20142789

Greenbank Synagogue

RIBA Workstage 2
Concept Structural Design Report

Initial Issue 08/03/2016

Document Control

Revision	Originator	Checked By	Reviewed By	Approved By	Issued to	Issue Date
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The above signatures confirm that:

- the ***originator*** has to the best of their ability produced a document of high quality work, and made any amendments as required during the checking and reviewing process
- the ***checker*** has completed a line by line check using source data and agreed changes to be made with the originator
- the ***reviewer*** has completed a high level review and agreed any changes/corrections with the originator and ensured they have been completed
- the **approver** has confirmed that the check and review has been completed by persons appropriately qualified and that the document is fit for issue

Contents

1 Introduction

1.1 General

This report outlines the structural concept for the Greenbank Synagogue development.

The report has been completed to RIBA workstage 3; concept design. The purpose of the report is to provide structural concepts and outline specifications for informing the project strategy.

The structural concept considered is subject to design development and detailed design to confirm viability as well as integration with both architectural and services design.

We have been instructed to complete a concept design for the structural aspects of the synagogue only.

2 Site Location

The site is located on the East of Greenbank Drive, Sefton Park, Liverpool.

The site currently houses a purpose built Synagogue positioned relatively central to the site.

3 Proposed Development

Current proposals are set out by NCH Architects drawings reference 2214, planning drawings dated February 2016.

The proposed development seeks to convert the Synagogue into apartments, with the inclusion of a new building within the site to form a purpose built apartment block.

3.1 Design Development

A separate Structural Appraisal of the existing structure has been completed and should be read in conjunction with this report.

BDI have been appointed to develop a design concept to provide a concept design prior to submission of a planning application. The level of information produced is to RIBA workstage 2; concept design. The structural information will generally comprise structural layouts indicating element positions, and form a structural strategy for the scheme.

3.2 Development Constraints

General

The development is within the constraints of an existing building. There is reasonable working space to the front and rear of the site and some vehicular access around the perimeter of the building. This should aid deliveries and manoeuvring of materials around site.

Existing Building

Owing to the constraints of working within an existing building structural element sizes and weights should be limited where possible.

Sewerage Network

A sewerage mapping exercise has not yet been undertaken but it is anticipated a combined public sewer exists to the main road. It is not anticipated to be of significant depth.

4 Geotechnical Conditions

Basic intrusive investigation works on site suggest the ground strata to be characterised by sands.

5 Existing Building

5.1 History

The existing building is understood to be a purpose built synagogue.

Historical review suggests the synagogue was consecrated in 1937.

We understand the building was subject to a fire in 1959. Shortly after the fire, the building was refurbished by the original Architects of the building. The refurbishment incorporated an additional building adjacent and attached to the existing, to the south of the site.

The building has been unoccupied since 2008.

5.2 Listing

The existing building is Grade II listed.

The listing summarises:

- First listed in 1983
- Architect: Alfred Ernest
- Reinforced concrete and steel structure with buff facing bricks and filed roof
- Art Deco style
- Decorative Arched Ceiling

5.3 Building Form

A detailed structural investigation has been completed. The intrusive investigation report should be read in conjunction with this report.

5.3.1 Layout

The building is over three storeys comprising a part basement, ground floor and first floor gallery.

A vaulted arched roof exists to the majority of the building.

To the front and rear, the building steps down in massing with a number of flat roofs in existence.

5.3.2 Structure

From review of existing survey data, photos and a high level inspection of the structure on site, we surmise the structure being formed as below:

Roof

Tiles supported on a pitched timber grillage. The timber is supported on a serious of steel trusses spanning the full width of the building to the main areas.

To the front and rear flat roofs, the roofs appear to be reinforced concrete supported on adjacent walls.

It is unclear how the two long lengths of flat roof adjacent to the main pitched roof are supported.

Ceiling

The decorative arched ceilings appear to be plastered, with support being offered by formwork being hung off the steel trusses.

Floors

The internal gallery to level 1 and suspended level 0 appear to be cast in-situ reinforced concrete supported on a steel beam system supported on internal columns.

Walls

The external side walls flanking the main area to the synagogue are of masonry construction. Within the masonry construction a number of steel columns exist, running from foundation level up to the steel trusses at roof level. These columns also support the floors at level 0 and level 1.

It is anticipated some of the internal and external masonry walls are load bearing, and support flat roofs and small areas of floor etc.

6 Proposed Structure

6.1 Structural Philosophy

Subject to detailed structural analysis and material testing, the existing foundations, basement slabs, ground and first floors and roofs are to be retained. The only wholly new structural element to be installed is the structural support around a new opening in the suspended ground floor and structural support to form a level first floor.

New steel framing is to be installed within the existing structure to support a level first floor structure.

Isolated openings are to be formed within the existing structure to facilitate services.

6.2 Substructure

A series of new pad foundations are to be installed to support the proposed new steel columns. The existing slab will be cut out locally to allow excavation for the new pad foundations.

A series of new strip footings are to be installed to support sleeper walls which in turn will support a new suspended basement floor. The existing slab will be cut out locally to allow excavation for the new strip footings.

It is worth noting the anticipated bearing strata is wet sand, as such temporary water management is likely to be required during the course of the works to manage the water within the excavations.

6.3 Basement and Waterproofing

The existing basement currently has no waterproofing syste. As part of the conversion into habitable space a new waterproofing system should be installed in accordance with BS8102:2209 Code of practice for protection of below ground structures against water from the ground. Given that the structure is existing, it would be our recommendation to install a water management system to control any water ingress. This would require draining both the walls and floor to a sump pump, and then discharging of the water.

The choice of basement waterproofing should be agreed between all members of the design team and the client. A high groundwater level is anticipated.

6.4 Superstructure

Generally the existing synagogue is likely to have been subjected to imposed floor loads of approximately $3.0kNm^{-2}$.

The proposed building use will be subjected to the following imposed floor loads:

Residential dwellings	$1.5kNm^{-2}$
Circulation space	$3.0kNm^{-2}$
Balconies	$4.0kNm^{-2}$
Cafes	$2.0kNm^{-2}$

It is anticipated that existing floors which are in the position of apartments will not have a net change in overall floor load. This is owing to the reduction of imposed floor load being counteracted by the addition of finishes, and partition walls etc.

Balcony areas are to be new structure which can be designed to support the required floor loading.

The main elements of superstructure to consider are:

1. Opening to ground floor slab
2. Levelling of ground floor to facilitate internal partitions
3. Levelling of first floor to facilitate internal partitions and balconies
4. Openings to facilitate services
5. Plant support at roof level

6.4.1 Opening to ground floor slab

An existing feature existed within the central area to the ground floor. It is apparent that there is existing steelwork trimming to support the feature. Ideally the opening within the ground floor slab should be set out to suit the existing steelwork. Should the opening be required to be larger (north to south) then additional trimming steel could be included to support the existing slab. The width of opening should be limited to the spacing of the existing columns.

6.4.2 Ground floor levelling

The finished floor level to a small proportion of ground floor will require lifting to make level. This is predominantly to the sloping ground floor areas. It is anticipated this will be completed using a simple arrangement of timber joists laid on the existing floor.

6.4.3 First floor levelling

The first floor is required to be both levelled and extended to form a balcony over the existing double height central space.

The first floor framing is to be formed with cantilevered steel beams propped off a new primary beam. Infill timber joists spanning between cantilevered beams form the floor structure. The new primary beams are supported upon new steel columns which run through the existing floors. The new cantilever beams will be affixed to existing structure and wholly rely on the existing structure for resistance to uplift and their global stability. To this end further investigation and detailed analysis will be required to demonstrate feasibility of this proposal.

First floor apartments are to be formed in light weight stud work built off the new first floor structure.

6.4.4 Openings for services

A number of isolated openings are required in flat roofs for services. Openings should be trimmed with isolated steel beams provided underneath the existing slab to support the existing slab.

6.4.5 Plant support

Plant in the form of 'Air Handling Units' are required on the flat roofs. This should be supported with isolated steelwork framing above roof level. The steelwork should be galvanised to counteract corrosion form its external environment.

7 Drainage

The majority of drainage will run vertically through the building within internal risers before travelling horizontally beneath the ground floor and out into the local sewerage network by gravity. Drainage to the basement will need to be locally pumped to high level and then out into the local sewerage network by gravity.

Sumps and pumps will also be required within the basement for the water management system.

An element of SUDS may be required. This would likely comprise soakaway infiltration of surface water into the ground around the site. Where additional hardstanding is provided, this should be of a permeable nature and designed with sufficient storage capacity.

We are not aware of any flow restrictions imposed by the sewerage undertaker, but would liaise with the undertaker to confirm prior to detailed below ground drainage design.

Permission will then be sought to form a new sewer connection from the sewerage undertaker.

8 Outline Design Criteria

8.1 Codes of practice and references

The following Eurocode Standards (including relevant National Annex information), Codes of Practice and References have been applied:

BS EN 1990:2002 Eurocode – Basis of Structural Design

BS EN 1991-1-1:2002 Eurocode 1: Actions on Structures. General actions – Densities, self-weight, imposed loads for buildings.

BS EN 1991-1-2:2002 Eurocode 1: Actions on structures. General actions – Actions on structures exposed to fire

BS EN 1991-1-4:2005 Eurocode 1: Actions on Structures. General actions – Wind actions

BS EN 1992-1-1:2004 Eurocode 2: Design of concrete structures. General rules and rules for buildings.

BS EN 1992-1-2:2004 Eurocode 2: Design of concrete structures. General rules – Structural fire design

BS EN 1993-1-1:2005 Eurocode 3: Design of steel structures. General rules

BS EN 1996-1-1:2005 Eurocode 6: Design of Masonry structures. General rules.

BS EN 1997-1:2004 Eurocode 7: Geotechnical design. General rules

Building Regulations

Approved Document A – Structure

Approved Document B2 – Fire

Approved Document H – Drainage and Waste Disposal

8.2 Design Loadings

8.2.1 Variable Loads : Imposed Floor Loads

Given the intended uses, the following minimum imposed floor loads are proposed as per BS EN 1991-1-1:2001:

Code	Activity	qk, UDL (kNm^{-2})	Qk, Point Load (kN)
A1	All areas within self-contained dwelling units	1.50	2.00
A3	Bathrooms	2.00	2.00
A5	Balconies	2.50	2.00
C31	Circulation Space; Corridor	3.00	4.50
C32	Stairs	3.00	4.00
D1	Retail Space	4.00	3.60

C11	Cafes and Restaurants	2.00	3.00
E213	Plant Rooms	7.50	4.50

8.2.2 Permanent Loads

Element	qk, UDL (kNm^{-2})
Partitions	1.00
Floor Finishes	0.35
Services	0.10
Suspended Ceilings	0.25

Structural self weight calculated as per members.

8.2.3 Wind Loads

Wind loads are calculated in accordance with Eurocode 1: Actions on Structures. General Actions – Wind actions (BS EN 1991-1-4:2005) and should be considered in conjunction with notional loads on the structure according to Eurocode 0 load combinations.

8.2.4 Notional Horizontal Loads

Notional horizontal loads are used in design to take account of the lack of fit and construction tolerances. The unfavourable effects of possible deviations in geometry of the structure and the position of loads have been taken into account in the ultimate limit state analysis of members and structures.

8.2.5 Snow Loads

The live load capacities of 1.5 kNm^{-2} used for the flat roofs provide sufficient capacity for snow loads of a 50 year return period.

8.3 Design Movements

8.3.1 Settlement

Overall settlement of the building is not expected to exceed 25mm.

Differential settlement between piles is not expected to exceed 5mm.

8.3.2 Vertical Deflection Limits

Concrete Slabs/Beams	Span / 250
Concrete Edge Beams supporting masonry or glazing	Span / 500
Concrete Slabs/Beams supporting brittle finishes	Span / 360
Structural Steel Elements generally	Span / 200
Structural Steel Elements supporting brittle finishes	Span / 360

8.3.3 Horizontal Deflection Limits

Structural Elements supporting masonry or glazing	Span / 500
Relative Floor to Floor movement generally	Height / 300
Overall Building Sway	Height / 500

8.4 Design Life

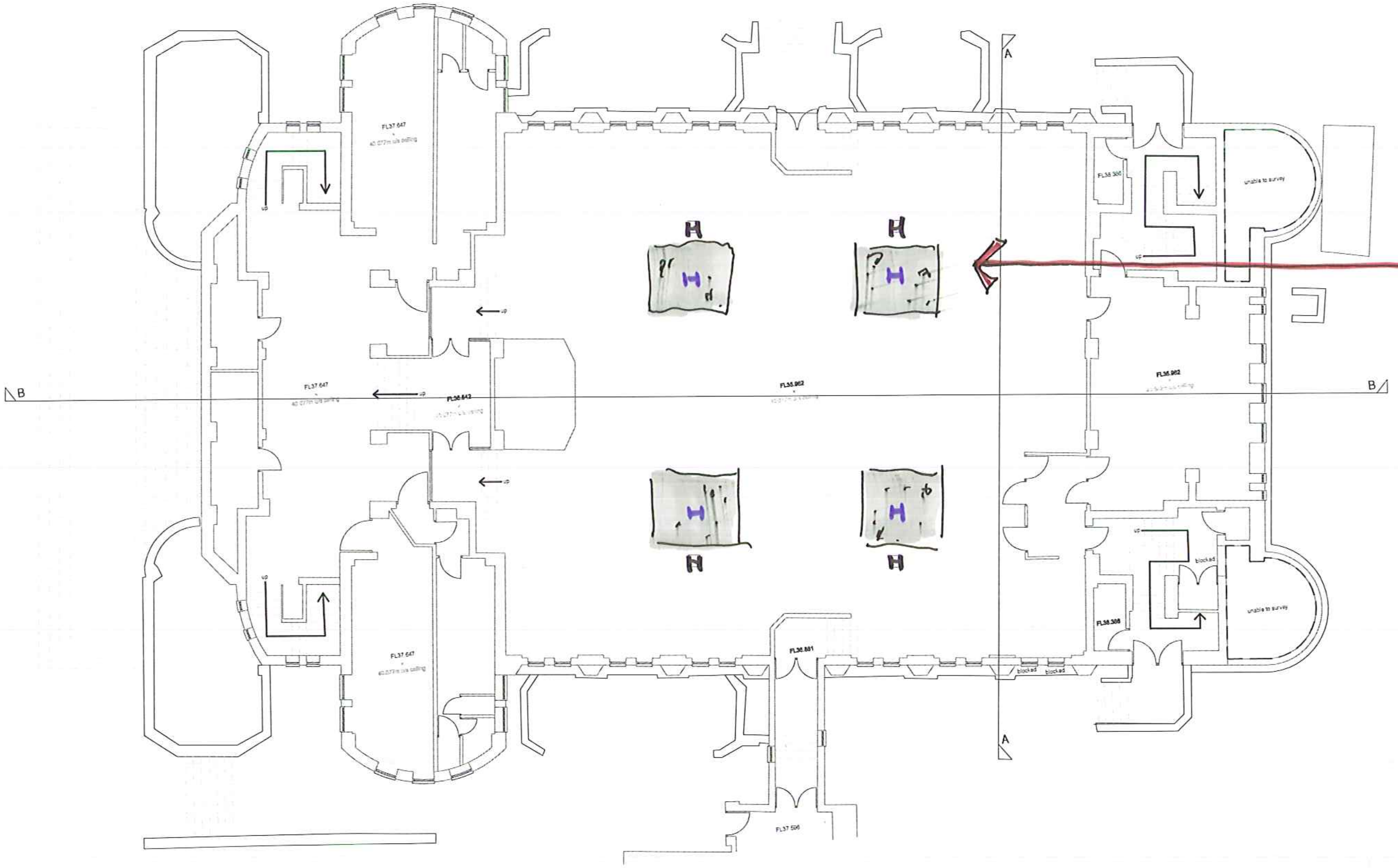
The design life of a building can be defined as the period of use intended by the designer as agreed with the client. It should be noted that the design life of a new building component might not be the same as the design life for the building. Three categories arise for defining the durability of building elements:

- Replaceable: shorter life than the building life with replacement envisaged.
- Maintainable: will last for the life of the building with periodic treatment.
- Lifelong: will last for the life of the building.

According to Eurocode 0, clause 2.3, for a non-monumental building structure, the indicative design working life for new building elements should be taken as 50 years (design working life category 4).

Protective coatings to structural steelwork will be specified to provide a minimum period of 20 years to first maintenance. Any steelwork inaccessible after completion of the structure will be specified to provide a minimum period of 60 years to first maintenance.

A. Appendix A Structural Proposals

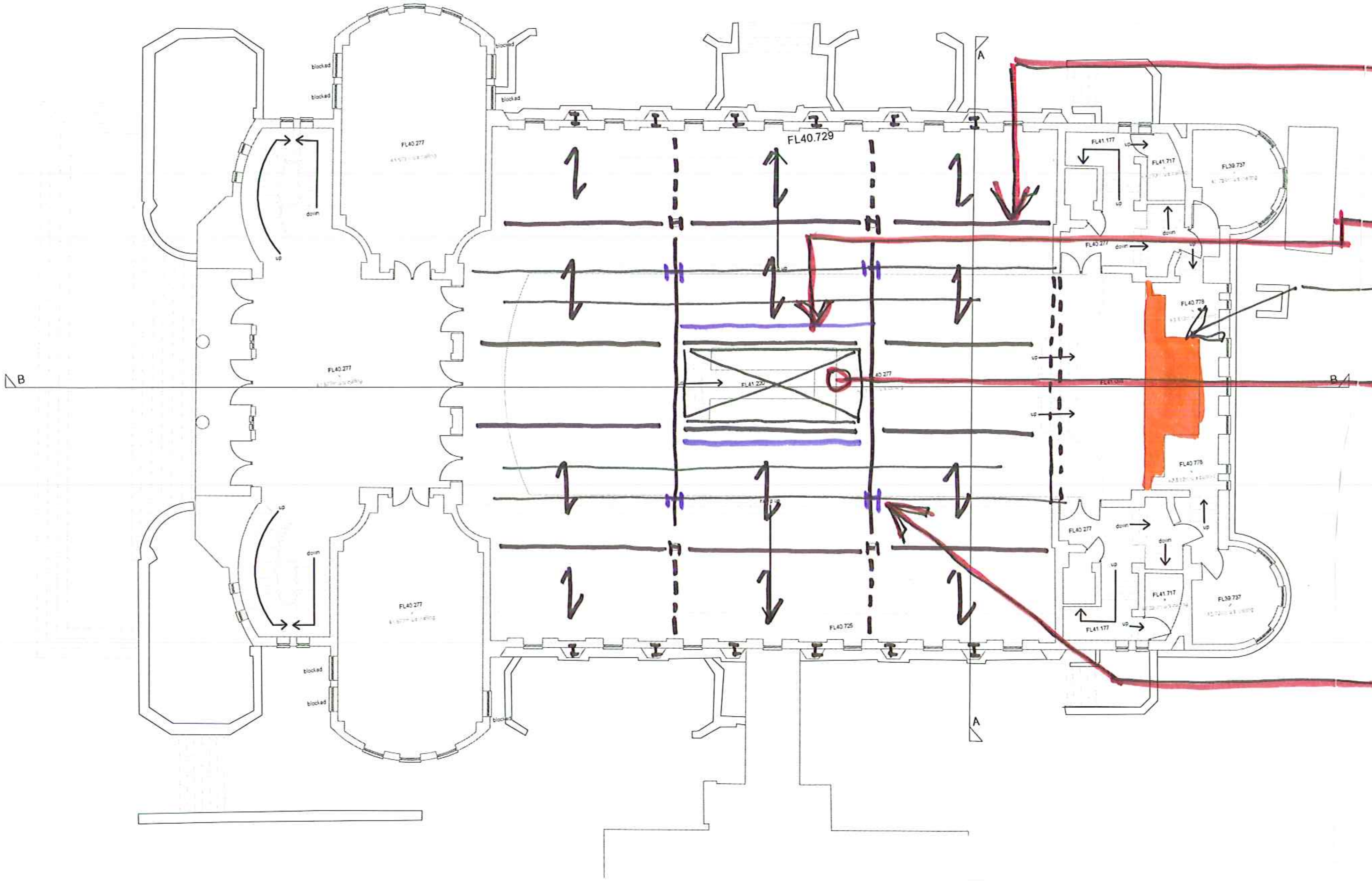


NEW COLUMNS SUPPORTED ON NEW PAD FOUNDATIONS

PROPOSED BASEMENT STRUCTURE

bdi Structural Engineering Solutions

Project		Date
GREENBANK		MAR '16
Title		**Drawn**
PROPOSED BASEMENT LAYOUT		JDY
Project No	**Sheet**	**Rev**
20142789	SK08	P0



EXISTING STEEL FRAME SUPPORTING EXISTING FLOOR SLABS RETAINED

PROVISIONAL TRIMMING STEEL

DEMOLISHED STRUCTURE

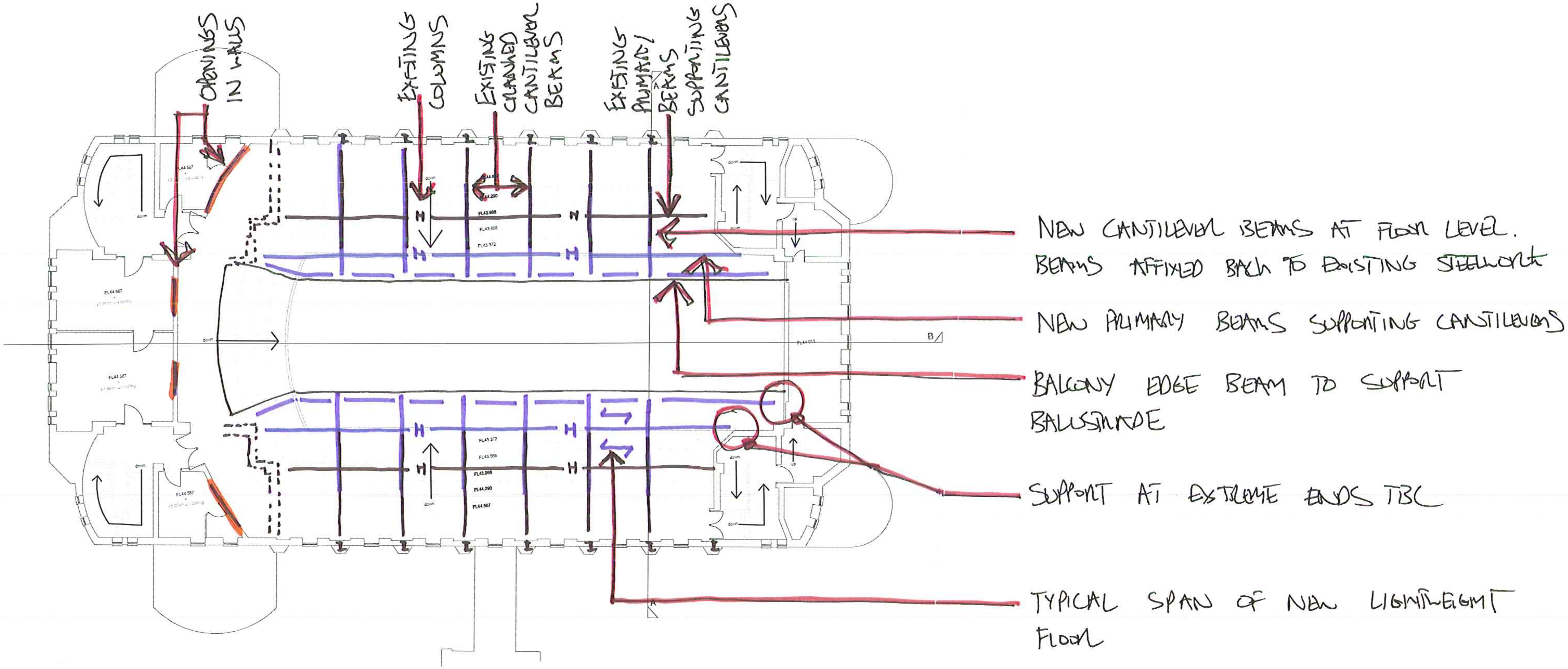
VOID FORMED IN EXISTING SLAB. SET OUT VOID TO EXTENT OF EXISTING STEELWORK. ALTERNATIVELY PROVIDE NEW TRIMMING. MUST NOT FOUL EXISTING PRIMARY BEAMS.

NEW COLUMNS ABOVE & BELOW EXISTING BEAMS TO 'PROP' NEW FIRST FLOOR STRUCTURE

PROPOSED GROUND FLOOR STRUCTURE

bdi Structural Engineering Solutions

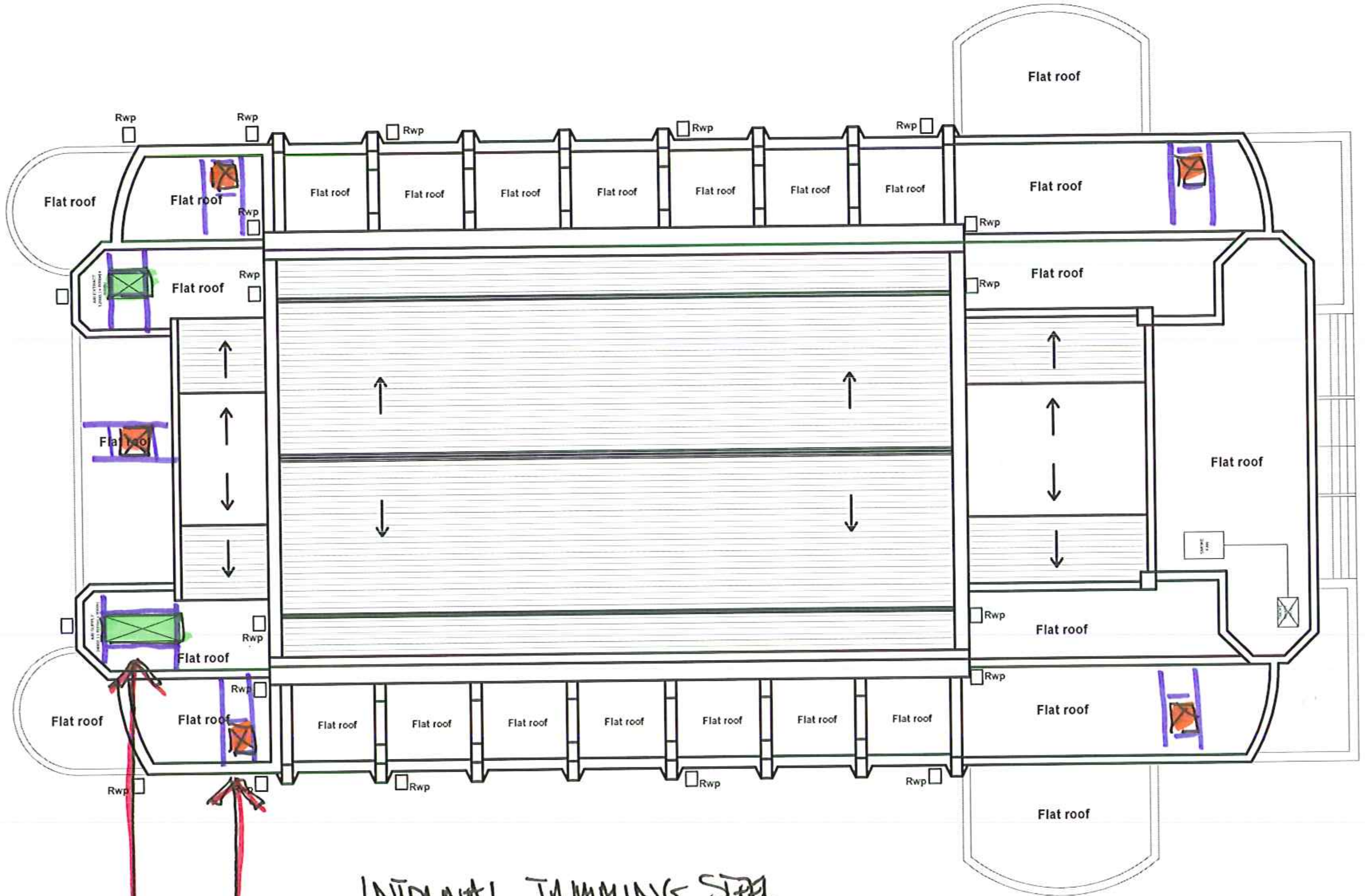
Project GREENBANK		Date MAR '16
Title PROPOSED GROUND LAYOUT		Drawn JDY
Project No 20192789	Sheet SK02	Rev P0



PROPOSED FIRST FLOOR STRUCTURE

bdi Structural Engineering Solutions

Project		Date
GREENBANK		MAR '16
Title		**Drawn**
PROPOSED FIRST FLOOR LAYOUT		JOY
Project No	**Sheet**	**Rev**
20142784	SK03	P0

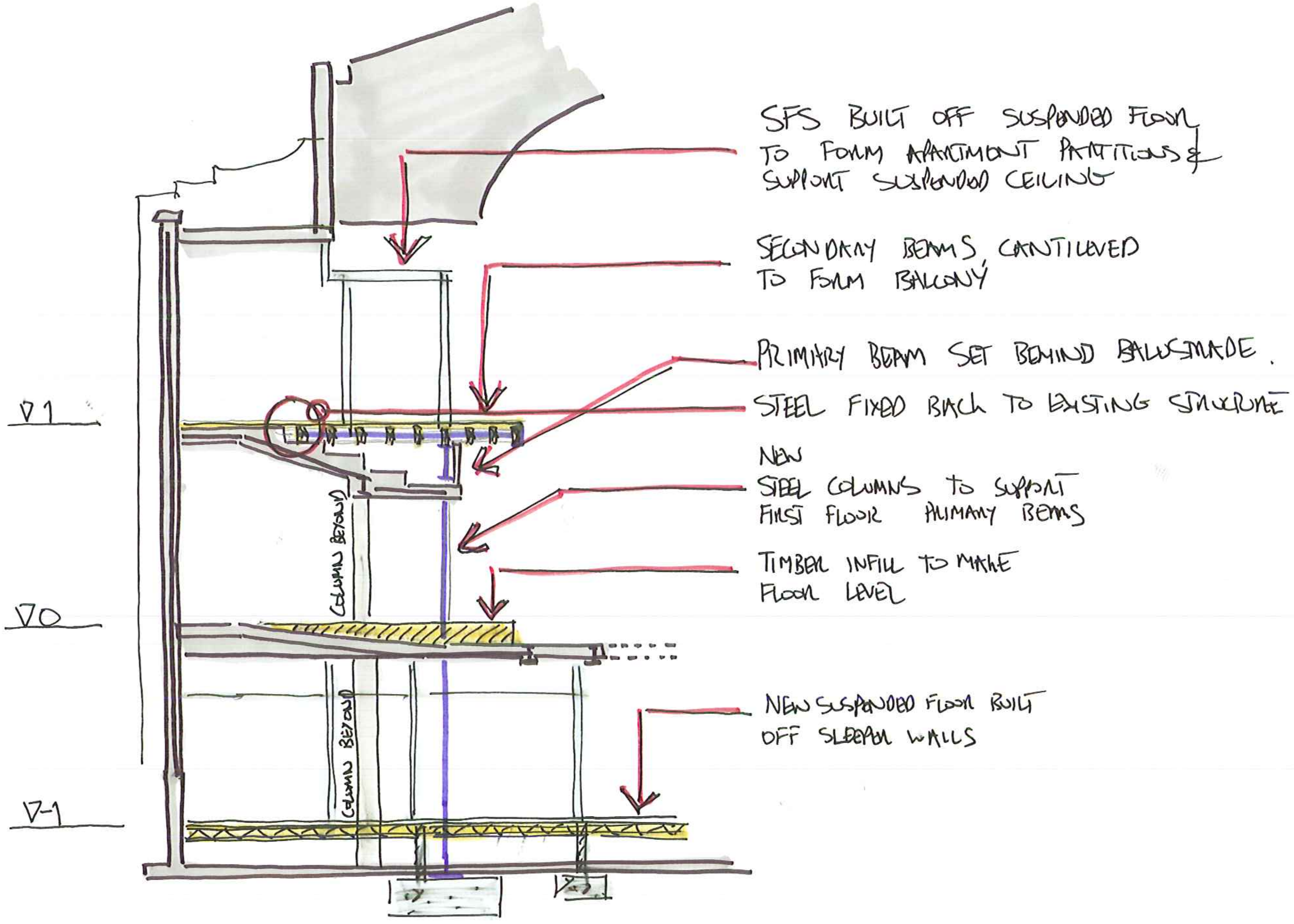


INTERNAL TRIMMING STEEL TO FACILITATE OPENING IN SLAB.

EXTERNAL GALVANISED STEELWORK ABOVE ROOF LEVEL TO SUPPORT PLANT.

bdi Structural Engineering Solutions

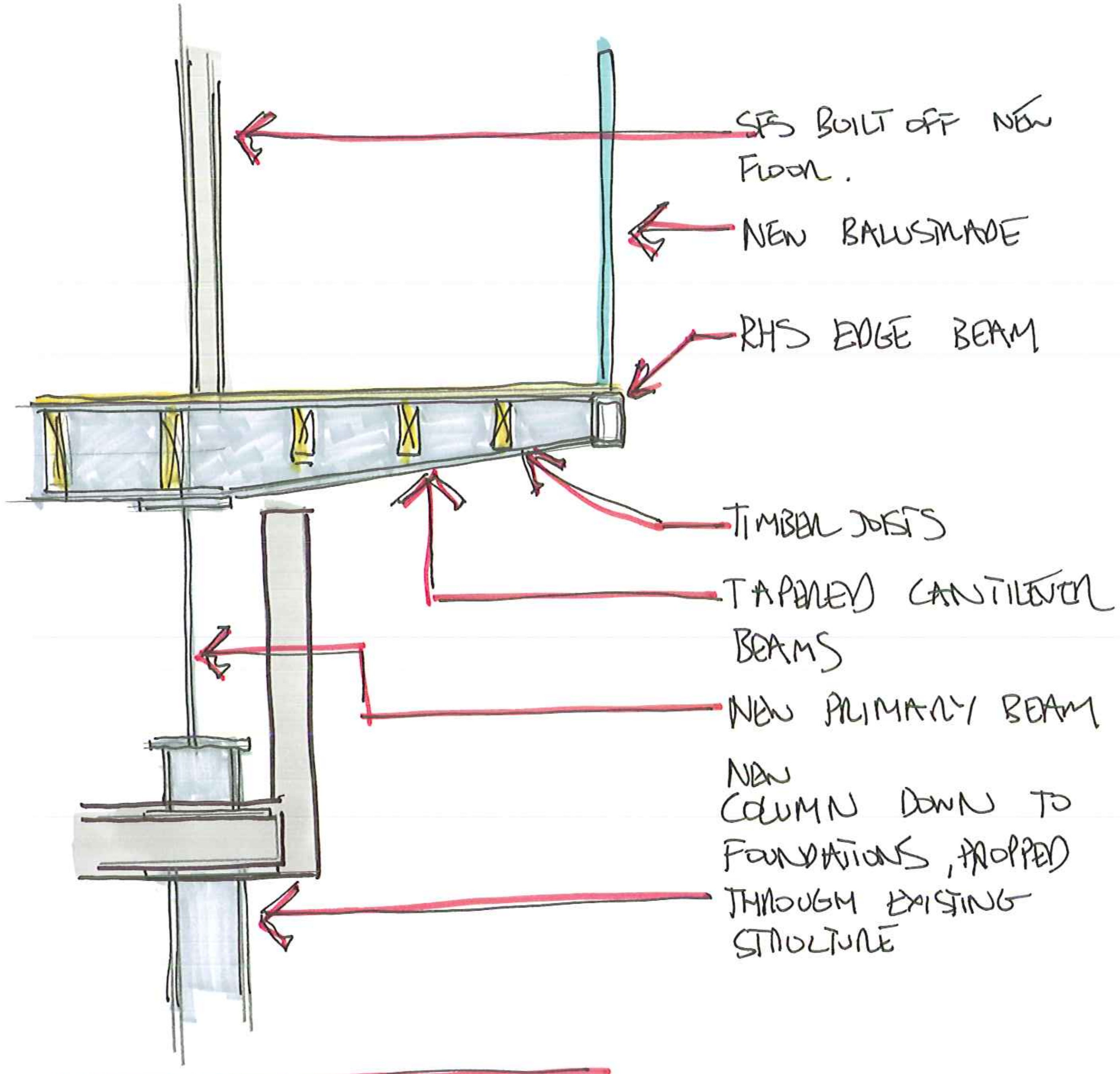
Project GREENBANK	Date MAR '16
Title PROPOSED ROOF LAYOUT	Drawn JDY
Project No 20142784 / Sheet SK 04	Rev P0



TYPICAL PART SECTION THROUGH PROPOSED STRUCTURE

bdi
Structural Engineering Solutions

Project		Date
GREENBANK		MAR '16
Title		**Drawn**
TYPICAL PART SECTION		JOY
Project No	**Sheet**	**Rev**
20142724	SK 15	P0



TYPICAL DETAIL AT BALCONY EDGE | NTS

Structural Engineering Solutions

Project GREENBANK		Date MAR '16
Title TYPICAL KEY DETAILS		Drawn JDY
Project No 20142789	Sheet SK 16	Rev P0