dda ENGINEERS

Project 2185
21-23 Bedford Place

Technical Note on Roof Structure

project manager	Jo Smith	26th September 2024
engineers	Jo Smith	

Rev	Purpose/ Description	Originated	Reviewed	Authorised	Date
B	For Information	JS	DD	JS	18/10/2024
A	For Information	JS	DD	JS	26/09/2024

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STRUCTURAL ENGINEERS

1.0 INTRODUCTION

DDA Engineers (DDA) have been engaged by Firmdale Hotels, as part of the wider design team, to look at the refurbishment of The Penn Club 21-23 Bedford Place into a 42 room boutique hotel.

As part of the structural design works, we have undertaken some opening up works to understand the structure, verify it matches the heritage information we have and assess its condition.

The current building is made up of 3 houses which have been previously refurbished into 1 building, likely when the Penn Club took over. The building is Grade II listed and within the Bloomsbury Conservation Area. The original buildings date from around 1815 and are of traditional masonry and timber construction generally sitting on shallow masonry strip footings.

This technical note refers specifically to the roof structure and covers all three roofs of the original houses.

Fig 1: Typical Roof Arrangement (External)

2.0 DESCRIPTION OF ROOF STRUCTURE

The form of the structure is described in the sketch in appendix A. This is as follows:

- 100mm deep rafters at approximately 360mm spacing spanning from the party walls to the central valley beam.
- 200mm deep hip members to form the front and rear roof lines.
- Timber purlins supporting the rafters were observed in some areas but not all.

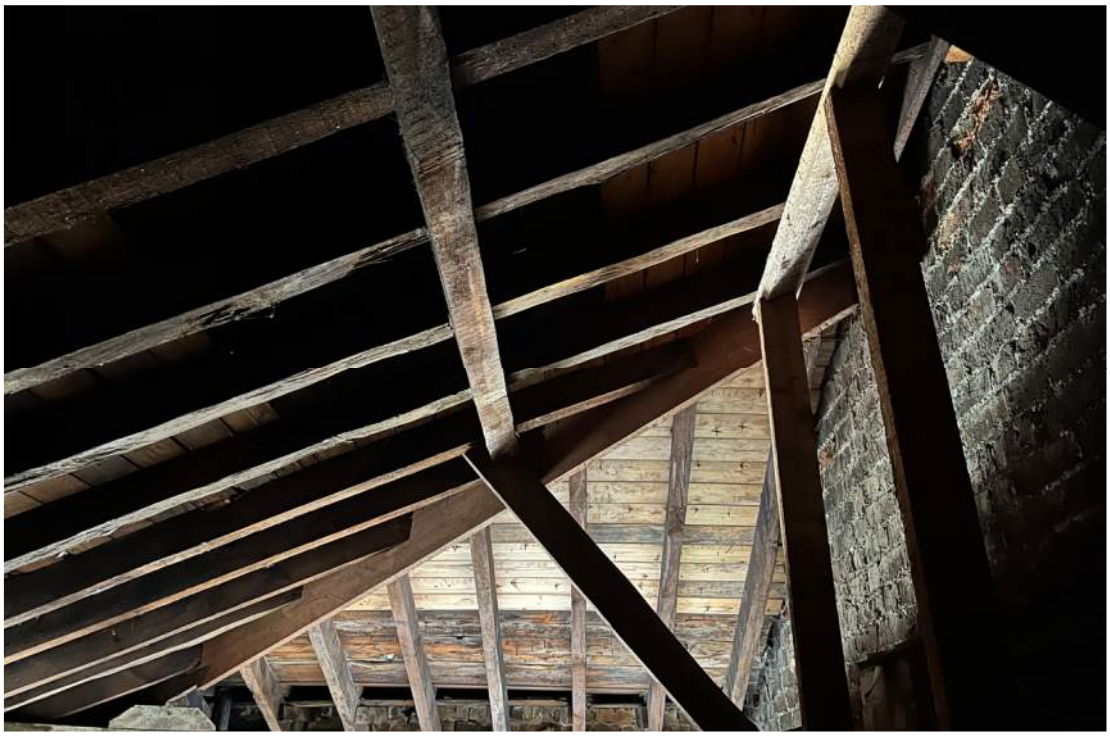

Fig 2: Internal Roof Space showing Rafters, Hip Beam and Purlins

- 160mm wide x 250mm deep valley beams located on the centreline of the buildings.

Fig 3: Valley Beam showing Rafters and Ceiling Joists

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- 32mm wide x 70mm deep ceiling joists span between the party walls and the valley beams with an additional intermediate beam spanning front to back. This is picked up on the stair walls on that side of the valley beam but has no clear line of support on the opposite side of the valley beam.

Fig 4: Inside of Roof showing Rafters, Hip Beam and Intermediate Ceiling Support Beam

The following should be noted with regards to the existing structure:

- There is some indication of rot close to the ends of the valley beam in some locations where it is supported on the external wall.
- We have considered all timber to be of equivalent to C24 timber softwood grade. It is likely that the beams themselves are either Oak or Scots Pine given the age of the building. The C24 assumption is conservative.
- The roof build up looks to be similar to the original. Whilst slates may have been replaced over time, no additional loading has been added.
- It is not completely clear how the valley beam was originally supported. It is likely that it was intended to span front to back. The beam is offset from the stair walls and heritage layouts do not show outriggers or similar to pick up the load.
- There are signs that the valley beam has settled over time to be supported on the cross partitions within the third floor creating unintended load paths further down the building. It is clear that this was not the original intent as the partitions are showing signs of deformation.

Fig 5: Examples of Deformed Partitions below Valley Beams

- The valleys collect the rain water for the building. There is evidence from below that areas have been repaired over time with fresh timber. This is likely due to water ingress although is not confined to the valley areas.

3.0 Structural Capacity of Existing Timber Elements

Our calculations have shown the following (refer to Appendix B for the Tedds calculations):

- The valley beams are undersized for the larger spans for both the original and current condition. This presents itself as both visible deflection and deformation of both original and more contemporary partitions below creating unintended load paths down the building.
- When considered as a single span front to back, the valley beam exceeds the capacity for bending stress, shear stress, compressive stress and deflection. The bending stress is around 8 times its capacity.

- Based on the above, additional supports will be required to pick up the valley beam at intermediate points. The best option for this will be at the stair walls by inserting cross beams to span between the stair wall and the party walls. These beams have been sized as 203UC sections – refer to appendix B for proposed arrangement.

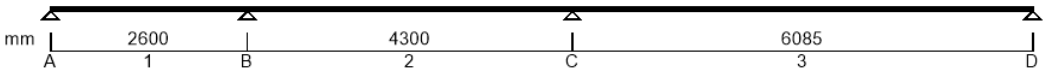

Fig 6: Analysis of Valley Beam in Proposed Arrangement

- When considering the support arrangement shown above, the valley beam will be acting as simply supported with 3 no. different spans as shown in figure 6 above.
- When considering the 3 separate spans, the valley beam would still exceed capacity for bending stress, shear stress, compressive stress and deflection on span 3 but to a much lesser degree. The bending stress is now 2.6 times the capacity for this span. Span 2 exceeds the deflection requirements but is within stress limits.
- As such, the valley beam will also need to be strengthened as well. We consider it prudent, given the age of the valley beam to strengthen all three spans to future proof the beam rather than just the two spans which exceed capacity.
- A timber specialist has been contacted and they have advised that the below arrangement would be appropriate in the circumstances and that this could be installed in a safe and heritage appropriate manner.

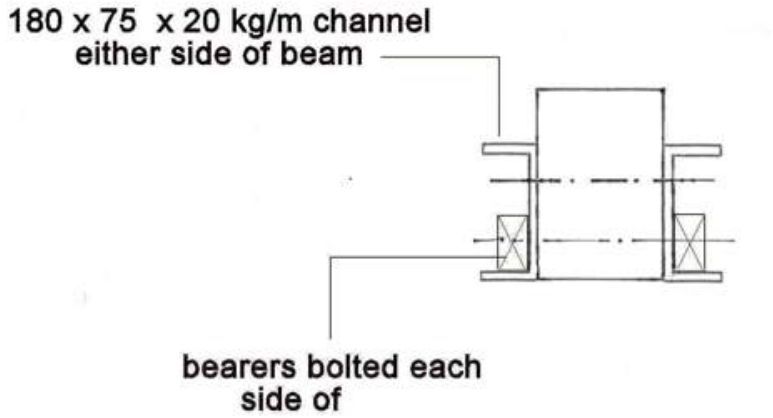

Fig 7: Proposed Strengthening of Valley Beam

- Refer to Appendix B for the proposed arrangement.

4.0 Conclusions and Recommendations

The roof has been stable over its life and is not in any immediate danger of collapse due to the beam being propped on the partitions. However this is not sustainable going forward and intervention is required to return the valley beam to the original line, avoiding loading areas below which are not intended for the loads and protecting this heritage element for the future.

We would recommend the following course of action to protect and strengthen the valley beam in-situ.

- Prop the valley beam to enable the strengthening works.
- Expose the full length of the valley beams from below to allow inspection of the full extent for any areas of decay or rot.
- Remove rafters to allow for strengthening
- Repair any decayed sections using a Rotafix detail in line with the manufacturers recommendations.
- Cut the existing valley beam to allow the insertion of the new trimming beams. The intermediate ceiling joist support beam will also need to be cut to suit.
- Install strengthening channels either side of the valley beams as shown on enclosed details
- Remove temporary propping.
- Replace existing rafters and ceiling joists alongside new timber members if/where required.

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APPENDIX A

ROOF STRUCTURE BASED ON OPENING UP WORKS

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ORIGINAL WALL LINES BELOW FROM ASSUMED HISTORIC PLANS

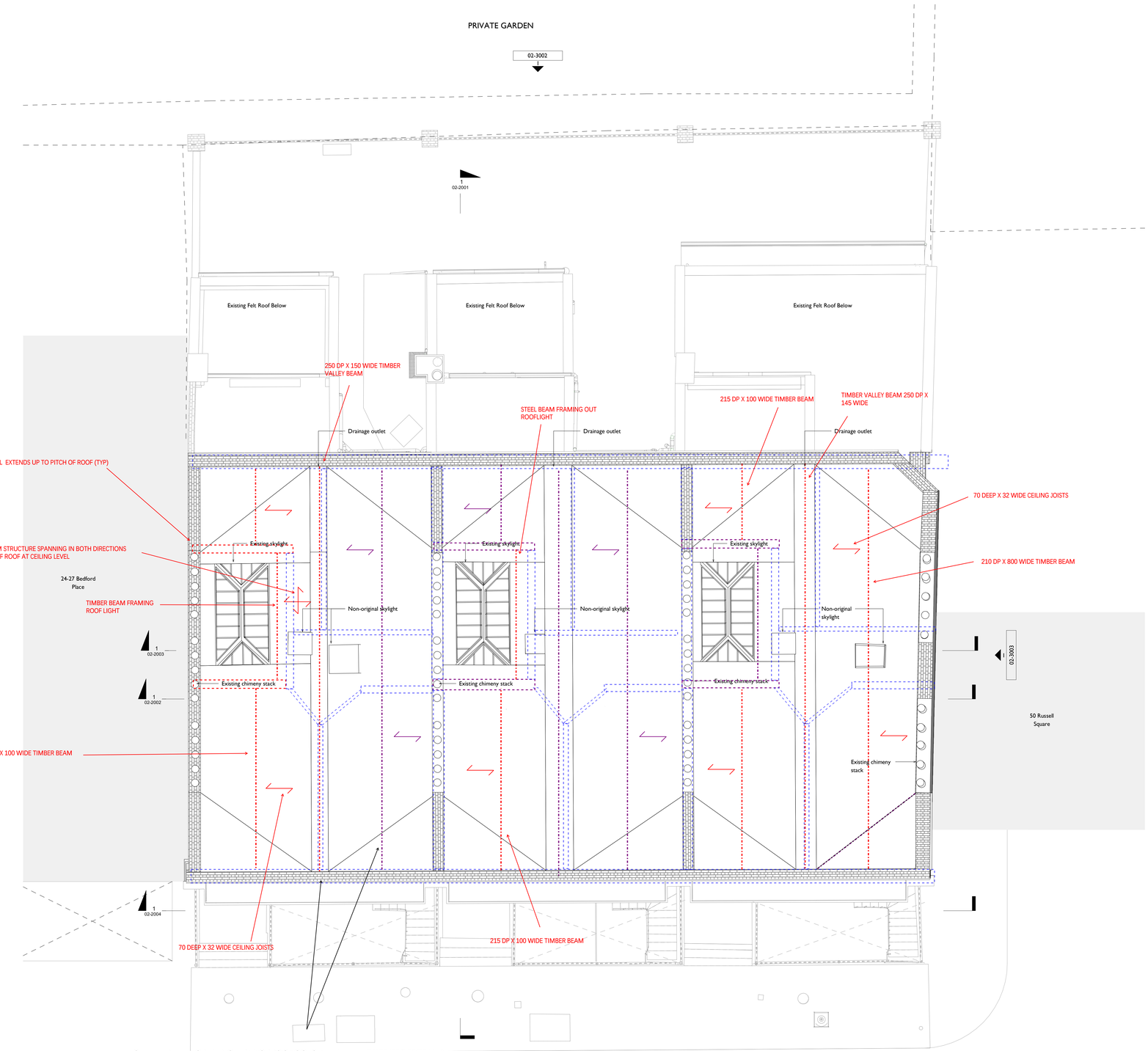
EXISTING STRUCTURE FOUND WITH OPENING UP WORKS

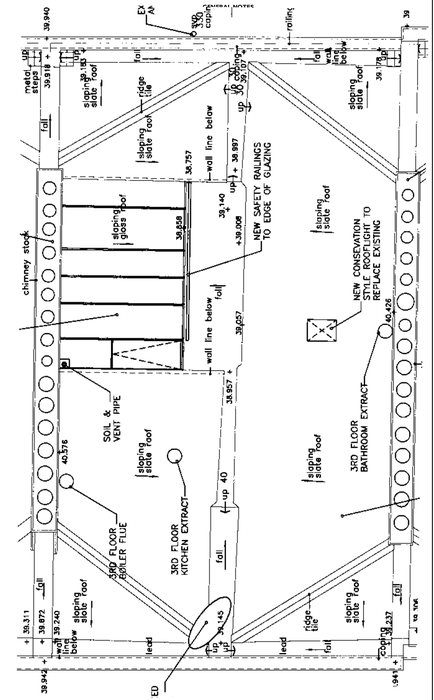
EXISTING STRUCTURE ASSUMED BASED ON DESK STUDY AND OPENING UP WORKS

NOTE: POSITION OF RED EXISTING STRUCTURE IS SHOWN TO SCALE BASED ON OPENING UP WORKS. POSITION OF PURPLE EXISTING STRUCTURE IS SHOWN APPROXIMATELY BASED ON DESK STUDY AND OTHER OPENING UP WORKS

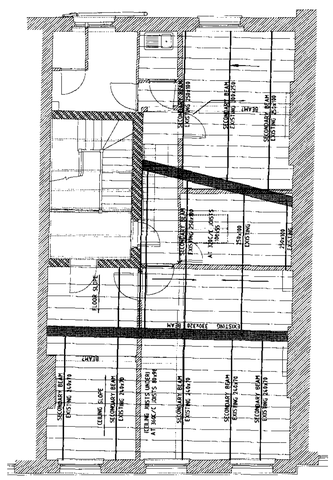
RAFTER, PURLIN AND HIP BEAMS UNABLE TO BE MEASURED AT CURRENT TIME WITHOUT SAFE ACCESS INTO ROOF SPACE.

LOW LEVEL ROOF STRUCTURE - CEILING ETC





ORIGINAL STRUCTURAL LAYOUT AT 38 BEDFORD PLACE



ORIGINAL STRUCTURAL LAYOUT AT 38 BEDFORD PLACE: FLOOR BELOW

NOTE: FURTHER OPENING UP WORKS SUGGEST THAT THE VALLEY BEAM AND CEILING JOIST SUPPORT BEAM TO THE RIGHT OF THE STAIRWELL ARE SUPPORTED ON THE PARTITION WALLS.

BASED ON THE SIZE OF THE MEMBERS, IT LOOKS AS IF THERE WILL HAVE BEEN SOME SUPPORT HERE IN THE ORIGINAL BUILDING BUT THE CURRENT PARTITIONS DO NOT LOOK TO HAVE BEEN DESIGNED FOR THIS AND DO NOT GO ALL THE WAY TO THE BASEMENT/FOUNDATIONS. THIS MAY BE WHY SOME OF THE DOOR OPENINGS LOCAL TO THE VALLEY BEAMS ARE NOT STRAIGHT.

AS PART OF THE WORKS TO SUPPORT THE PLANT AND REPLACEMENT LANTERN, WE WILL LOOK TO REINSTATE A LINE OF SUPPORT HERE; LIKELY WITH STEEL FRAMING

BEDFORD PLACE

1 02-3001

N

0m 1m 2m 3m 4m 5m

VISUAL SCALE 1:50 @ A0

Notes, legends or Key plans to be added above here

DATE	REV	BY	DESCRIPTION
27.10.23	P01	PL	ISSUED FOR PLANNING

SPPARC

N°10 BAYLEY STREET
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Client
FIRMDALE HOTELS

Job Title
2205 - Bedford Place Hotel

Drawing Title
Existing Roof Level Plan

Drawing Number & Revision
2205-SPP-BP-0R-DR-A-02-1005

Scale	Date Amended	Amended By	Revision
1 : 50	27.10.23	PL	P01
Checked	Date Created	Drawn By	SUITABILITY
TM	02.02.23	PL	S2

ORIGINAL WALL LINES BELOW FROM ASSUMED HISTORIC PLANS. NOT ALL ARE STRUCTURAL

EXISTING STRUCTURE FOUND WITH OPENING UP WORKS

EXISTING STRUCTURE ASSUMED BASED ON DESK STUDY AND OPENING UP WORKS

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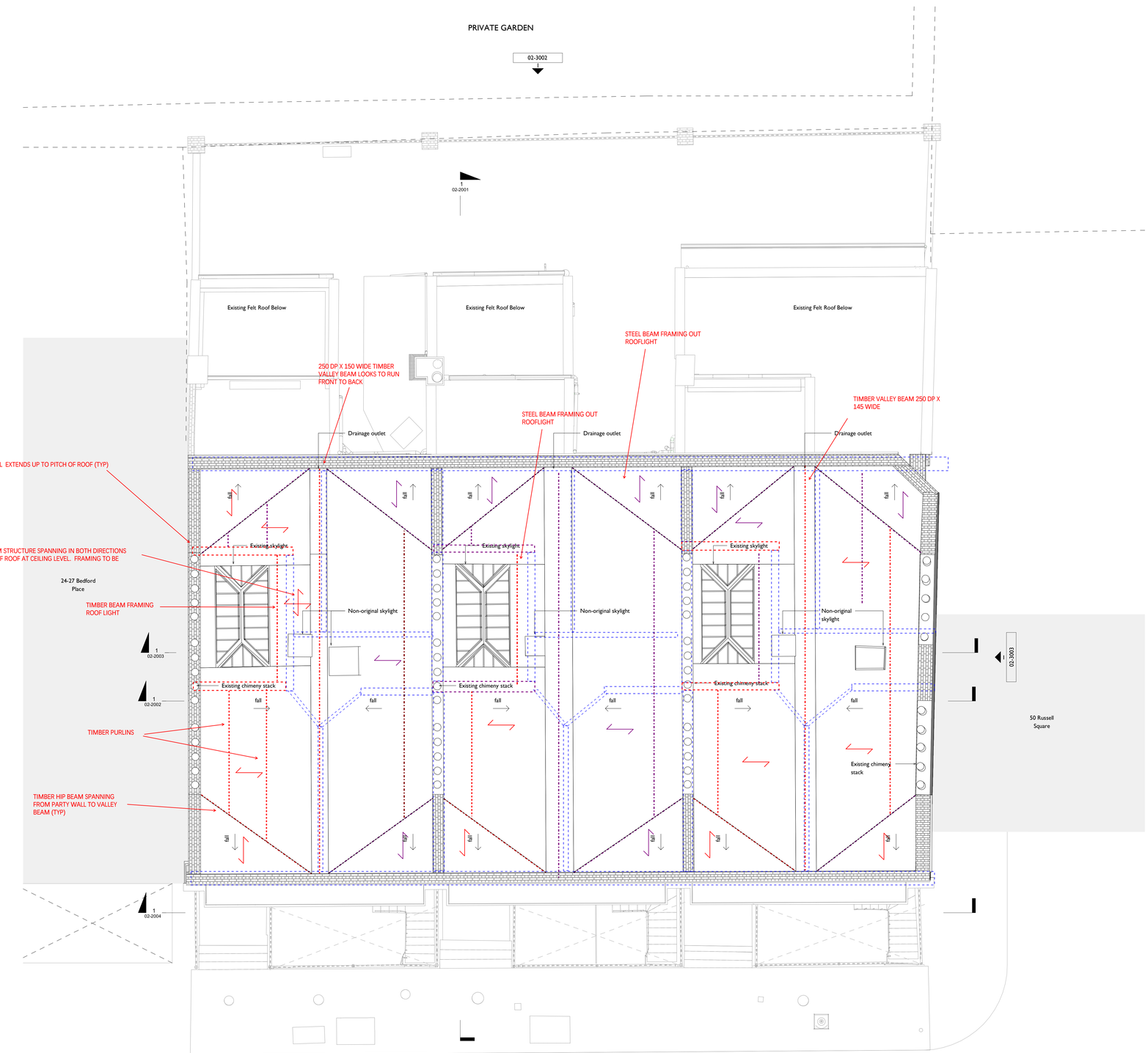
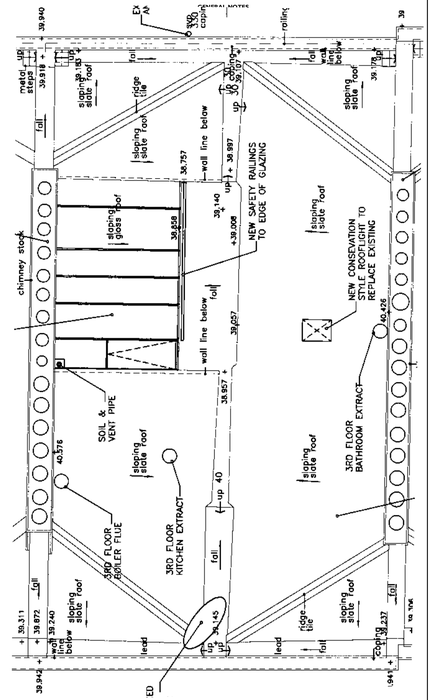
HIGH LEVEL ROOF STRUCTURE





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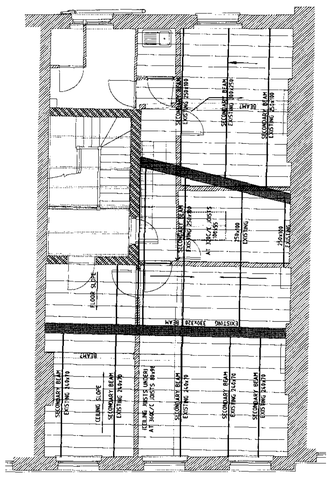

ORIGINAL STRUCTURAL LAYOUT AT 38 BEDFORD PLACE: FLOOR BELOW

NOTE: FURTHER OPENING UP WORKS SUGGEST THAT THE VALLEY BEAM IS SUPPORTED ON THE PARTITION WALLS.

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BEDFORD PLACE

02-3001

N

0m 1m 2m 3m 4m 5m

VISUAL SCALE 1:50 @ A0

Notes, legends or Key plans to be added above here

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Scale	Date Amended	Amended By	Revision
1 : 50	27.10.23	PL	P01
Checked	Date Created	Drawn By	SUITABILITY
TM	02.02.23	PL	S2

APPENDIX B

PROPOSED STRENGTHENING WORKS

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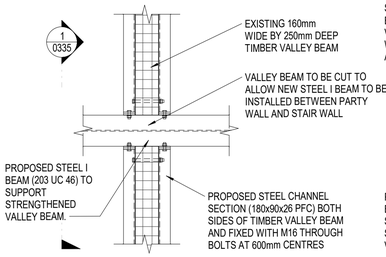

SECTION A-A
DETAIL A
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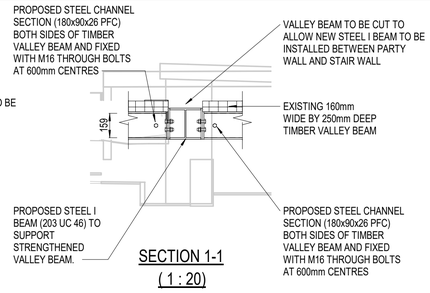

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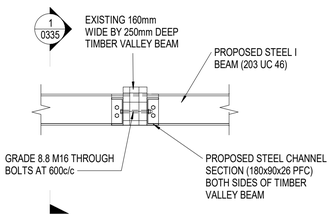

SECTION 2-2
STRENGTHENING DETAIL OF EXISTING
TIMBER VALLEY BEAM
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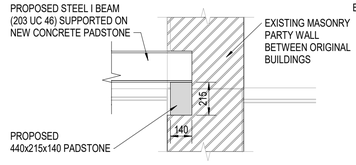

SECTION 3-3
PADSTONE DETAIL FOR 203UC BEAM
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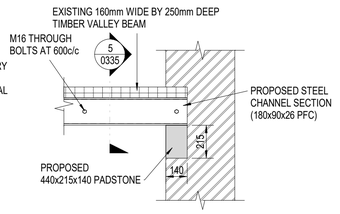
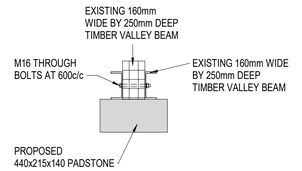


SECTION 4-4
EXISTING TIMBER VALLEY BEAM AND PFC
STRENGTHENING PADSTONE DETAIL
(1 : 20)



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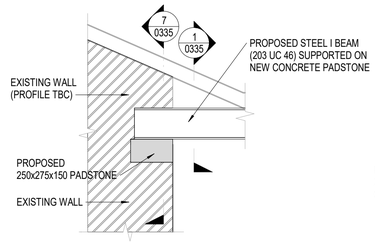

SECTION 6-6
STRENGTHENING DETAIL OF EXISTING
TIMBER VALLEY BEAM
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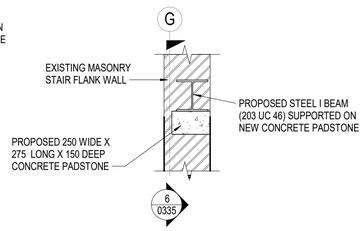

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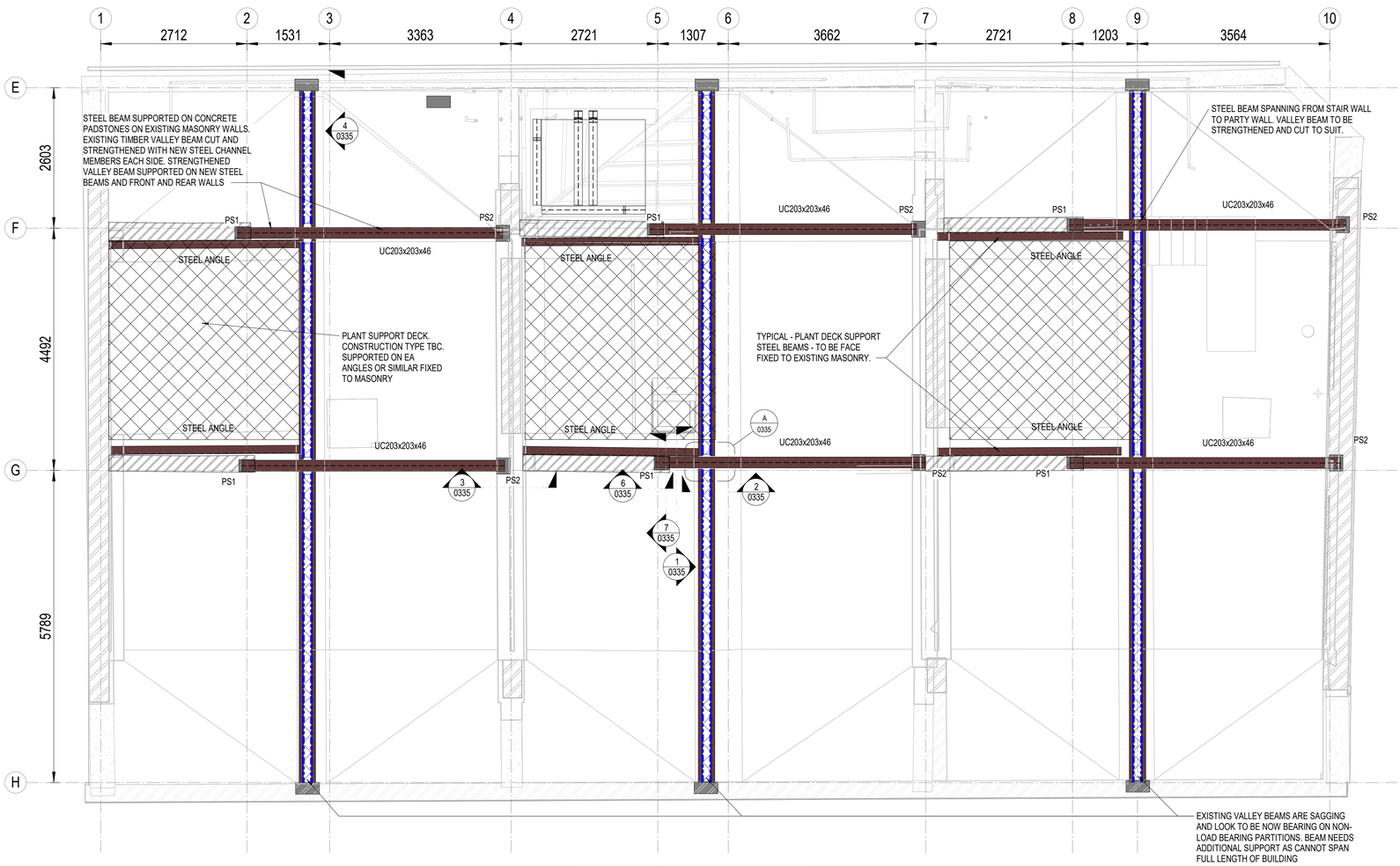

ROOF LEVEL - ROOF STRENGTHENING
WORKS
(1 : 50)

GENERAL NOTES

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, SERVICE ENGINEERS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.

2. DO NOT SCALE FROM THIS DRAWING, WORK ONLY TO FIGURED DIMENSIONS.

ISSUE	DATE	REVISION	INITIAL

Amendments

Project

BEDFORD PLACE 21-23

Title

STRENGTHENING WORKS
ROOF LEVEL

Client

FIRMDALE

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STAGE 3

Suitability

STAGE APPROVAL — S4

Designed By	Checked By	DDA Ref.
JS	DD	2185
Drawn By	**Date**	**Scales @ A1**
PBH	APRIL 24	As indicated

Project - Originator - Volume - Level - Type - Role - Number: 2205-DDA-BP-RF-DR-S-0335

Revision

DDA SITE ALL