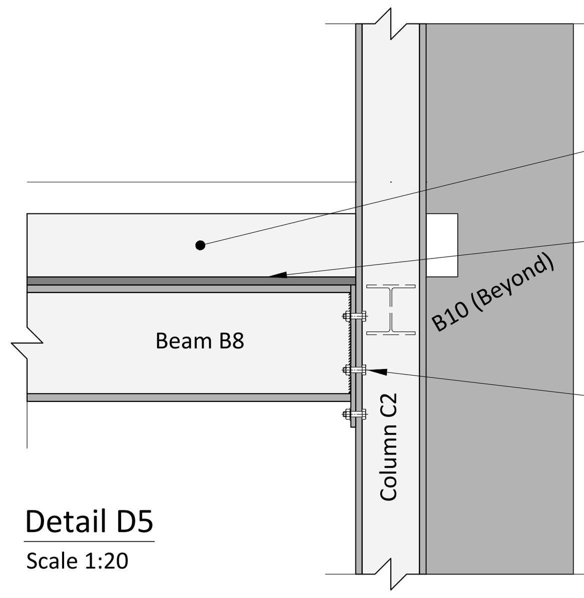
Detail D2
Scale 1:20



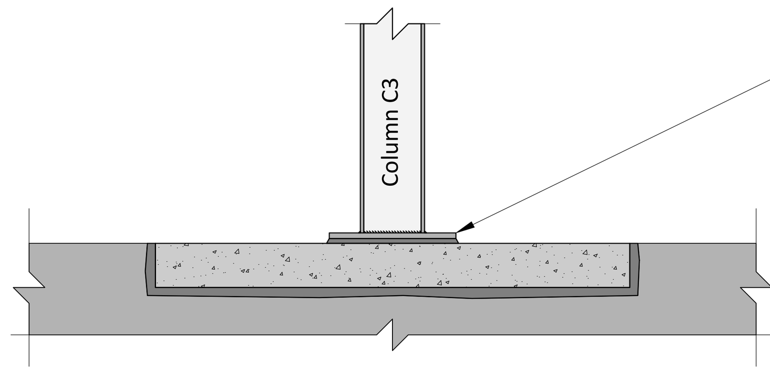
Detail D3
Scale 1:20



Detail D4
Scale 1:20

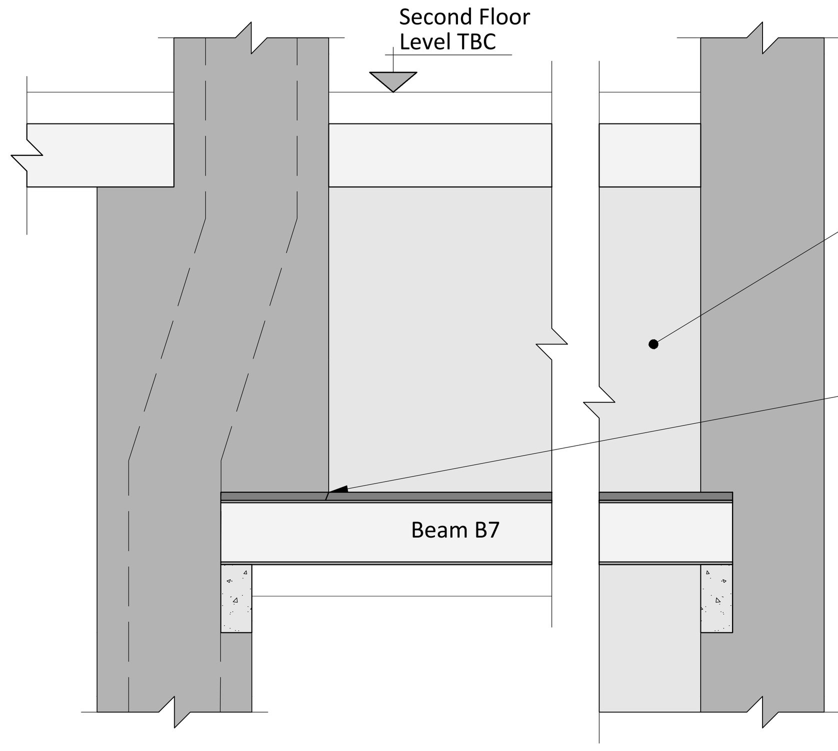


Detail D5
Scale 1:20

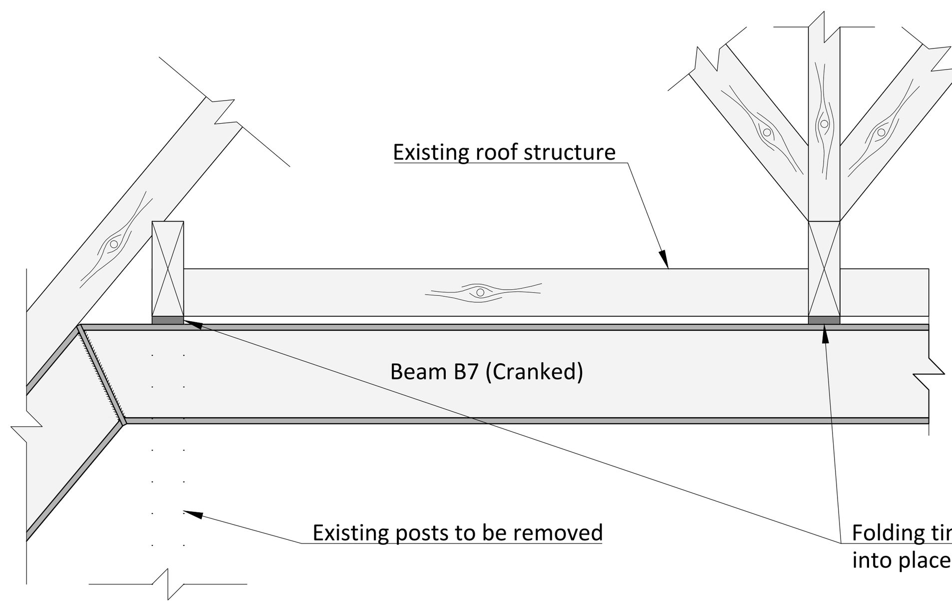


Detail D6
Scale 1:20

Unless noted otherwise:
All bolts to be grade 8.8
All welds to be 6mm full face fillet welds



Detail D7
Scale 1:20



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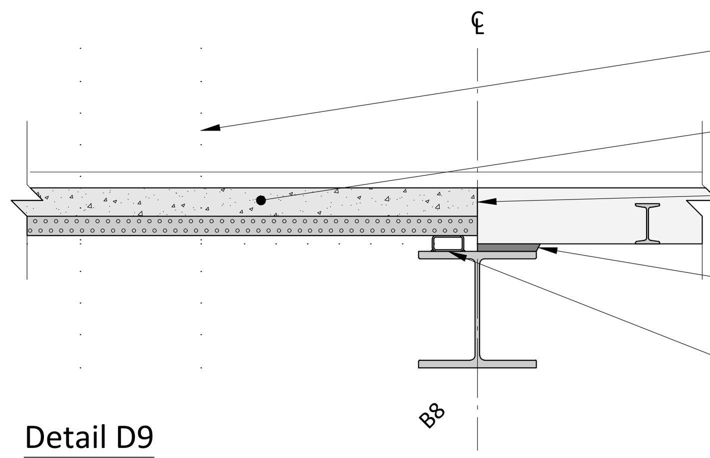

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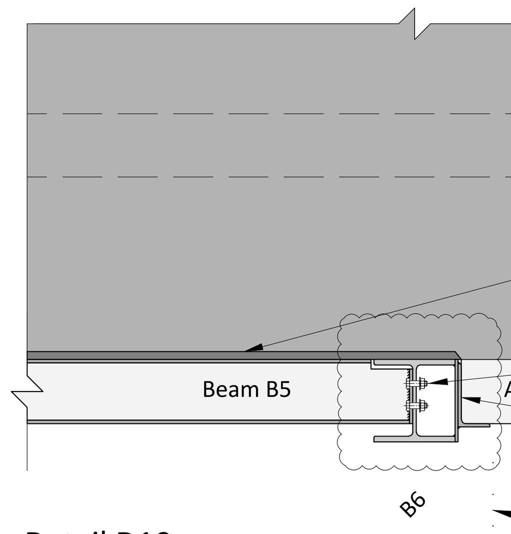

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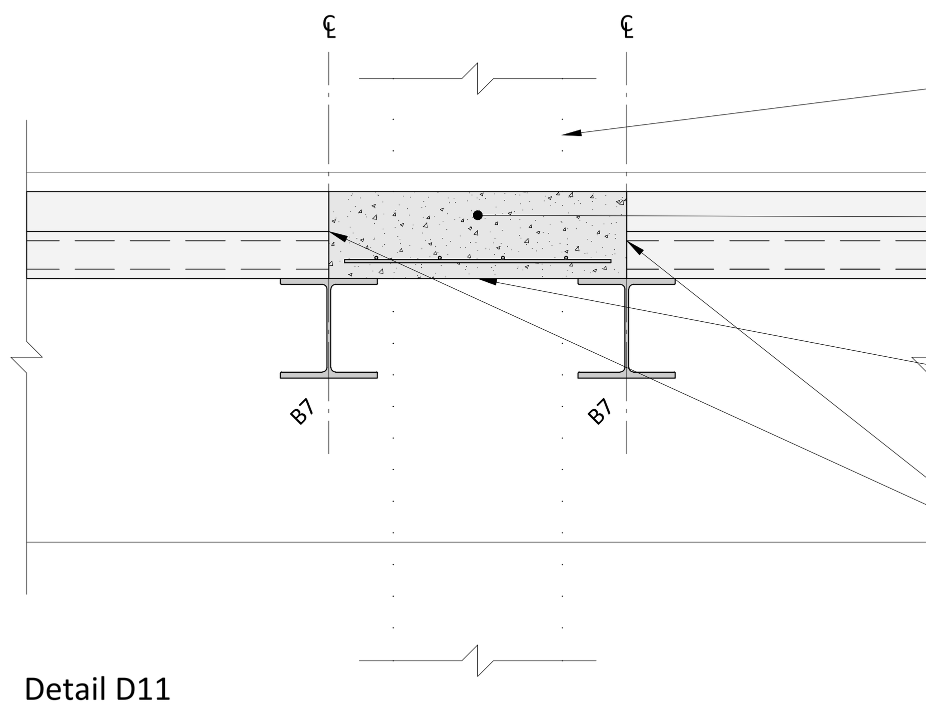

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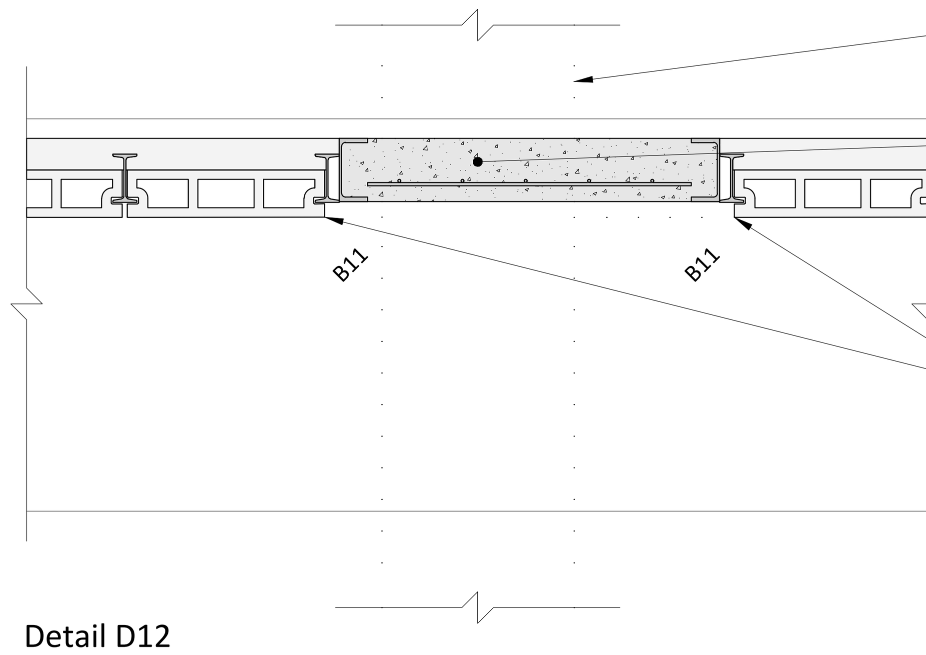

Detail D12
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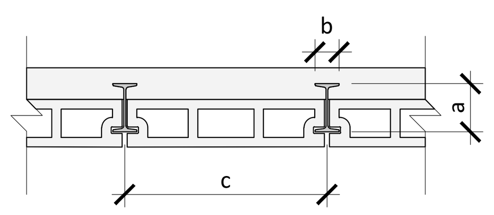
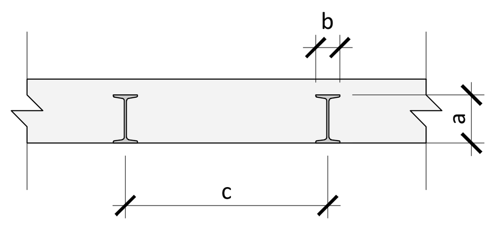


Beam and Pot Floor (B)
Scale 1:20



Filler Joist Floor (F)
Scale 1:20

Dimensions (mm)					
Location on Plan	Floor Type	Beam Size	a	b	c
2	B	BSB4	100	75	640
3	B and F	BSB6	125 - 130	75	600 - 660
4	B and F	BSB8	150	75	640 - 835
5	B and F	BSB11	180	100	640
6	B	BSB12	200	100	640

Note: based on limited opening-up works. Full survey required prior to final design

Typical Existing Floor Construction
Scale 1:20

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Drawing History

Rev	Date	Description	Drawn	Checked
P1	29.10.18	For Comment	RS	CG
P2	07.03.19	For Comment	ES	CG
P3	05.04.19	For Comment	ES	CG

Stage 3 Drawing

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Structural Engineering Details (Sheet 1 of 1)

Project
Abacus Belsize Primary School, NW3

Client
ESFA

Job No.
4343

Drawing No.
500

Revision
P3

Scale
1:20 at A1

A1

NOTES:

This scheme is based on limited opening up works of the existing structure. All assumptions subject to confirmation during next stage

Proposed Steel Schedule	
Ref.	Serial Size
Entrance Ramp Beam ERB1	200x100x10 RHS
Entrance Ramp Beam ERB2	100x60x5 RHS
Entrance Ramp Beam ERB3	100x100x10 SHS
Bracing BR1	70x70x5 EQA
Handrail Uprights H1	60x60x5 RHS
Posts C10	100x100x10 SHS 600 x 600 x 750m deep mass foundation

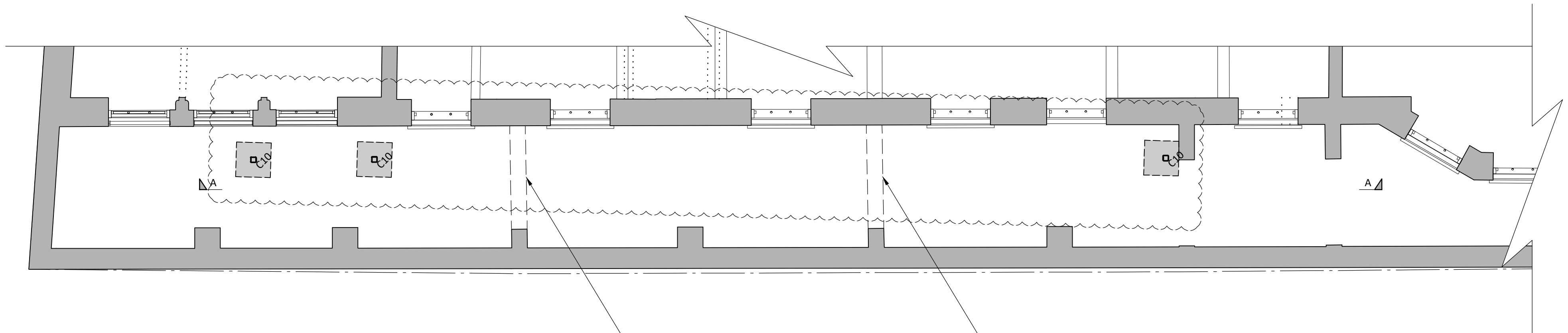
Key:

— — — Indicates line of structure under

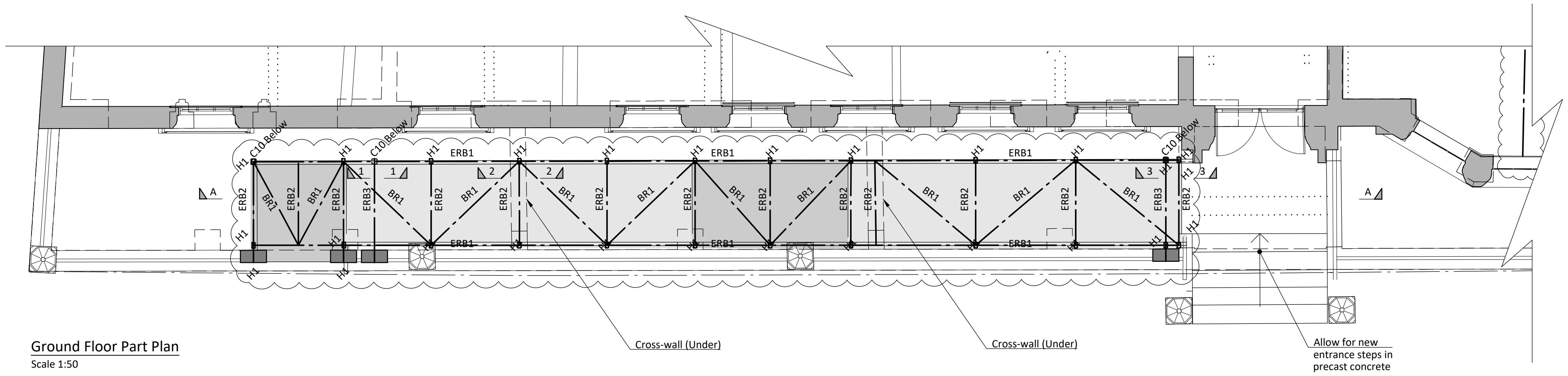
Indicates existing structure to be demolished. Where existing walls are being demolished, foundations are to be retained to provide support to new floor structure

Unless noted otherwise, allow for 450x215x215mm deep mass concrete padstones under all beams

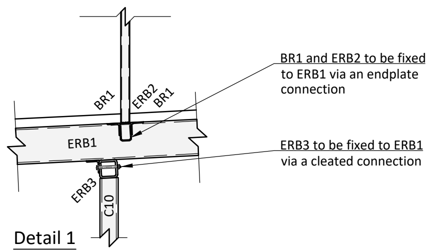
Decking to architect's requirements. Allow for Lionweld Kennedy Safegrid 5mm LK20BP



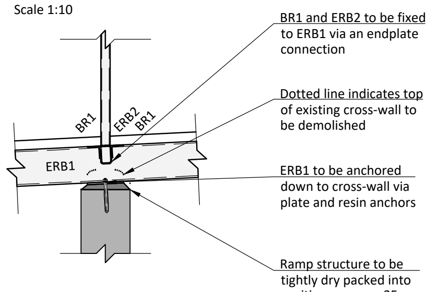
Lower Ground Floor Part Plan
Scale 1:50



Ground Floor Part Plan
Scale 1:50



Detail 1
Scale 1:10



Detail 2
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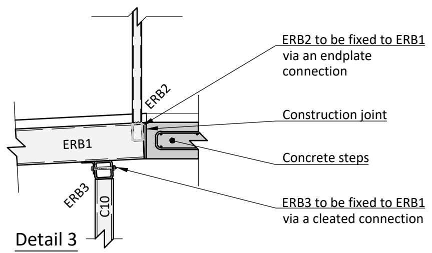
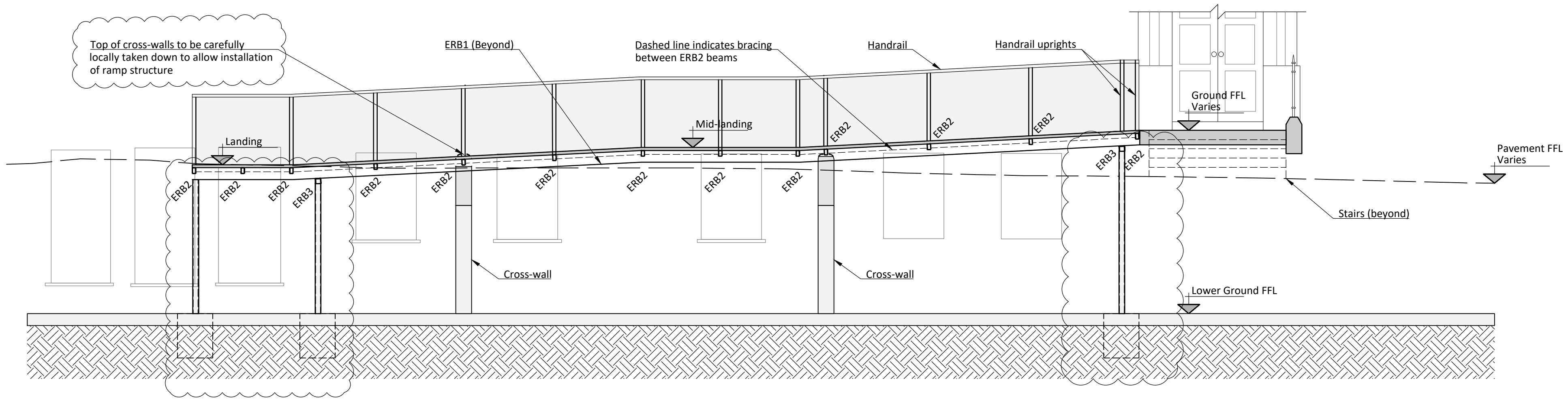


Detail 3
Scale 1:10



Section A
Scale 1:50

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P1	29.10.18	For Comment	RS	CG
P2	07.03.19	For Comment	ES	CG
P3	05.04.19	Updated	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Entrance Ramp, Structural Engineering Plans and Section

Project
Abacus Belsize Primary School, NW3

Client
ESFA

Job No.
4343

Drawing No.
501

Revision
P3

Scale
Varies at A1

A1

NOTES:

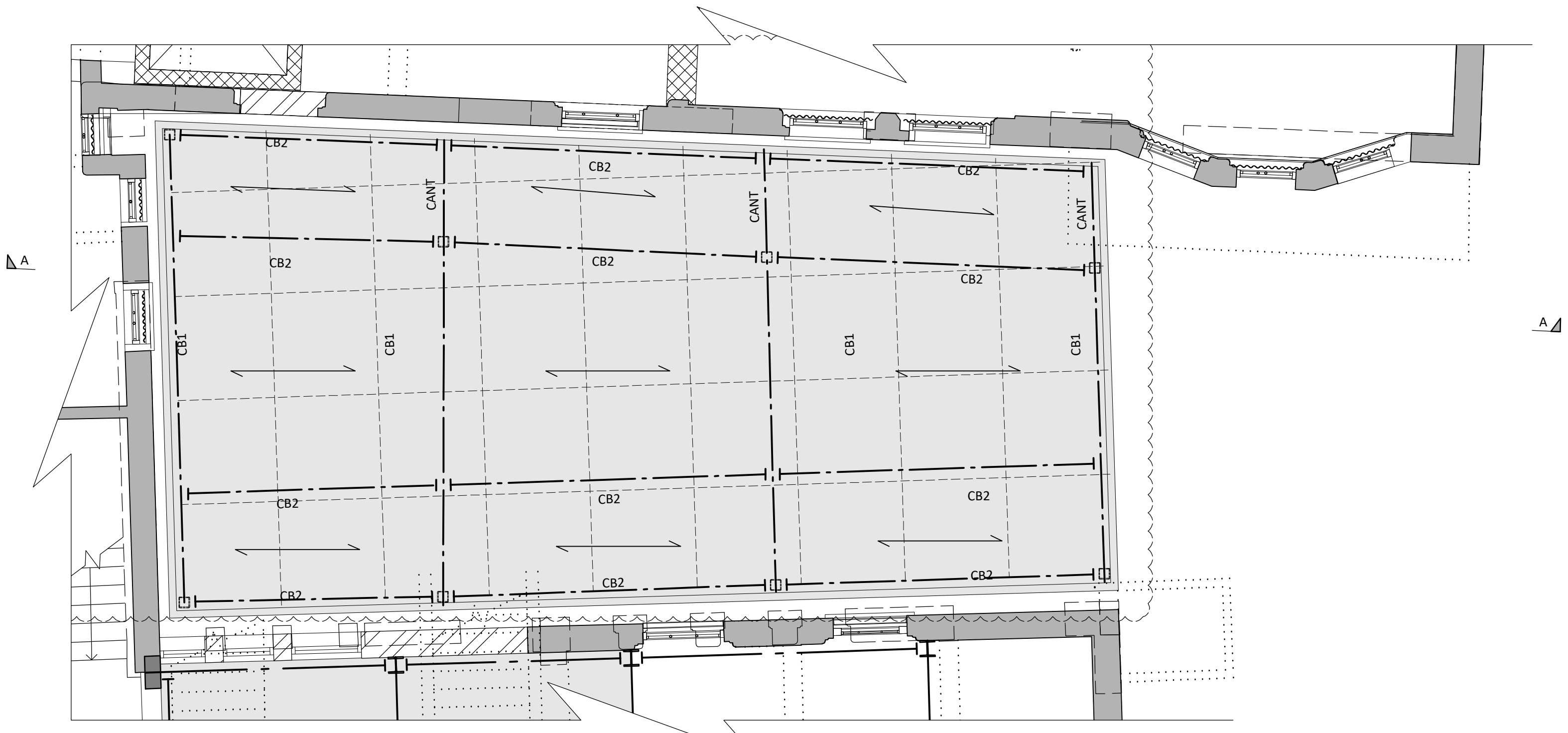
This scheme is based on limited opening up works of the existing structure. All assumptions subject to confirmation during next stage

Proposed Beam Schedule	
Ref.	Serial Size
Canopy Beam CB1	180x180x10 SHS
Canopy Beam CB2	180x180x10 SHS
Column C5	150x150x10 SHS

Key:

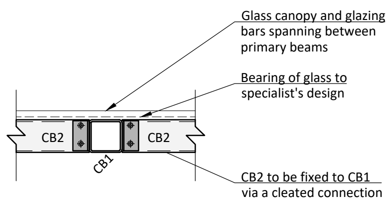
- – – Indicates line of structure under
- ······ Indicates existing structure to be demolished. Where existing walls are being demolished, foundations are to be retained to provide support to new floor structure
- Indicates span of glazing

Allow for 16mm laminated glass on supports to specialist's design. Details to Architect's drawings including drainage and perimeter details



Ground Floor Part Plan
Scale 1:50

Refer to Drawing 100 for plan of columns and foundation



Detail 1
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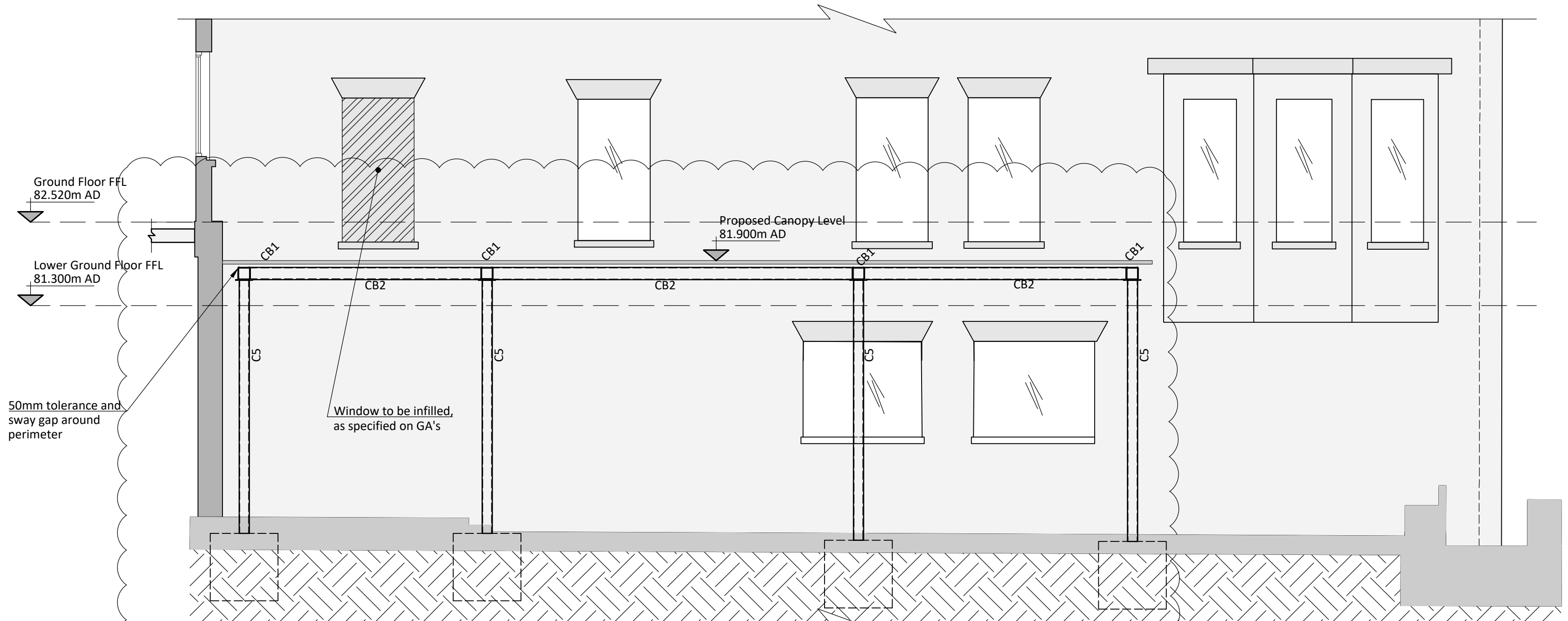

Section A
Scale 1:50

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Rev	Date	Description	Drawn	Checked
P1	29.10.18	For Comment	RS	CG
P2	07.03.19	For Comment	ES	CG
P3	05.04.19	Updated	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Structural Engineering Canopy,Plan and Sections

Project
Abacus Belsize Primary School, NW3

Client
ESFA

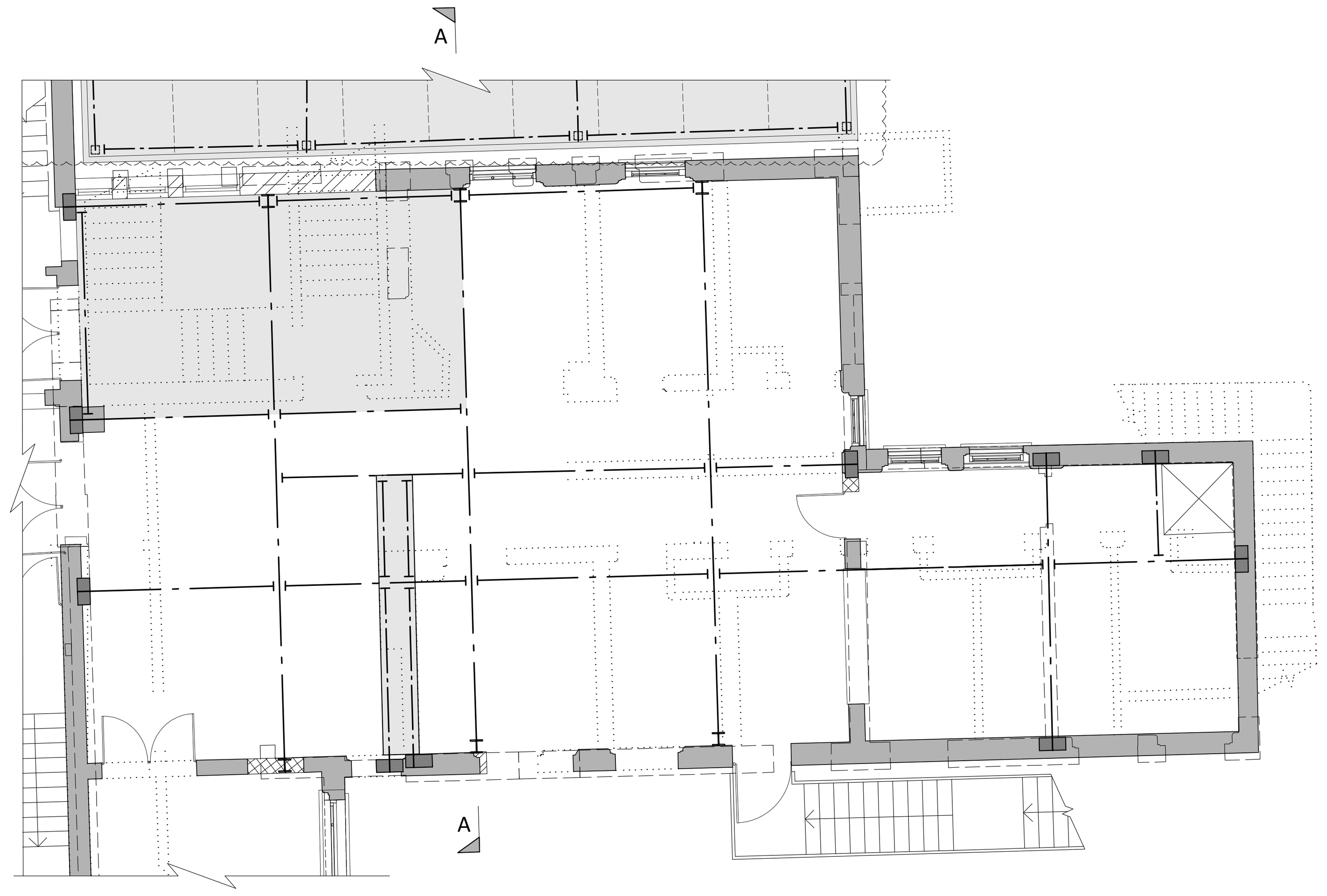
Job No.
4343

Drawing No.
502

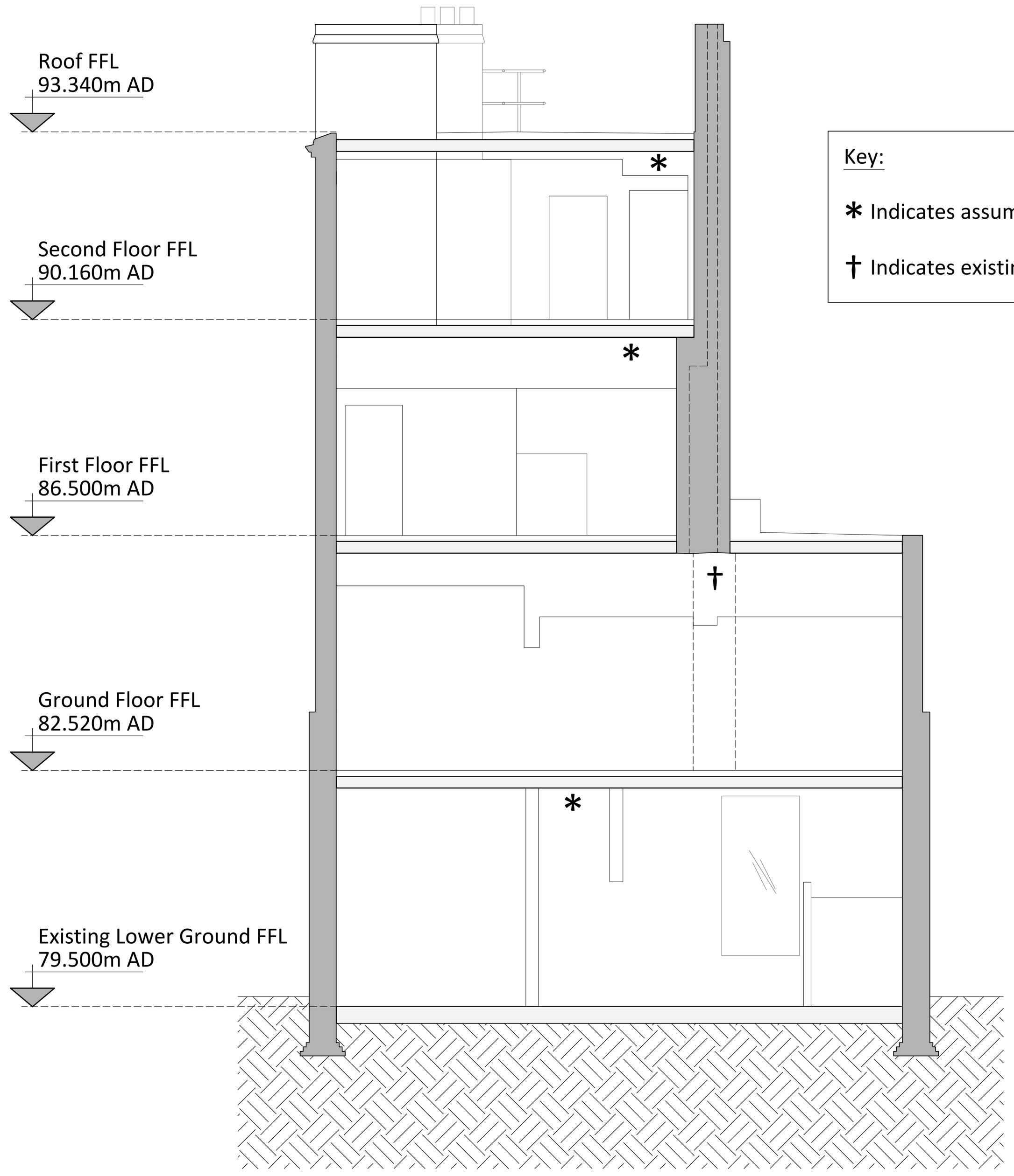
Revision
P3

Scale
Varies at A1

A1

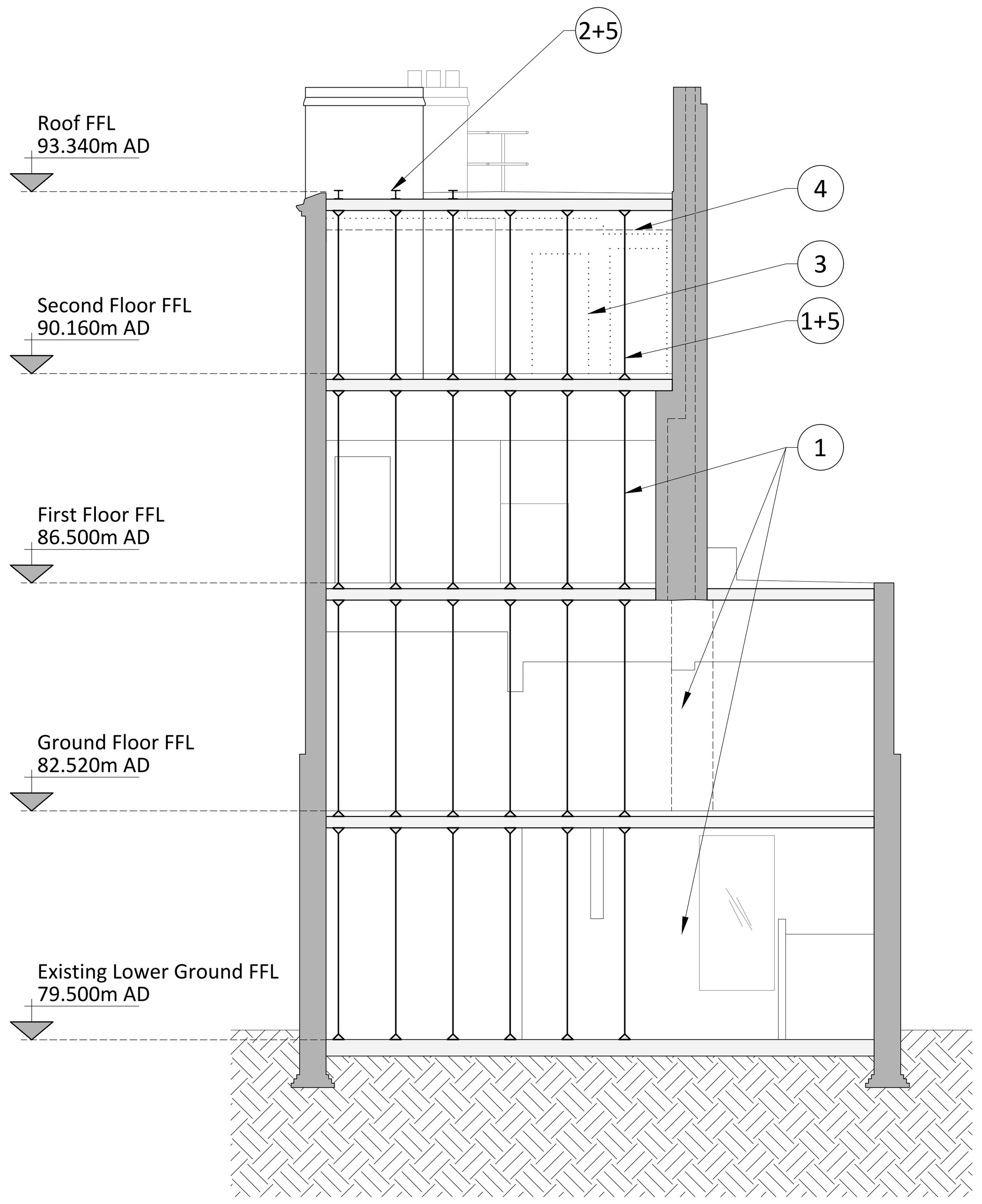


Proposed Ground Floor Part Plan
Scale 1:100



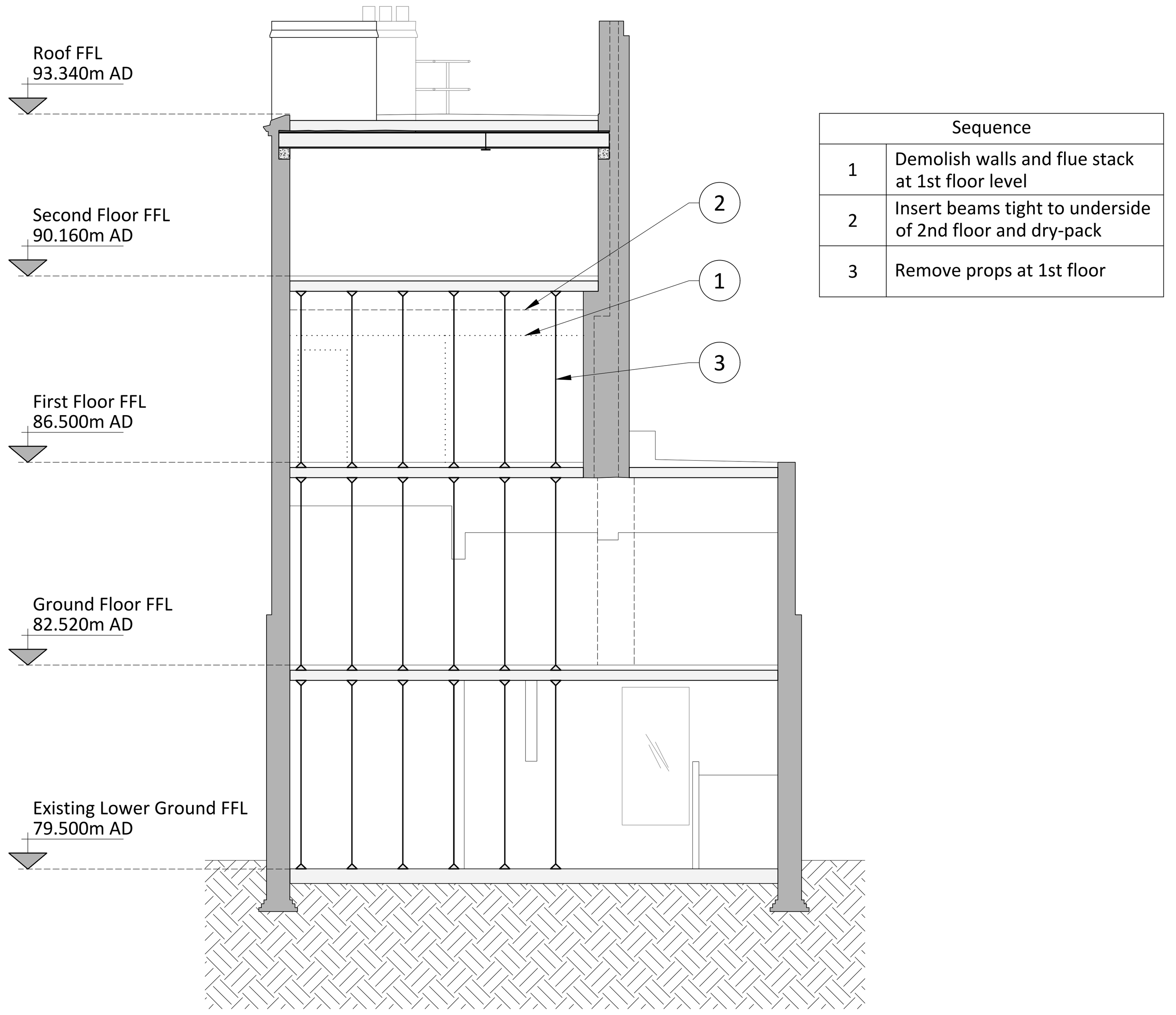
Key:
* Indicates assumed existing steel TBC
† Indicates existing transfer structure

Section A - Existing
Scale 1:100



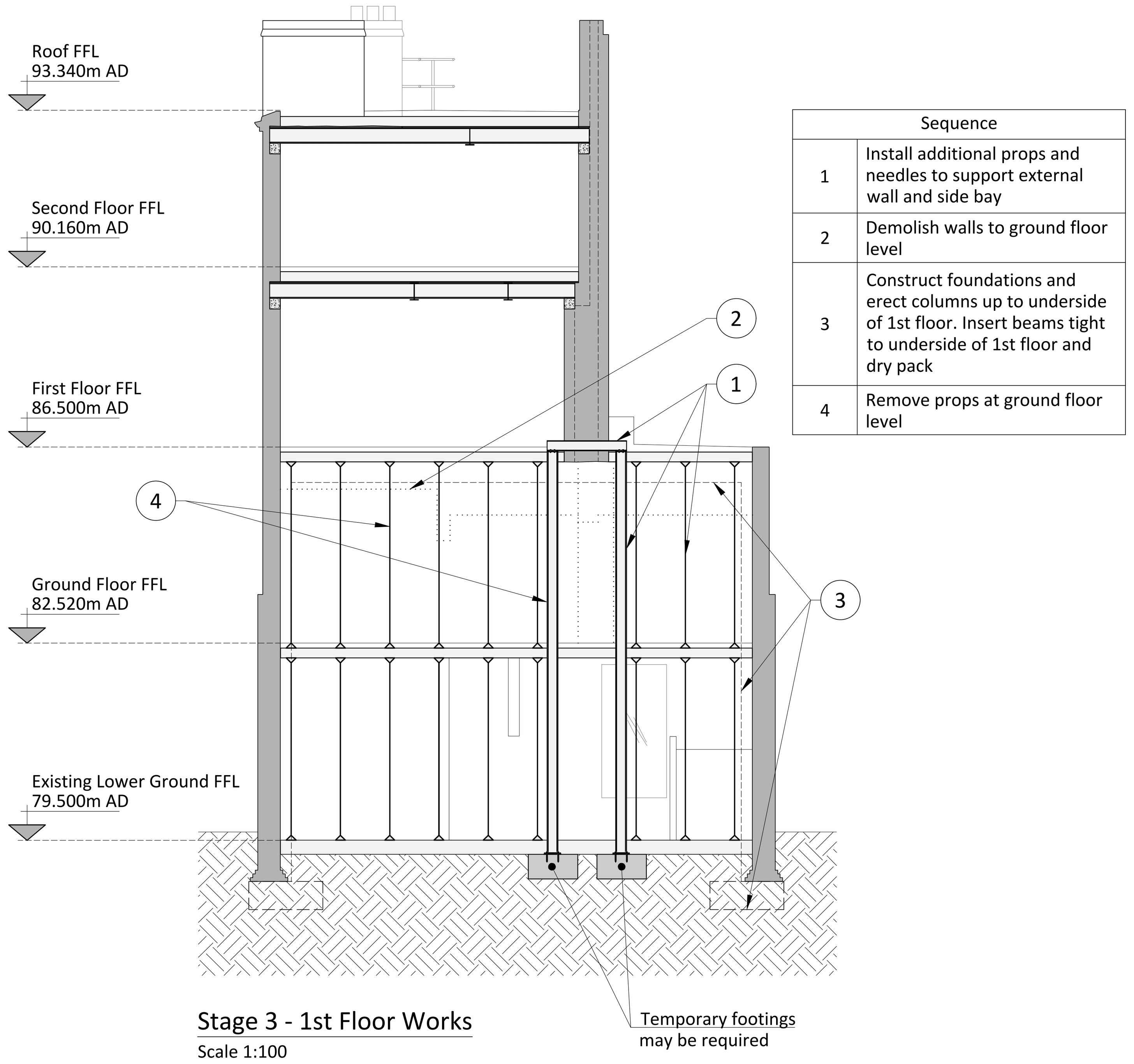
Sequence	
1	Through prop from roof to lower-ground
2	Install needles to support chimney stack
3	Demolish walls and flue stack at 2nd floor level
4	Insert beams tight to underside of roof and dry-pack
5	Remove needles and top level of props

Stage 1 - Roof Works
Scale 1:100



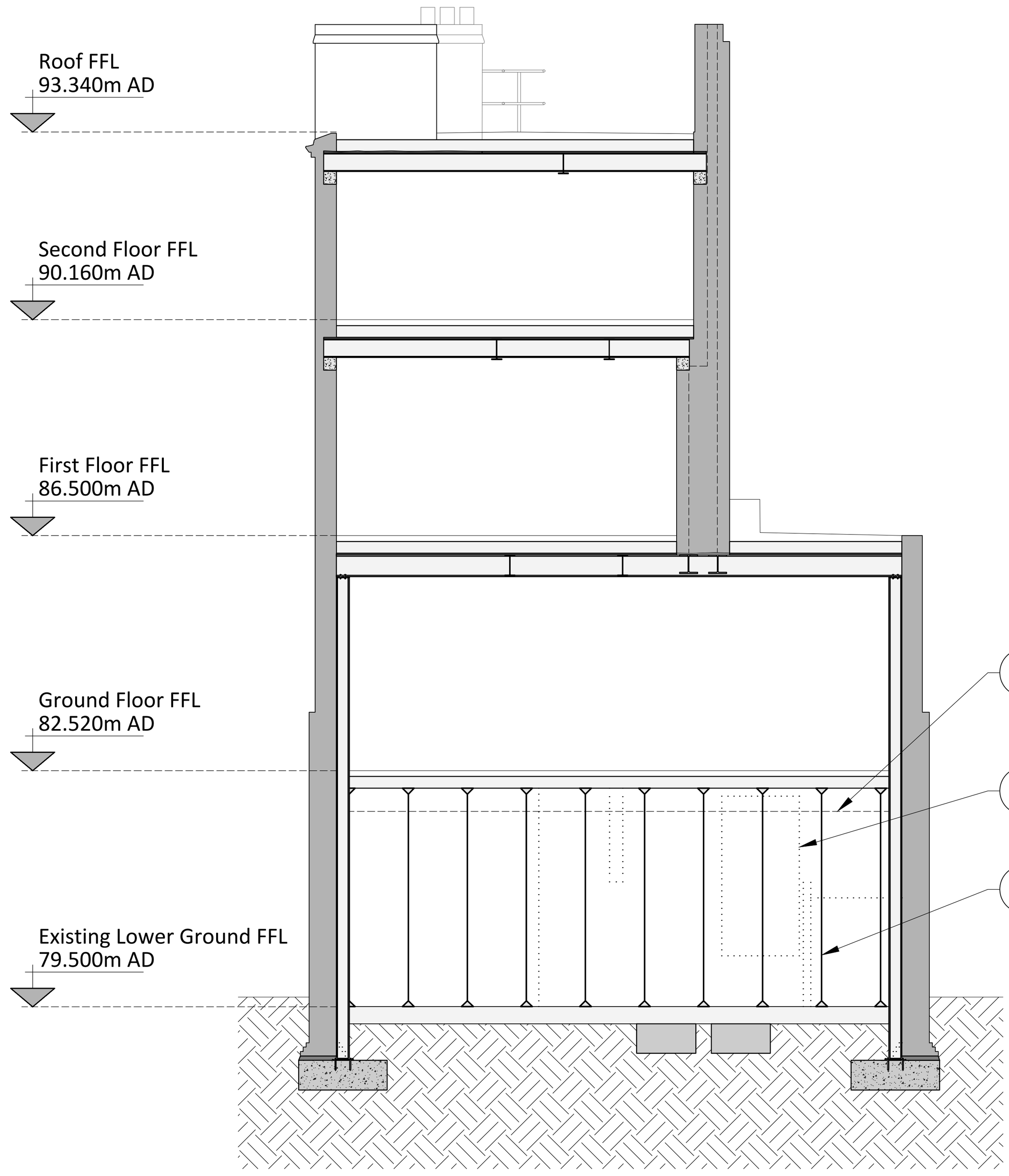
Sequence	
1	Demolish walls and flue stack at 1st floor level
2	Insert beams tight to underside of 2nd floor and dry-pack
3	Remove props at 1st floor

Stage 2 - 2nd Floor Works
Scale 1:100



Sequence	
1	Install additional props and needles to support external wall and side bay
2	Demolish walls to ground floor level
3	Construct foundations and erect columns up to underside of 1st floor. Insert beams tight to underside of 1st floor and dry pack
4	Remove props at ground floor level

Stage 3 - 1st Floor Works
Scale 1:100



Sequence	
1	Demolish walls to lower ground floor level
2	Insert beams tight to underside of ground floor and dry pack
3	Remove props at lower ground floor level

Stage 4 - Ground Floor Works
Scale 1:100

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P1	29.10.18	For Comment	RS	CG
P2	07.03.19	For Comment	ES	CG

PRELIMINARY
NOT FOR CONSTRUCTION

Title
Structural Engineering Temporary Works Stages 1 - 4

Project
Abacus Belsize Primary School, NW3

Client
ESFA

Job No.
4343

Drawing No.
700

Revision
P2

Scale
1:100 at A1

A1

Appendix B

Floor Construction Investigation

STRUCTURAL REPORT, STRUCTURAL FLOOR INVESTIGATION

Abacus Belsize Primary School, NW3 1PD

Project Number: 4343

Revision B

Prepared by Clive Goadby
1 May 2019

Checked By James Nevin

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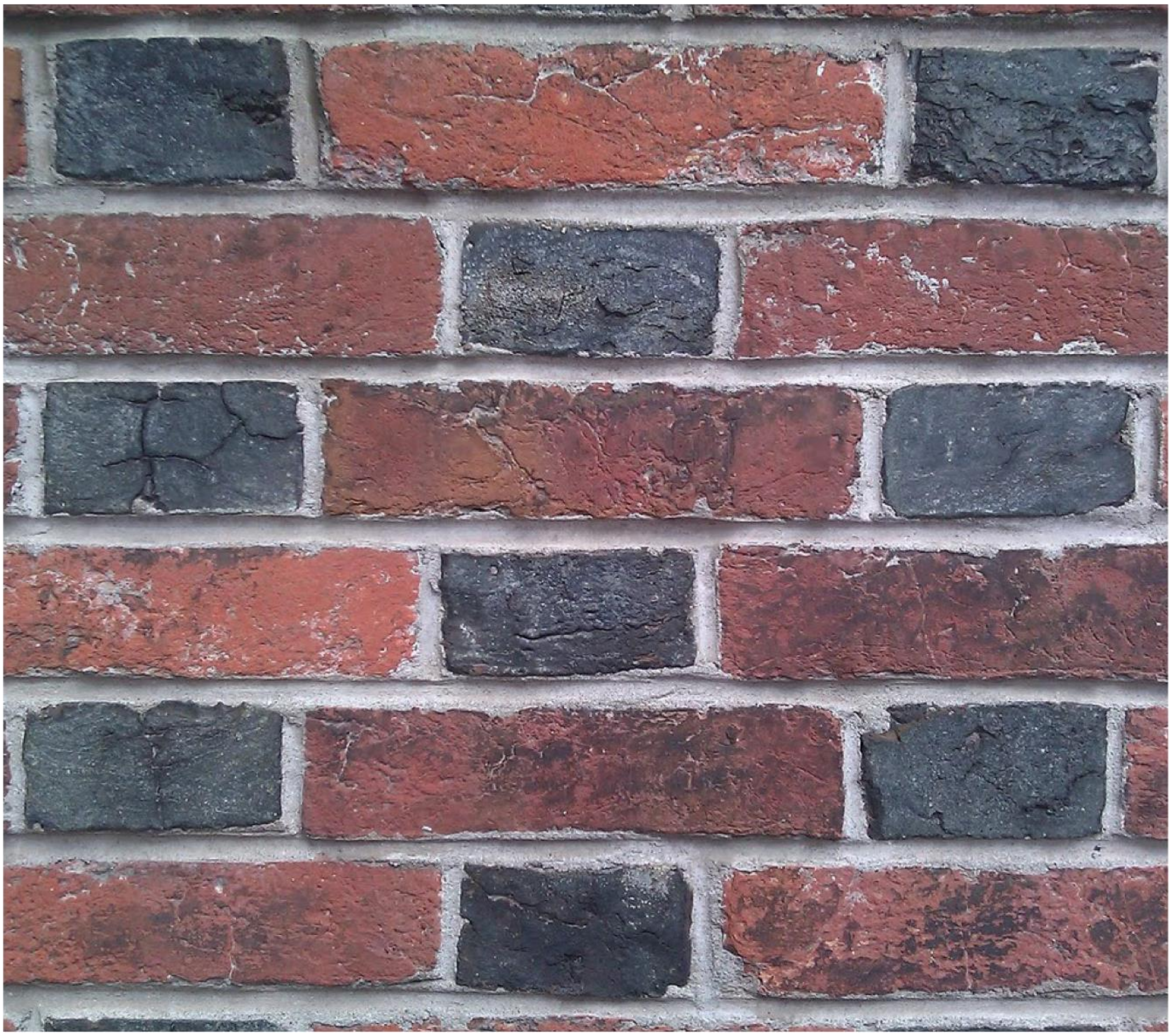

Contents

1.0 Introduction

This report has been produced by Blue Engineering on behalf of client the ESFA, for the proposed redevelopment of Abacus Belsize Primary School. This document covers the fabric investigation work undertaken during the Stage 3 on floor construction at various locations through the existing building.
A description of the findings of the investigation is given, with further recommendations.
It should be noted that this fabric investigation is limited in scope and was intended to determine the general structural floor construction of the existing buildings. It is not comprehensive and suitable allowance and cost contingency should be made for further work to complete the investigations during subsequent detailed design and construction stages.

2.0 Background

The existing buildings were reportedly constructed in 1913, designed by the Architect John Dixon Butler, and designated Grade II listed in 1998. It has several distinct parts:

- A magistrate's court which comprises an open space at first floor level, offices at ground floor and cells at lower ground. This has different floor levels than the main building.
- The main police station building on 4 levels with pitched roof.
- The attached rear wing to the south, again on 4 levels but with flat roof and cells at lower ground floor.
- The annex building within the rear courtyard, a separate domestic scale 2-storey building possibly originally a stable.

The structure has masonry walls, mass concrete strip foundations, proprietary joist and pot floors with concrete topping, and a trussed pitched roof constructed in timber. Surveys and investigations
The structure of the existing main building was investigated, to a limited extent, during a previous scheme. A report entitled 'Structural Investigations and Report', written by **hsp consulting**, highlights several defects - principally where timber roof structures are subject to damp and decay - and also describes in general terms the floor construction as 'concrete'.
The investigation reported on here was a further intrusive investigation to determine floor construction, depth and span direction in a number of locations.
A contractor Walter Lilley was engaged on behalf of the ESFA to undertake the investigation works to a scope defined by Blue Engineering. The scope was strategically targeted to determine a representative number of floor areas. Due to the varied layout of the structure it was not considered economical to investigate fully all locations. The work was completed in 5 days and is summarised below

3.0 Results of Investigation

3.1 Main Findings

The floor of the main buildings are found to be constructed from steel joists at close centres, with infill between the joists being provided by either clay hollow pots bearing on the bottom flanges, supporting a loose 'clinker' concrete between and over the joists ('Joist and Pot Floor') to make what was possibly classified as a 'fire-proof' floor, or beams with clinker concrete infill ('Filler joist Floor). It has been possible to establish the historical BSB sizes of joists from the survey and thus confirm their structural properties. The joists are generally supported on masonry load-bearing walls although in some cases these have been replaced with steelwork.

In some cases visible cracking was evident to plaster finishes of soffits, generally along the line of steel joists. There was no evidence of a defect causing this cracking. However in the south block the flat roofs appear to be constructed with the same construction technique and cracking may have been more significant. One defect of filler joist construction is when the clinker based mix comes into contact with water. The impurities of the clinker react with the water and with the addition of oxygen forms sulphuric acid. This corrodes the steel joist and examples are known where the web has corroded through (Holden, 2012).

The annex building was also investigated, and the first floor was found to be constructed of contemporary beam and block construction in part (and timber joists elsewhere).

3.2 Detailed Findings

A total of 16 openings were planned in the main building and 2 in the annex. One was abandoned in each of the buildings due to site constraints. The complex layout of masonry walls in some areas of the building meant that span direction was not immediately obvious and, in a large proportion of cases, was found to be a different direction to that predicted.
The plans below indicate the investigations completed and the spans confirmed.
Floor capacities have been estimated, using the data collected, the section properties published in the BCSA Historic Steel Work handbook handbook (Bates,1991) and the spans assessed and results summarised in Appendices 3 and 4. The table present two columns – the joists have been checked for bending strength (M) and live load deflection (d), and the worst case of these is highlighted. For the cases checked the Live Load capacity of the floor is in excess of 3.3 kN/m^2. In one case, the principal room in the main building, it was not possible to assess the span of the joists and it appears likely that there is additional embedded steelwork within the floor not located. Further investigation will be required in this area to confirm the arrangement.

4.0 Discussion and Recommendations

The proposed use of the building could theoretically impose heavier loads onto the floors than the original use of offices.
A summary off current imposed floor load requirements is below ('Actions' from BS-EN 1991-1).

Classification	**Sub-Classification**	**Usage**	**Imposed Load**
B Offices	B1	Offices generally	2.5 kN/m^2
	B2	Offices at ground floor level	3.0 kN/m^2
C1 Areas where people may congregate (with tables)	C11	Public, institutional and communal dining rooms and lounges, cafes and restaurants	2.0
	C12	Reading rooms with no book storage	2.5
	C13	Classrooms	3.0
C4 Areas where people may congregate (with possible physical activities)	C41	Dance halls and studios, gymnasia, stages	5.0

The picture is a complex one as the floor construction varies both in terms of the use of lightweight pots and infill concrete and, also, the spans and joist depths. However, whilst the estimated live load capacity varies widely, in all cases it appears to be in excess of 3.0 kN/m^2. For example in the area proposed for the School hall our findings suggest the floor capacity to be between 5.9 kN/m^2 and 9.0 kN/m^2 depending on the location.

Of 15 locations checked 2 were worthy of further comment - one is a community space (Community Space 1 – Ground Floor, beneath the Magistrates Court) and one was the principal room noted above (3.2). The conclusion is that there may be isolated cases where floor spans need strengthening to give the desired capacity or, conversely, the usage of those spaces could be restricted. The loading categories are broad so, for instance, for the community space (noted above) the usage would be up to and including use as a dance hall with a Live Load requirement of 5.0 kN/m^2, showing a theoretical under-capacity. This may be an unduly onerous loading requirement and, in discussion with Building Control, it may be preferable to agree a less onerous loading requirement with, possibly, a restriction on occupancy.

The study carried therefore has limitations. We have taken a representative snapshot of floors throughout the building but the results showed that there is not a clear pattern of construction across the different blocks. As the spans and floor constructions vary so widely it is becoming clear that a more comprehensive fabric investigation would be valuable to obtain a full picture of the existing construction and mitigate the risk of unknown construction. This would be done through confirming span and support conditions in every case, as well as determining joist size, spacing, and floor infill construction. And, as noted above, areas with potential water ingress should be investigated in detail to confirm integrity of the structure.

5.0 BIBLIOGRAPHY

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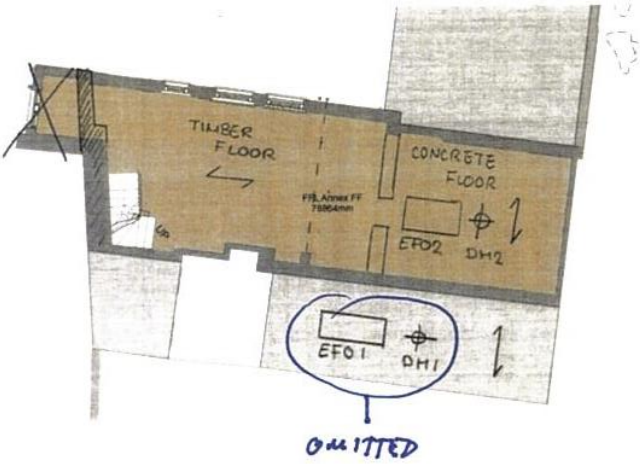
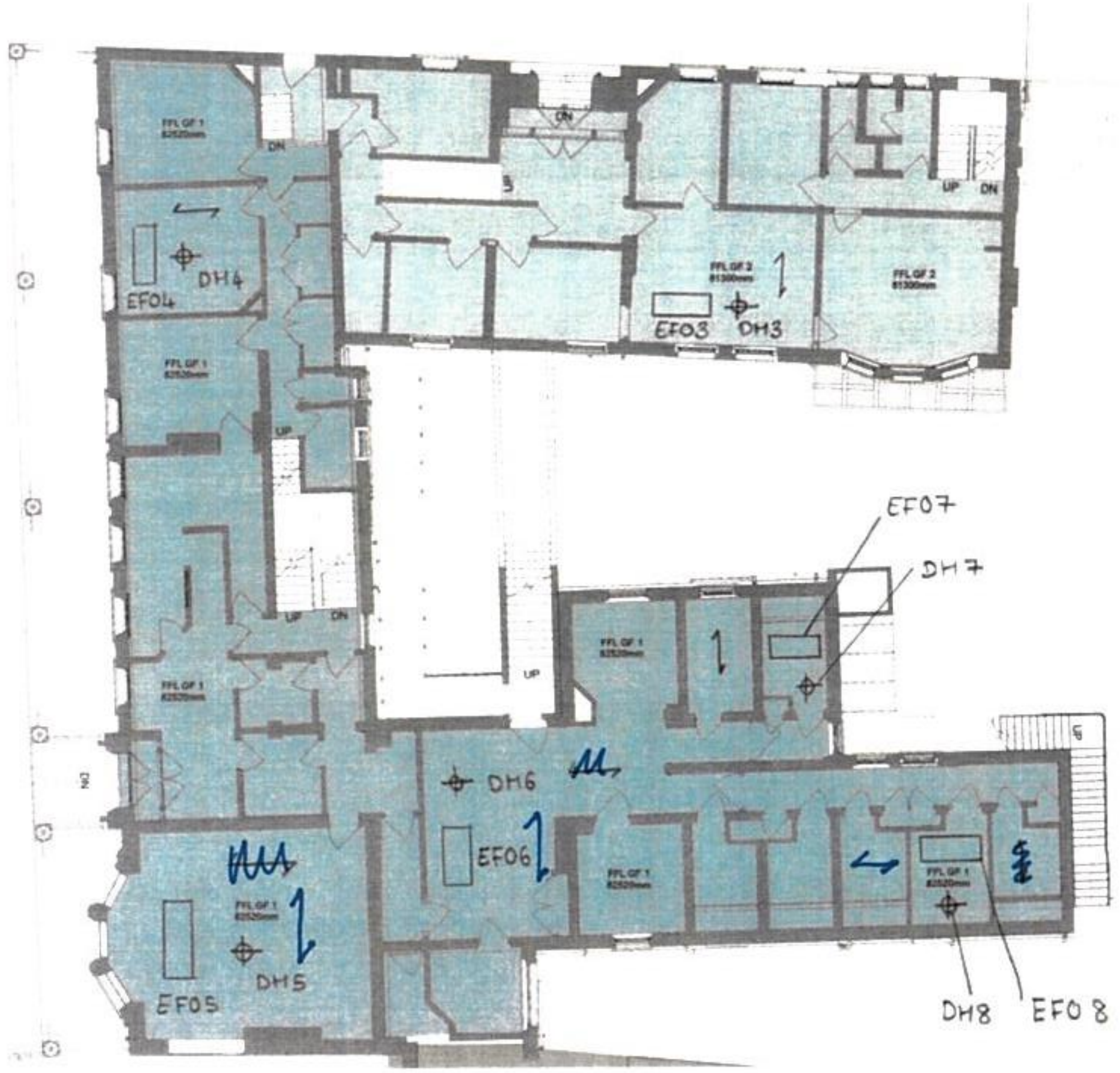
Rushton, T (2009). *Investigating Defects in Commercial and Industrial Buildings*. London : RICS. p185-189.

6.0 APPENDICES

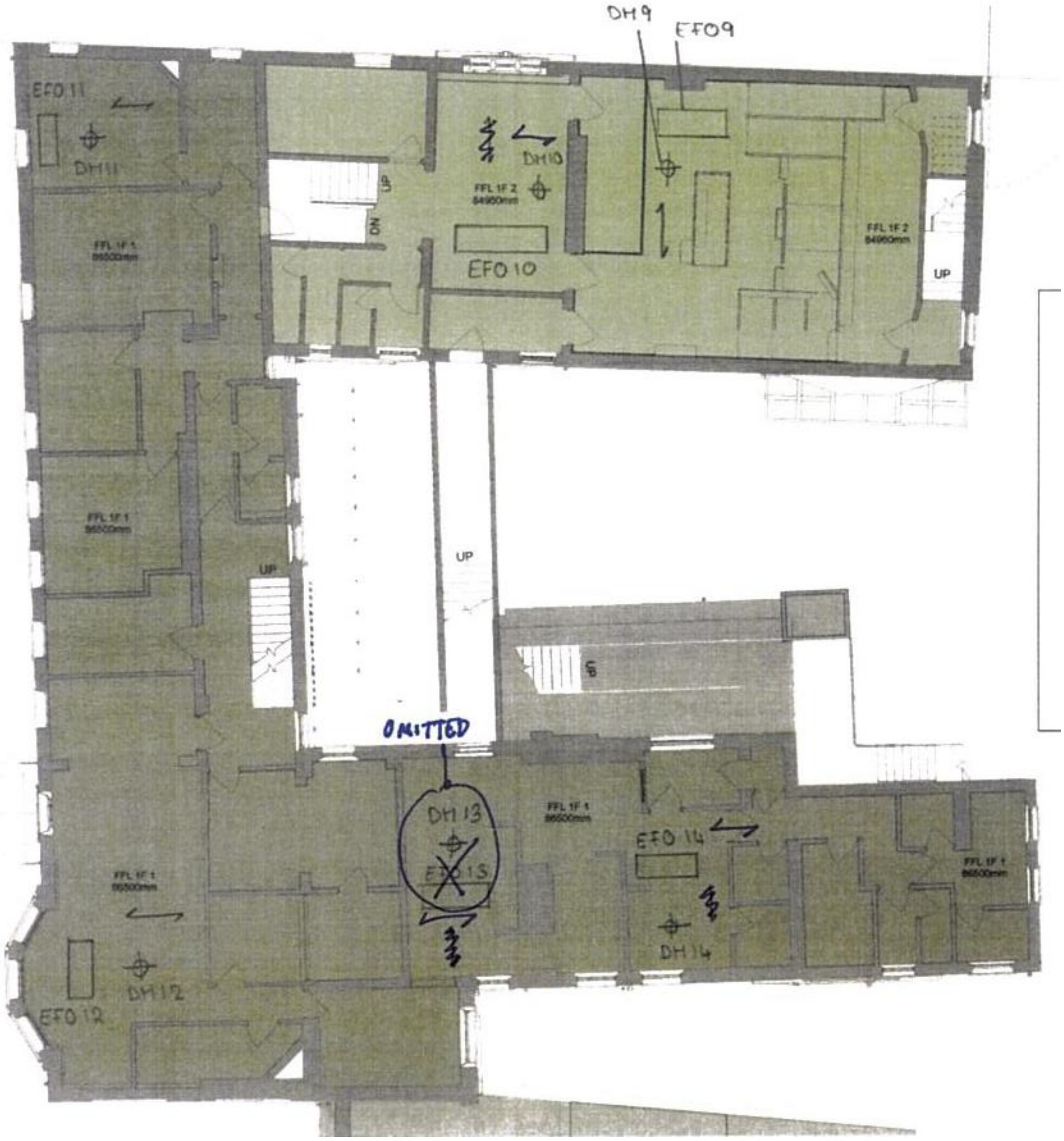
6.1 APPENDIX 1 – INVESTIGATION LOCATIONS



First Floor Annex



Ground Floor



First Floor

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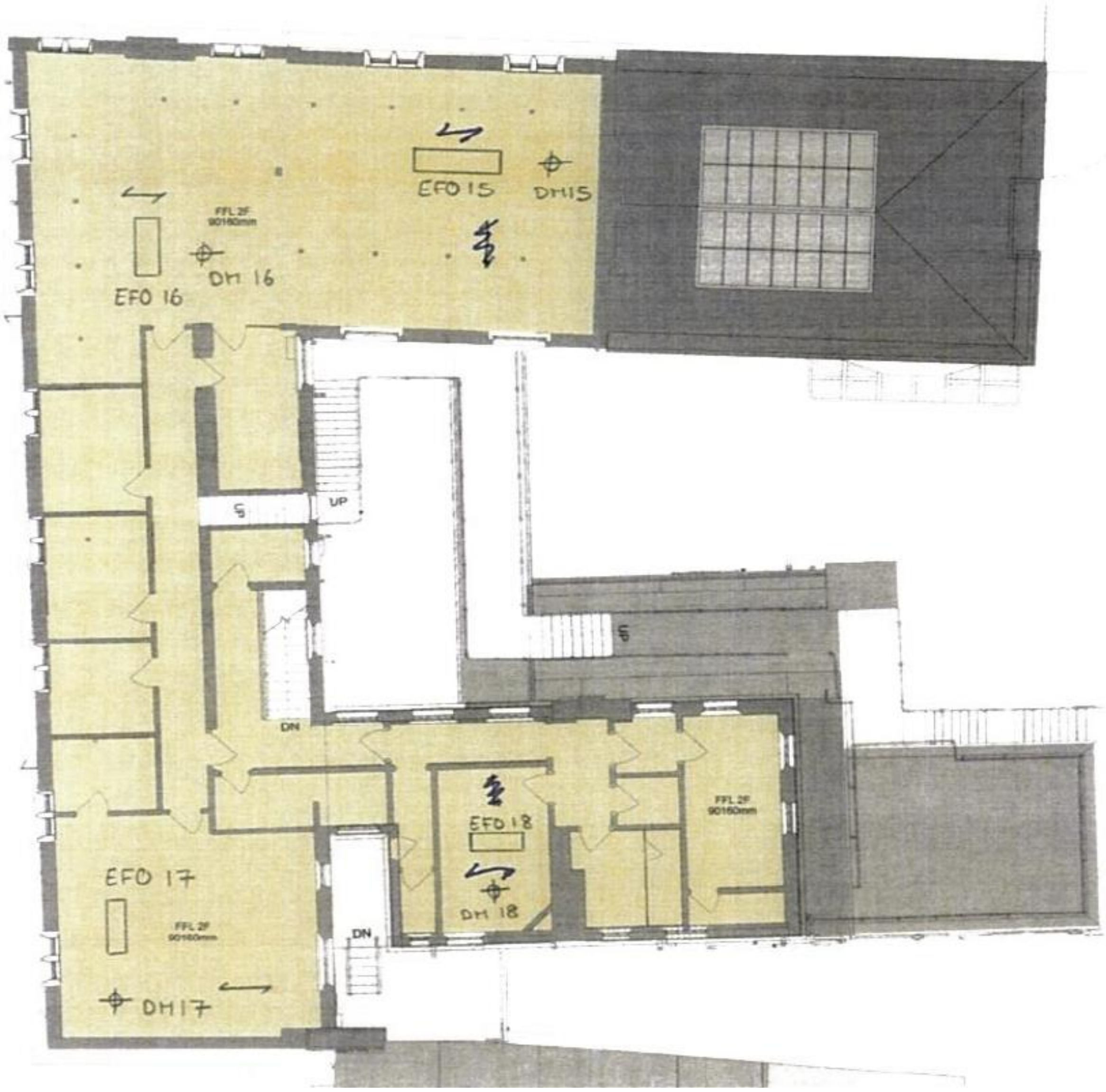


Second Floor

6.2 APPENDIX 2 – SUMMARY TABLE OF EXPLORATORY WORKS

Napier Construction (SE) Ltd - Abacus Belsize Primary School - Structural Floor Slab Survey

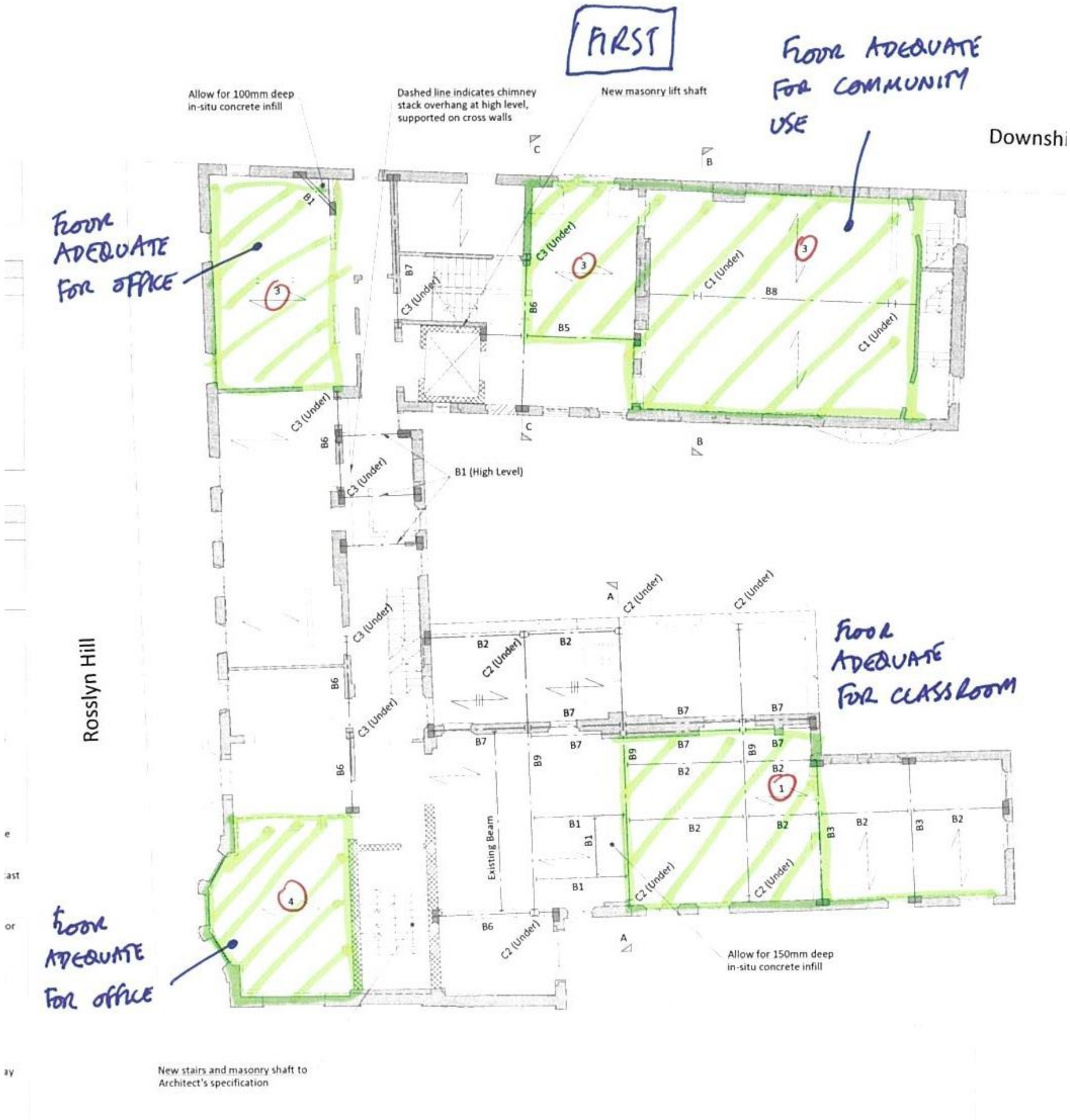
EFO No.	Building level	Floor Construction	Span orientation	Cover Level	Slab depth	Beam Size w x d	Beam Centres	Timber overfloor
1	Omitted by SE	-	-	-	-	-	-	-
2	1st	Pre-cast Beam and concrete block floor	N-S	0	150	125 x 150	500	No
3	G	*no pots visible: filler joist*	E-W	30	260	75 x 125	660	No
4	G	Unknown	Unknown	80	260	75 x 125	N/A	No
5	G	*no pots visible: filler joist*	N-S	50	260	75 x 150	650	Yes
6	G	*no pots visible: filler joist*	N-S	35	240	75 x 160	835	No
7	G	*no pots visible: filler joist*	E - W	80	260	75 x 125	700	No
8	G	Steel Beam and Clay Pot	E - W	80	300	75 x 125	600	No
9	1st	Steel Beam and Clay Pot	N - S	50	250	75 x 160	625	Y (Parquet)
10	1st	Steel Beam and Clay Pot	E - W	50	250	75 x 160	640	Y (Parquet)
11	1st	Steel Beam and Clay Pot	E - W	50	250	75 x 160	640	Yes
12	1st	*no pots visible: filler joist*	N - S	40	260	100 x 180	650	Yes
13	Omitted by SE	-	-	-	-	-	-	-
14	1st	Steel Beam and Clay Pot	E - W	115	250	75 x 100	640	No
15	2nd	*no pots visible: filler joist*	E - W	50	225	75 x 130	640	Yes
16	2nd	Steel Beam and Clay Pot	E - W	0	215	100 x 180	640	Yes
17	2nd	*no pots visible: filler joist*	E - W	0	250	100 x 200	640	Yes
18	2nd	Steel Beam and Clay Pot	E - W	0	230	100 x 180	640	Y (Parquet)

(Dimensions in mm)

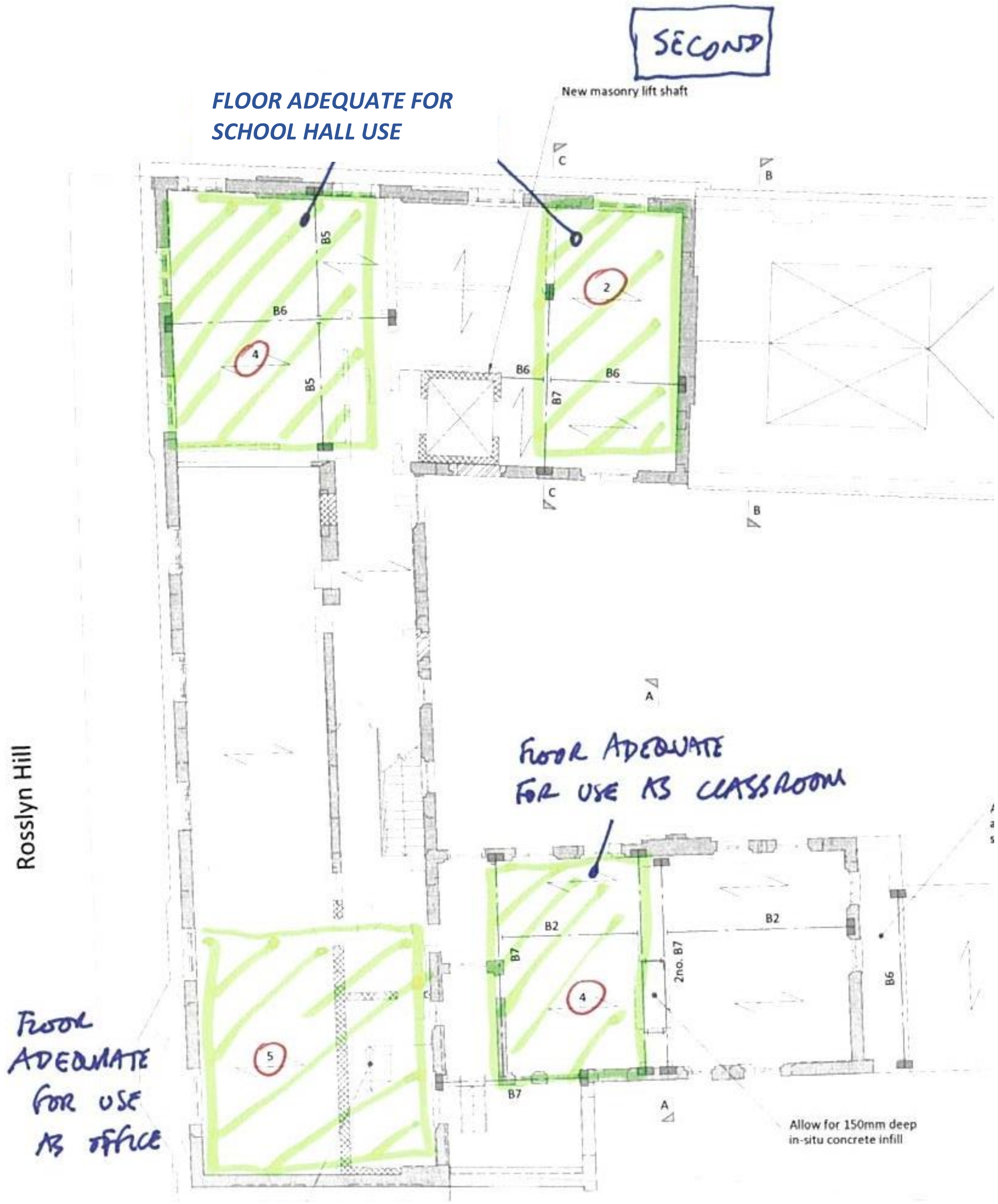
6.3 Appendix 3 – Appraisal of floor capacity

EFO No.	Building level	Floor Construction	BSB size	I cm^4	Z cm^3	M capacity/ joist kNm	Span m	DL kN/m^2	Residual LL capacity (M)	Residual LL capacity (d)
1	Omitted by SE	-		42	16	1.85		Clinker conc 18 kN/m^3		
2	1st	Pre-cast Beam and concrete block floor	N/A							
3	G	*no pots visible: filler joist*	5x3	566	89	10.09	3.9	4.68	3.36	4.63
4	G	Unknown	5x3	566	89	10.09	3.9	4.68	3.49	4.78
5	G	*no pots visible: filler joist*	4X1.75	153	30	3.41	5.7	4.68	-3.30	-3.81
6	G	*no pots visible: filler joist*	6X3	841	110	12.48	3.0	4.32	8.97	19.70
7	G	*no pots visible: filler joist*	5x3	566	89	10.09	3.3	4.68	5.91	9.82
8	G	Steel Beam and Clay Pot	5x3	566	89	10.09	3.1	3.96	10.04	16.44
9	1st	Steel Beam and Clay Pot	6X3	841	110	12.48	3.4	3.06	10.76	18.99
10	1st	Steel Beam and Clay Pot	6X3	841	110	12.48	3.4	3.06	10.44	18.47
11	1st	Steel Beam and Clay Pot	6X3	841	110	12.48	4.0	3.06	6.69	10.16
12	1st	*no pots visible: filler joist*	7X4	1632	184	20.74	5.7	4.68	3.18	4.05
13	Omitted by SE	-				0.00				
14	1st	Steel Beam and Clay Pot	4X3	313	62	6.96	3.8	2.40	3.63	3.35
15	2nd	*no pots visible: filler joist*	5x3	566	89	10.09	3.4	4.05	6.86	10.45
16	2nd	Steel Beam and Clay Pot	7X4	1632	184	20.74	4.7	2.43	9.31	13.39
17	2nd	*no pots visible: filler joist*	8X4	2318	228	25.74	6.3	4.50	3.61	4.83
18	2nd	Steel Beam and Clay Pot	7X4	1632	184	20.74	5.5	2.70	5.87	7.17


FLOOR ADEQUATE FOR OFFICE
Allow for new ramp structure, formed from precast concrete slab on steel supports
Allow for 100mm deep in-situ concrete infill
New masonry lift shaft
GROUND
Downshire Hill
FLOOR LOADING SLIGHTLY LIGHT FOR COMMUNITY USE
Allow for roof canopy - details TBC
FLOOR LOADING ADEQUATE FOR HALL
Rosslyn Hill
Allow for new entrance steps in precast concrete
Allow for 150mm deep in-situ concrete infill
INVESTIGATION INCONCLUSIVE



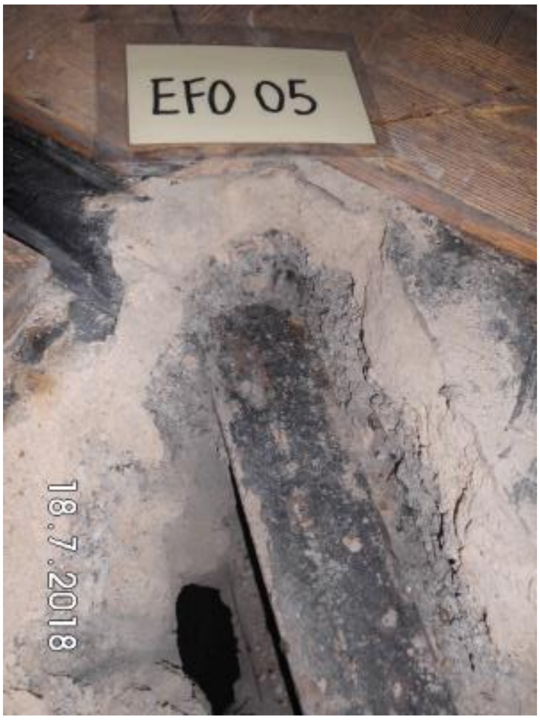
BLUE ENGINEERING


SECOND
FLOOR ADEQUATE FOR
SCHOOL HALL USE
New masonry lift shaft
FLOOR ADEQUATE
FOR USE AS CLASSROOM
Rosslyn Hill
FLOOR
ADEQUATE
FOR USE
AS OFFICE
Allow for 150mm deep
in-situ concrete infill

6.5 Appendix 5 – Site Photos - selection

EFO 2: Beam and block floor

EFO 3: Filler joist floor – RSJ and clinker concrete



EFO 5: Filler joist floor – RSJ and clinker concrete

EFO 6: Filler joist floor – RSJ and clinker concrete

EFO 7: Filler joist floor – RSJ and clinker concrete

EFO 9: Joist and pot floor with clay pots visible

EFO 10: Joist and pot floor with clay pots visible

EFO 11: Joist and pot floor with clay pots visible

BLUE ENGINEERING

EFO 12: Filler joist floor

EFO 14: Joist and pot floor with clay pots visible

EFO 15: Filler joist floor

EFO 16: Joist and pot floor

EFO 17: Filler joist floor

EFO 18: Joist and pot floor

Appendix C

CDM Designer’s Risk Assessment

DESIGNER'S RISK ASSESSMENT

Abacus Belsize Primary School, Rosslyn Hill, NW3 1PD
Project Number: 4343

Revision A

Prepared by Clive Goadby,
25 September 2018

Ref No.	Activity/Element	Potential Hazard	Level of Risk L/M/H	Population at Risk	Mitigating actions taken by designer	Level of Residual Risk - L/M/H	Recommended further mitigation by contractor
Site Constraints/ surroundings							
01	Change of site levels at boundaries (excavation and raising of levels)	Undermining or overloading existing boundary walls, and consequent collapse.	H	Public, construction workers	Initial visual assessment, and recommendation to minimise level changes	M	Close out question of adjoining levels and existing wall construction by survey. Review final proposals and design retaining structures and sequencing to accommodate
02	Excavations, esp in footpath and site car-park	Unidentified buried services struck during excavations	M	Public, construction workers	Below ground services surveys recommended	M	Complete below ground services surveys
Foundations							
03	Foundations final design and construction	Unknown ground conditions with consequent ground movement or collapse	M	Users, construction workers	Geotechnical / Geoenvironmental survey recommended	M	Complete surveys and/or circulate historical surveys, and revisit substructure design to reflect this information. Confirm at commencement of construction by trial pit excavations
04	Below ground drainage final design and construction	Unknown drainage layout with consequent deep excavations required	M	Construction workers	Below ground drainage survey recommended	M	Complete surveys and/or circulate historical surveys. Review below ground drainage design to reflect this information.
Primary structure							
05	Heavy long-span transfer beams over new school hall, ground floor level.	Overloading and/or excessive movement of existing structures	M	Construction workers	Explored alternative layouts, developed outline Method Sequence to demonstrate safe method of work	M	Contractor to develop detailed method/construction sequence prior to commencing work.
06	Alteration work generally	Proposed new structures overloaded due to excessive temporary loads	H	Construction workers/end users	Specification will require contractor to carry out alteration from the roof down, removing loads from the building and avoiding the risk of overloading. Investigation carried out to determine typical floor capacities.	M	Contractor to develop detailed method/construction sequence prior to commencing work. Contractor to ensure temporary loads do not exceed floor capacity or to prop accordingly to prevent overloading
07	Existing retained structure generally	Poor condition of existing structures (e.g. timber roof structures or steel/concrete floor structures) undetected, with sudden failure	H	Construction workers/end users	Risk of poor condition and decay highlighted on drawings. Further investigation recommended to identify.	M	Contractor to carry out comprehensive investigations of high risk areas to identify any poor condition and allow repair/replacement
08	Existing floor structures	Unknown construction or span directions: collapse due to alterations not reflecting actual condition.	H	Construction workers/end users	Targeted investigation undertaken during Stage 3, with report on findings	M	Contractor to carry out comprehensive investigation of all spans prior to construction to confirm construction and span direction and to incorporate into design.
09	Existing roof structures	Unknown construction and splice locations: collapse due to alterations not reflecting actual condition.	H	Construction workers	Limited investigation undertaken during Stage 3 with feasible scheme developed. Assumptions identified on drawings and in report	M	Contractor to carry out comprehensive investigation of timber roof beams and confirm assumptions.
Secondary structures/finishes							

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