

ADEPT

CIVIL AND STRUCTURAL CONSULTING ENGINEERS



STRUCTURAL REPORT The George Hotel, Huddersfield

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1. Introduction

1.1. Introduction

- 1.1.1. Adept Consulting Engineers Limited was instructed by GMI Construction to inspect the central stair within Block A.
- 1.1.2. The inspection was carried out on 18th March 2025.
- 1.1.3. This report should be read in conjunction with the previous structural condition report dated 24th September 2023, which includes inspection dates of 4th August and 11th September 2023.
- 1.1.4. The objective is to restore the staircase to full operational use. This will require structural repairs, strengthening works, and the repair and upgrading of the balustrade to comply with current Building Regulations.

2. Limitations of Report

2.1. Limitation of Report

- 2.1.1. The limitations of our structural inspection report are included in the text at the end of this report.

3. Observations / Discussion

3.1. Cantilevering Staircase

- 3.1.1. The stair is of the traditional stone cantilevering / stacking tread type from ground floor level up to level 2.0, after which it continues in timber. The first flight up from ground floor level appears to have been amended and overlain in timber to give a wider, more impressive appearance when seen from the entrance foyer. The original stone tread units and their supporting side wall can be seen still to be in place when the flight is viewed from below. (Photo 1).
- 3.1.2. Not all areas of the staircase were accessible for inspection. However, a visual inspection was carried out of those areas of the staircase that could be reached, as a follow-up to the inspections that were carried out on 4th August 2023 and 11th September 2023. During the inspection, particular attention was paid to the points raised in CROSS Safety Report 1147.
- 3.1.3. The stone tread units were inspected for any signs of cracking. It was found that the roots of the tread units (i.e. where they are supported vertically and restrained torsionally by the adjacent flank walls) were concealed from above by thick decorative timber skirtings, and from below by multiple coats of paint and decorative plaster finishes to the supporting walls. Notwithstanding this, no cracks were noted in the visible parts of the tread units in the vicinity of the roots.
- 3.1.4. The top surfaces of the treads were checked for the presence of recessing and the installation of wearing surface veneer inlays, but none were observed.
- 3.1.5. The outer (balustrade) ends of the tread units were inspected. A diagonal crack of long standing was noted in the top of the first tread unit in the flight up from level 1.0 to level 1.5, running from the end of the tread through one of the rectangular baluster sockets, towards the nosing. This is likely to have been caused when the previously-adjointing cast iron baluster was damaged. (Photo 2).
- 3.1.6. The thick build-up of paint to the soffit of the stone tread units was noted to have split and peeled along the tread joint lines, indicating that small amounts of movement have occurred between adjacent stone tread units. Notwithstanding this, where it could be inspected, the bedding mortar between the individual tread units appeared to have remained in place, and to be in satisfactory condition. (Photo 3).
- 3.1.7. A near-vertical crack is visible in the riser face of the first tread unit up from stone slab cross-landing at level 1.0, set back approx. 10mm from the riser face, as well as slight separation of the rebate joint between the bottom tread and the supporting edge of the landing. (Photo 4).
- 3.1.8. The balustrade comprises individual cast iron balusters, set at approx. 160mm centres, either fixed into rectangular sockets into the stone tread units, or screwed to the timber stair strings. A wrought iron top rail is fixed to the balusters using machine screws. A hardwood timber capping is fixed to the wrought iron top rail. The handrail appears to wrap round continuously from flight to flight, terminating at the cross-landing at level 0.5.
- 3.1.9. Several areas of impact damage were noted in the balustrade, where the balusters have been either partially broken off, or are missing altogether. The top corner of the lowest tread in the flight up from level 0.5 to level 1.0 was noted to have been cracked off beyond the corner baluster pocket. (Photo 5).
- 3.1.10. The stair continues as a timber structure above level 2.0. It is thought that the change to timber construction for the upper flights is due to the inability of the upper flank walls to provide sufficient pre-compressive dead load to resist the in-plane torsional forces that would have been generated, had additional flights formed of stone tread units been used.

- 3.1.11. The balustrade handrail heights and baluster spacing distances would not comply with current Building Regulations (England and Wales) Regulations, as set out in Approved Document K.

3.2. Temporary Support

- 3.2.1. Temporary scaffolding was noted to have been installed directly onto the flight from the level 1.5 half-landing, to provide support the floors and stair above level 2.0. The scaffolding bears onto and is carried by a single stone tread unit towards the middle of the flight, without any corresponding temporary support below. (Photo 6).
- 3.2.2. CROSS Safety Report 1147 draws attention to the possible risks of applying direct localised load onto individual stone tread units (or onto stone landing slabs), which could cause them to fracture. It also draws attention to the possible risk of fracturing due to upward jacking forces being inadvertently applied to the underside of the tread units and landing slabs.
- 3.2.3. The transfer of temporary support loading from the upper stair flights and landings is dependent at least in part on the stone tread units and landings below. This is an undesirable and potentially unsafe situation. It would be preferable for any temporary support or working access scaffolding to be independent of the treads and landings, and for the load to be transferred independently down to foundation level.
- 3.2.4. It appears possible that this could be achieved by locating any vertical supporting structure within the stair void between the flights and landings. Putlogs or other horizontal supports could then span between the central vertical support and the flank walls, clear of the stair flights and landings.

3.3. Assessment of Stresses in the Tread Units

- 3.3.1. The analytical model and calculation method proposed by Price and Rogers in their technical paper published in The Structural Engineer Magazine on 18 January 2005, have been applied to make an estimate of the front edge bearing stress and torsional shear stress that could be expected in the critical lowest tread (i.e., the first tread up from the bottom of the flight), in the lower flight between levels 1.0 and 1.5.
- 3.3.2. Under the self-weight loading of the stair, the critical tread unit front edge bearing stress calculates to be approx. 0.30 N/mm^2 , and the torsional shear stress in the critical tread unit to be approx. 0.82 N/mm^2 . When compared with a typical shear strength of 3.2 N/mm^2 for sandstone, this gives factors of safety of approx. 10.7 in bearing and 3.9 in torsional shear, which are considered acceptable.
- 3.3.3. Under the self-weight of the full flight, in combination with a single localised point live loading of 4.5 kN applied to the critical tread, the front edge bearing stress works out to be approx. 0.56 N/mm^2 , and the torsional shear stress in the tread unit to be approx. 0.94 N/mm^2 . This combination gives safety factors of approx. 5.7 in bearing, and 3.4 in torsional shear, which are considered to be low, but acceptable.
- 3.3.4. Under the self-weight of the flight, in combination with a uniformly-distributed live loading of 4.0 kN/m^2 over the whole flight, the critical tread front edge bearing stress increases to approx. 0.67 N/mm^2 , and the torsional shear stress in the critical tread unit to approx. 1.85 N/mm^2 . Compared with a typical shear strength of 3.2 N/mm^2 , this gives reduced factors of safety of approx. 4.8 in bearing, and 1.7 in torsional shear, which are considered to be low for the bearing stress, and unacceptably low for the torsional shear.

4. Conclusions / Recommendations

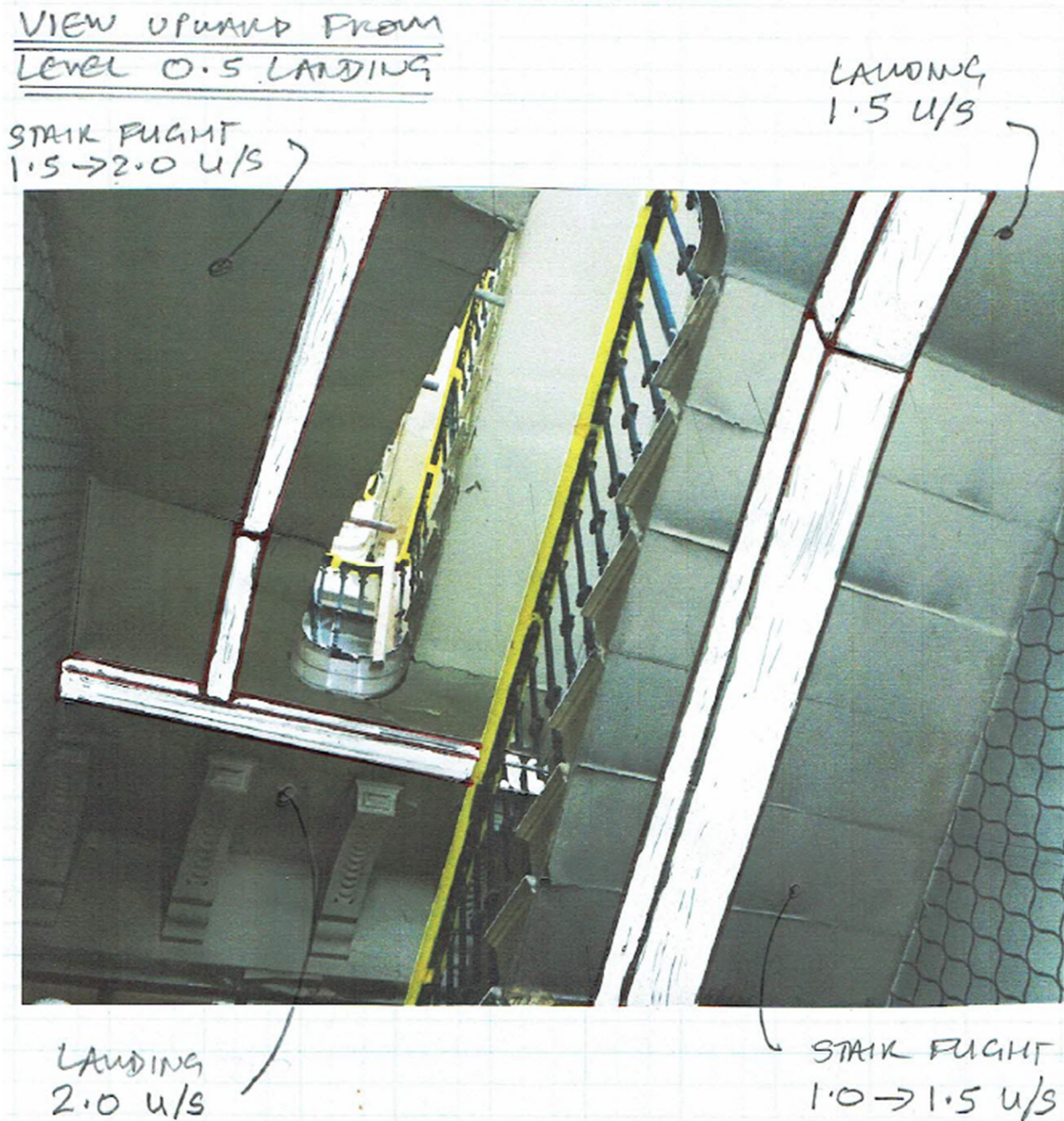
4.1. Confidence – Pros & Cons

- 4.1.1. The full uniformly-distributed loading of 4.0 kN/m² and localised point loading of 4.5 kN/m² are both highly onerous loading requirements, which are unlikely to be applied in reality. The analytical model also does not take into account the fact that the individual tread units are rebated along their front edges, which is known to provide a beneficial horizontal (and hence, torsional) restraining effect to the treads. While very difficult to quantify reliably, this is acknowledged as helping to reduce the torsional moments, and therefore the torsional stresses, in the tread units.
- 4.1.2. Against this are the realities that the so-called 'cantilever' stair system depends principally upon the successive propping effect of the tread units to remain stable, and that it has not been possible to visually inspect the root area of the tread units thoroughly, due to their concealment by the timber skirtings above and the plaster finishes below.
- 4.1.3. The failure of any one individual unit, for example under accidental impact loading, is capable of leading to a partial and possibly even more widespread collapse, as evidenced by the case recorded in CROSS Safety Report 1147.
- 4.1.4. The stone half-landing slabs also play a part in the vertical and lateral support of the stair flights but due to timber overlays, they could not be thoroughly inspected. As a result, very little is known about their structural condition, or even their geometrical configuration.
- 4.1.5. There is also the evidence of slight movements having occurred between the individual tread units, and the partial spalling of the riser face, as noted in Sections 1.6 and 1.7 above.
- 4.1.6. The central staircase will play an important role in the means of escape strategy for the refurbished building. In the circumstances, it is considered that there cannot currently be sufficient confidence in the existing structure to be able to rely upon it, without the installation of additional structural support.

4.2. Strengthening of the Stair Flights and Landings

- 4.2.1. It is therefore proposed that a minimal structural intervention be implemented to provide additional support to the landing slabs at levels 0.5, 1.0, 1.5 and 2.0 and to the stone tread unit flights from level 0.5 to 1.0, level 1.0 to 1.5, and level 1.5 to 2.0. Above this level the stair continues as a timber structure.
- 4.2.2. There are different ways in which this could be achieved, for example by installing steel cross-members spanning between the main stairwell flank walls beneath the stone slab landings at levels 0.5, 1.0, 1.5 and 2.0, to carry the ends of cranked soffit beams, which would then support the stone tread unit stair flights from level 0.5 to 1.0, level 1.0 to 1.5, and level 1.5 to 2.0.
- 4.2.3. At this stage, it is likely that these could be 250x150 RHS sections laid 'flat', or alternatively an inverted asymmetrical beam section if there is a desire for the intervention to appear more visibly as a remedial measure.
- 4.2.4. The line of the steels has been shown offset from the stair flight centrelines. This is due to the treads being built into the walls at one end—structurally, the optimal support position would be approximately 3/4 of the way across the tread width. We have indicated a position at 2/3 width as a visual compromise.

- 4.2.5. We propose the use of a layer of Tremco 'Compriband' or similar self-adhesive expanding foam rubber strip along the top surfaces of the steel members. This would serve to provide a relatively soft interface between the steel and stone, accommodate any minor surface irregularities, and dampen footfall induced ringing in the steelwork.
- 4.2.6. Fire protection is to be provided by others, likely in the form of an intumescent coating to achieve up to 60 minutes of fire resistance.
- 4.2.7. Refer to Appendix B for sketch drawings and mark-ups.



- 4.2.8. Alternatively, two steel columns could be introduced to rise from lower ground floor level, up to level 2.0 (and possibly full-height up to level 4.0) with projecting cross members to support the stone tread unit flights from level 0.5 to 2.0 via cranked soffit members.
- 4.2.9. This would allow the direct transfer of load down to ground, independently of the stone flights and landings.

- 4.2.10. It is envisaged that the damaged timber stair flights and landings above level 2.0 could be repaired using conventional timber repair methods, in conjunction with the additional steel supporting structure that had been installed previously. Additional strengthening is also likely to be needed to meet the 4.0 kN/m² uniformly distributed loading condition.

4.3. Upgrading of the Balustrade

- 4.3.1. As noted above, the existing balustrade does not comply with current regulations. In order to comply, remedial works would be needed to close any gaps through the balustrade to less than 100mm, and to increase the heights from the string line and floors to the handrail to 0.9m and 1.1m respectively.
- 4.3.2. It is envisaged that this could best be achieved by repairing and retaining the existing cast iron balustrade as part of the visible heritage fabric, and by installing a second balustrade in parallel with the original, comprising laminated glass panels of sufficient strength and height to meet the regulatory requirements.
- 4.3.3. We note that the proposed AHR layouts indicate the new, compliant glass balustrading positioned on the inside of the existing cast iron balustrade.
- 4.3.4. An alternative approach would be to place the glass on the outside of the balustrade and secure it using patch fixings into short stubs, fixed horizontally into the ends of the stone tread units or landing slabs. We believe this option offers a simpler detailing solution and may eliminate the need for the faceted transitions currently shown at the edges of the landings.
- 4.3.5. Advantage could potentially be taken of a column-supported strengthening system of the type referred to in Section 5.3 above to provide the additional vertical and lateral support needed for the new, compliant balustrade, independently of the existing stair flights and landings.

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For and on behalf of Adept Consulting Engineers Limited.
24th March 2025

Limitations of Report

- a) Adept Consulting Engineers Ltd have prepared this report for the sole use and benefit of the client and/or his appointed agent only and no liability is accepted to any third party who may seek to rely on the whole or any part of this report. Should the client not act upon specific reasonable advice contained in the report, no responsibility is accepted for the consequences.
- b) Comments are restricted to those elements of the structure which are loadbearing and/or provide stability to the buildings, and to the external envelope. Non-structural items of interior or exterior fabric are excluded, except where deterioration or damage to such items may have caused or may in the future cause, damage to or loss of integrity of the structure.
- c) Comments are restricted to those elements of the structure which were readily available for visual inspection and exclude all items or elements which were covered in any way by, for example, fittings, fixtures, carpets, floor coverings, furniture, stored goods or plaster/finishes etc. or any items which are buried. No "opening up" of the structure or exposure of foundations took place and none of the above items were moved or disturbed.
- d) The external inspection of the roof, chimneys and rainwater goods, was made from ground floor level. It should be noted that the efficiency of rainwater goods, which may appear in good condition, can only be assessed if there is heavy rain falling during the inspection.
- e) Roof voids are only inspected from the access hatch, unless there are fully boarded walkways and adequate light available. Should it be felt necessary to make a more detailed inspection and walkways or light are not available, suitable access arrangements may need to be made, the costs of which would be the responsibility of the client.
- f) Similarly basements or under floor voids will only be inspected if adequate light and safe access are available.
- g) It is not practical to itemise every defect and minor defects which are obvious to the layman are not generally noted unless they are symptomatic of a more serious underlying structural fault.
- h) The inspection does not include any services in or to the building and the services of appropriate experts should be sought if deemed necessary.
- i) The detection and eradication of timber infestation and rising damp are specialist matters and as such are outside the scope of this report. We would, nevertheless, recommend that a firm of appropriate experts should be employed to carry out an independent survey and prepare a report.
- j) Although mention may be made in this report, we have not carried out an exhaustive survey as to whether hazardous or deleterious materials such as asbestos is used in the construction of the buildings, neither have we carried out any tests or other investigation to determine the presence or otherwise of methane gases or other noxious substances of any kind whatsoever on the site. Appropriate experts should be consulted if deemed necessary.
- k) It should be noted that further deterioration of existing defects, or the presence of any defects undetectable at the time of the inspection, cannot be ruled out.

Appendix A Photographs



Photo 1

Timber overlay over the widened first flight up from ground floor level, concealing the original stone tread unit stair flight below.



Photo 2

Diagonal crack, running through one of the baluster sockets in the top of the first tread unit in the flight up from level 1.0 to level 1.5.



Photo 3

Splitting and peeling of painted soffit finishes along the joint lines between individual stone tread units, indicating that minor movements have occurred.



Photo 4

Half-height near-vertical crack, approx. 10mm back from the riser face of the first tread unit in the flight up from level 1.5 to level 2.0.



Photo 5

Example of damage to the (modified) cast iron balustrade to the flight up from the landing at level 0.5 to level 1.0.



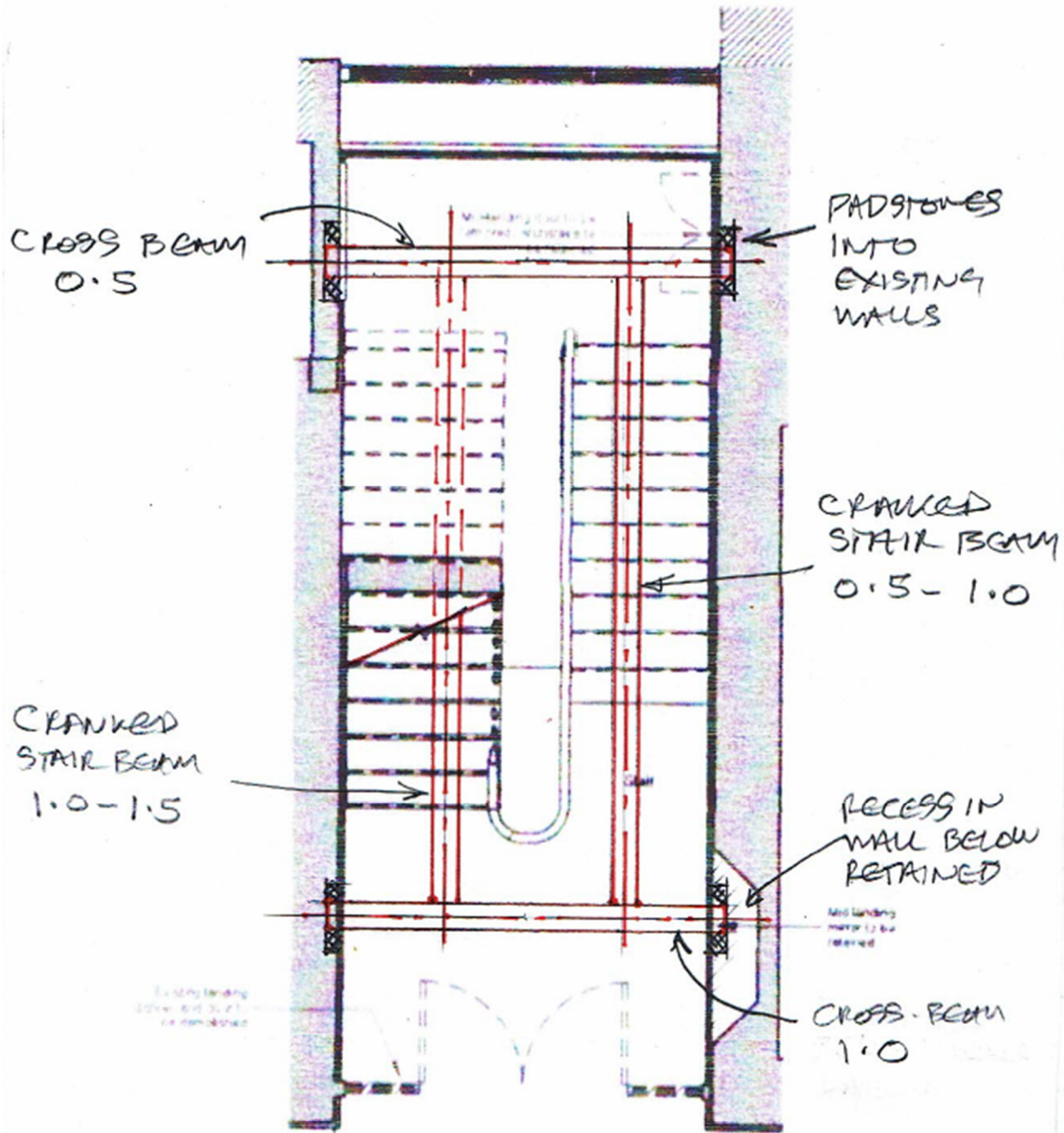
Photo 6

Temporary scaffold support to second floor, bearing onto the middle stone tread unit of the flight from level 1.5 to level 2.0, with no corresponding support below.

Appendix B

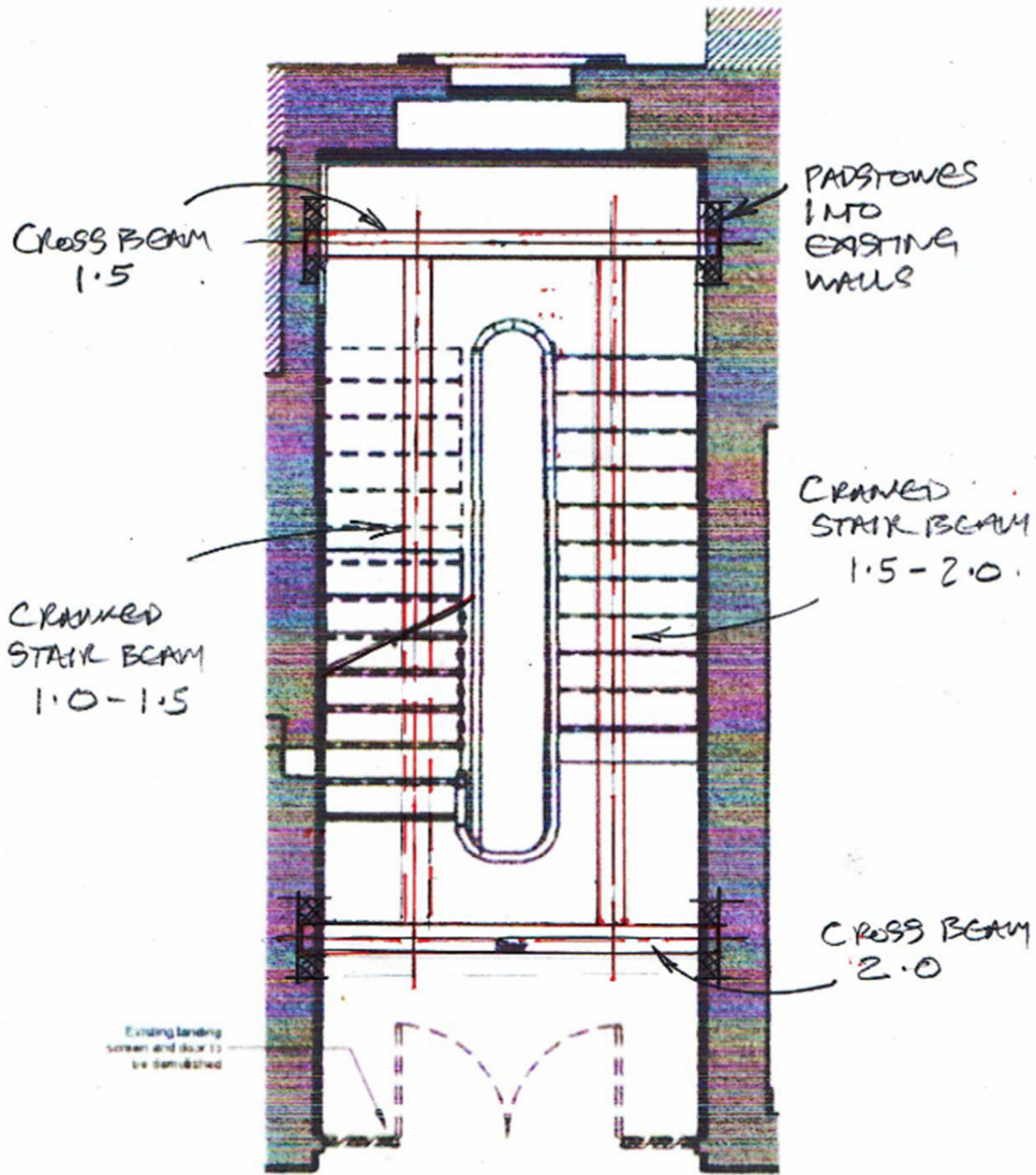
Sketch Drawings / Mark-ups.

STEEL SUPPORT STRUCTURE
LEVELS 0.0 → 1.0



STEEL BEAM SIZES TBC.
- LIKELY TO BE 250X150 RHS
LAD 'FLAT ON' TO SOFFITS

STEEL SUPPORT STRUCTURE
LEVELS 1.0 → 2.0

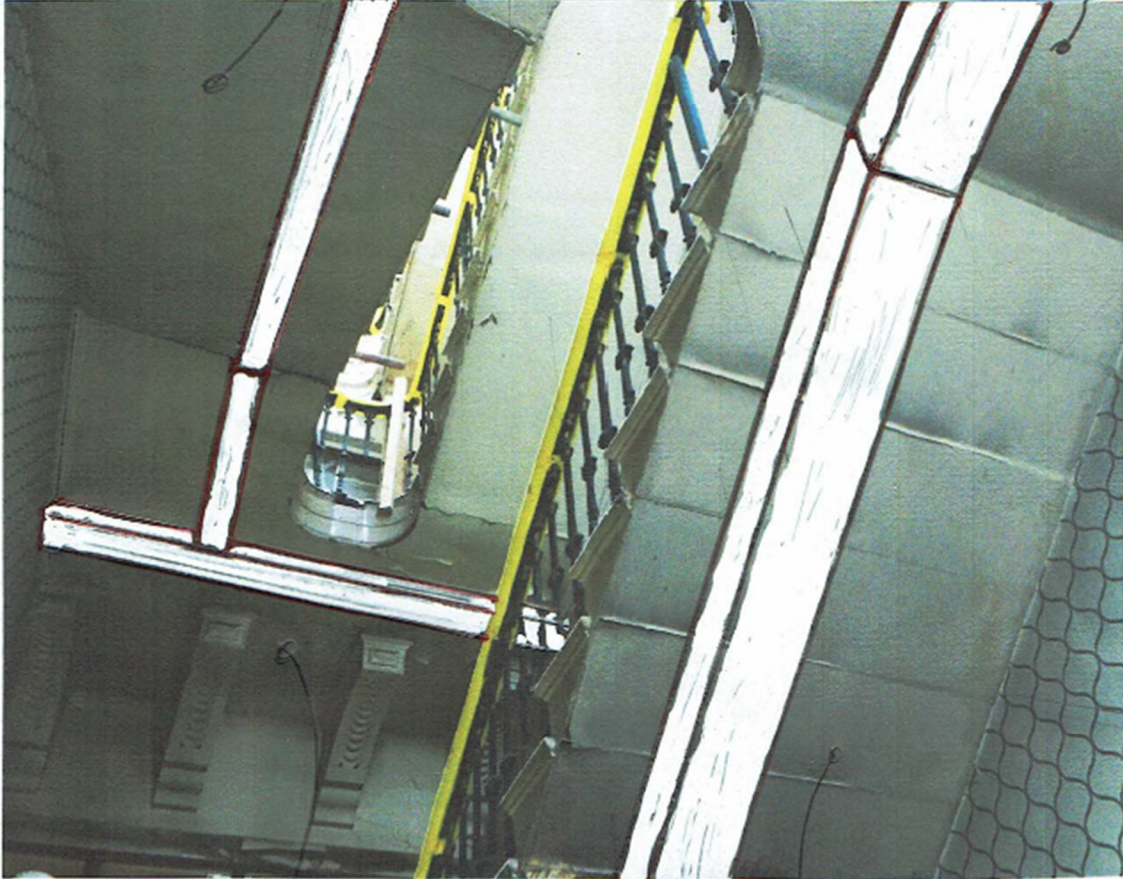


STEEL BEAM SIZES TBC - W/ENH TO BE 250 X 150 RHS LAID 'FLAT ON' TO SOFFITS.

VIEW UPWARD FROM
LEVEL 0.5 LANDING

STAIR FLIGHT
1.5 → 2.0 U/S

LANDING
1.5 U/S



LANDING
2.0 U/S

STAIR FLIGHT
1.0 → 1.5 U/S

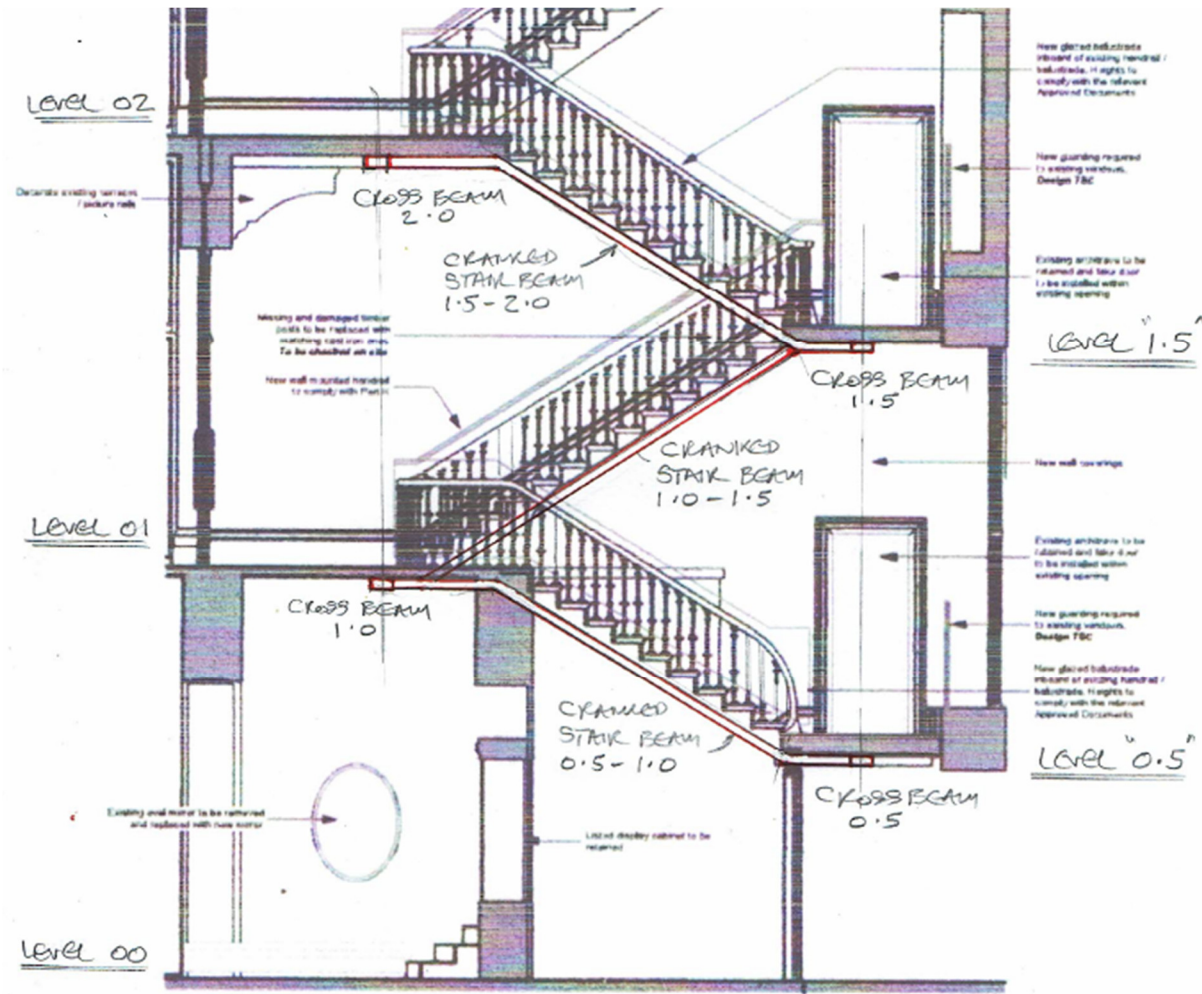


Figure 2 – Adept Mark-up (AHR Elevation 02)