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Maynard Wing Structural Appraisal

Kidderpore Avenue Detailed Design Stage

9100-REP-015

11581

For Mount Anvil

Engineering at its Best

Report For

Scheme No: 11581

Mount Anvil

Kidderpore Avenue Detailed Design Stage
9100-REP-015

Maynard Wing Structural Appraisal

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1.0 Introduction

1.1 This Structural Engineering Appraisal Report has been prepared for Mount Anvil. It considers the structural engineering aspects associated with the proposed refurbishment of the Maynard Wing which is being carried out as part of a redevelopment of the former Westfield College Estate in Kidderpore Avenue, for which A&Q Partnership are acting as Architect. The Maynard Wing is also known as Maynard House or Maynard Hall.

1.2 The observations and comments provided in this report are based on walks around the building on 19th June 2014, and during March to May 2016, opening up works carried out in March and April 2016 by ESG, and the following information:

- Existing building survey drawings prepared by Murphy Surveys, reference numbers MSL9992-MH-FPB sheets 01 and 02, FPG sheets 01 and 02, FP1 sheets 01 and 02, FP2 sheets 01 and 02, and FP3, dated October 2014;
- Historic record drawings, received from Mount Anvil on 22nd October 2015;
- Heritage Statement by Montagu Evans dated June 2015;
- Architect's proposed layouts – drawing references 9000-DRG-03MW-LG010, UG010, 01010, 02010 and 03010;
- Report for Maynard Wing Fabric Survey by ESG, dated 29th April 2016, reference STR 642, Issue No. 001 (Draft);
- Factual Site Investigation Report prepared by Soiltechnics dated July 2015;
- Arboricultural Report prepared by Crown Consultants, dated 1st July 2015, reference 09166;
- "Preliminary timber decay and damp survey of the Kidderpore Avenue development site – Maynard Wing", prepared by Hutton and Rostron dated 4th June 2015;
- "Kidderpore Avenue: Maynard Wing timber condition survey", Site Note 27 for 7th to 14th April 2016, prepared by Hutton and Rostron;
- Kidderpore Avenue: Maynard Wing lintels condition survey", Site Note 28 for 7th to 14th April 2016, prepared by Hutton and Rostron;

1.3 Observations are based on access to all internal areas where the structure was viewed from floor level. By their nature, the opening up works and other observations have been limited in their extent at this stage of the design. It is therefore possible that details of the structure that are later opened up as part of the refurbishment works will be different from that inferred to date.

1.4 The following drawings have been prepared by Tully De'Ath as part of the design development and should be referred in when reading this report:

- 9100-DRG-03MW-LG900 Maynard Wing Existing Floor Plans sheet 1 of 3
- 9100-DRG-03MW-01900 Maynard Wing Existing Floor Plans sheet 2 of 3
- 9100-DRG-03MW-RF900 Maynard Wing Existing Floor Plans sheet 3 of 3
- 9100-DRG-03MW-LG001 Maynard Wing Level LG Proposed Floor Plan sheet 1 of 2
- 9100-DRG-03MW-LG002 Maynard Wing Level LG Proposed Floor Plan sheet 2 of 2
- 9100-DRG-03MW-UG001 Maynard Wing Level UG Proposed Floor Plan sheet 1 of 2
- 9100-DRG-03MW-UG002 Maynard Wing Level UG Proposed Floor Plan sheet 2 of 2
- 9100-DRG-03MW-01001 Maynard Wing Level 01 Proposed Floor Plan sheet 1 of 2
- 9100-DRG-03MW-01002 Maynard Wing Level 01 Proposed Floor Plan sheet 2 of 2
- 9100-DRG-03MW-02001 Maynard Wing Level 02 Proposed Floor Plan sheet 1 of 2
- 9100-DRG-03MW-02002 Maynard Wing Level 02 Proposed Floor Plan sheet 2 of 2
- 9100-DRG-03MW-03001 Maynard Wing Level 03 Proposed Floor Plan sheet 1 of 2
- 9100-DRG-03MW-03002 Maynard Wing Level 03 Proposed Floor Plan sheet 2 of 2
- 9100-DRG-03MW-RF001 Maynard Wing Level RF Proposed Roof Plan

2.0 Historic Development of the Site

2.1 The site forms the former Westfield College campus, associated with King's College London. It contains a number of historic buildings – some of which are listed Grade II. Immediately to the north of the site is Kidderpore Reservoir.

2.2 Kidderpore Hall forms the earliest building on the estate and dates from 1843. It was designed by T Howard for a merchant, John Teil who ran a leather concern in India. John Teil died in 1854 and following several changes of ownership, the house and two acres of ground were bought by Westfield College in 1889

2.3 Westfield College then began a process of developing the grounds for use as a college and halls of residence. The developments included:

i. Maynard Hall was added by the college in 1889. It was designed by Robert Falconer Macdonald and provided expanded accommodation for the college on the site.

ii. Skeel House – also known as Skeel Library – was added in 1903-04 along the southern boundary of the site. It was also designed by Robert Falconer Macdonald and was built to allow Westfield College to be admitted as a teaching school of the University of London. A further building, Dudin Brown House, was added to the east of Skeel Library about the same time. The construction of these two buildings began to define the Quadrangle – a landscaped space to the north of these buildings and to the east of Maynard Hall.

iii. The Chapel was added in 1928/29 towards the north west corner of the site.

iv. Bay House was developed to the east of Kidderpore Hall. The original structure probably dates back to 1889 when it formed the southern end of Maynard Hall. Historic records indicate it was later altered and extended around 1921 and later about 1935. This included works along the main southern elevation and to the rear facing the Principal's Lawn.

v. Lady Chapman was added on the north side of the Quadrangle in c.1927.

vi. Lord Cameron Hall was then added along the eastern boundary of the site in c.1935. The north eastern corner of the site was then developed with the construction of Rosalind Franklin Hall in c.1965. This building abutted the eastern end of Lady Chapman Hall and completed the Quadrangle which exists today.

vii. Queen Mother Hall was constructed to the west of Kidderpore Hall in 1982.

2.4 There is also a timber-framed summerhouse on the site, which is located by the northern boundary by the reservoir.

2.5 Of the 11 existing buildings on the site, five are Grade II listed. This consist of Kidderpore Hall, Maynard House, Skeel Library, the Chapel and the summerhouse.

3.0 Summary of Ground Conditions Generally on the Site

3.1 A site investigation has been carried out by Soiltechnics and is summarized in a Factual Report dated July 2015. The report is based on 10 bore holes, 10 window samples, and 22 exploratory trial pits across the entire site.

3.2 In summary, the ground conditions have been shown to comprise top soil and made ground overlying the Claygate Member with the London Formation at depth.

Strata	Depth (below ground level)	Description
Top soil and Made Ground	0.3m to 1.8m	
The Claygate Member	4.9m and 8.7m	Slightly gravelly silty sandy clay, very sandy clay and silty sand.
London Clay Formation	Proven to 25.8m	Silty clay with occasional shelly material at depth

3.3 Groundwater levels across the site vary between 1.3m and 6.0m. The levels are subject to further monitoring.

4.0 Description of Existing Structure

4.1 The Setting

4.1.1 The Maynard Wing was constructed between 1889 and 1891 to the designs of Robert Falconer MacDonald. It was built to the east of Kidderpore Hall and provided bedrooms and sitting rooms for students and a new lecture hall provided in the middle of the range. The original building included a southern wing that incorporated a large dining room. This southern wing was later altered to form part of Bay House and as such is not discussed in this report. Reference to the Bay House Structural Appraisal report, reference 9100-REP-012 should be made.

4.1.2 The Maynard Wing was constructed between 1889 and 1891 to the designs of Robert Falconer MacDonald. It was built to the east of Kidderpore Hall and provided bedrooms and sitting rooms for students and a new lecture hall provided in the middle of the range. The original building included a southern wing that incorporated a large dining room. This southern wing was later altered to form part of Bay House and as such is not discussed in this report. Reference to the Bay House Structural Appraisal report, reference 9100-REP-012 should be made.

4.1.3 The architecture is in the William and Mary style and the elevations are dominated by brickwork. The main façade faces east and is more elaborate than the west elevation.

4.1.4 The east elevation faces the Quadrangle and rises from lower ground floor to second floor level, with the top floors accommodated behind a tiled hipped roof. This contains gabled ends and dormer windows. The central section rises to third floor level. A stone or reconstituted stone cornice forms the base to the roof and rises on the gable ends. In front of the elevation is a cobbled walkway. This elevation historically included a main entrance to the building. This is accessed centrally along the elevation and is accessed at upper ground floor level via stone steps leading up from the walkway.

4.1.5 The west elevation faces the Principal's Lawn and is planer and shorter in height. It rises from upper ground floor to second floor level, with the central section rising to third floor level. The central section forms a projecting bay within the elevation. At roof level, there are dormer windows but no gable ends.

4.1.6 At the north end of the east elevation, there is an archway. This has a first floor corridor link to Lady Chapman Hall and so probably dates from the time Lady Chapman was constructed, in the late 1920's.

4.1.7 The north elevation contains an external fire escape staircase.

4.1.8 The roof forms a mansard containing the uppermost floor. It is tiled on the sloping sections and clad with lead on the flat sections. There are a number of dominant brick chimneystacks. A bell clock tower sits centrally on the roof above the local third floor level.

4.1.9 Internally the layouts on each of the three main floors is consistent – containing a central corridor with rooms laid out either side. Within the central section there are bathrooms and a larger room within the bay – presumably forming the lecture room described in historic documents. The corridors are served by two staircases, an original staircase at the southern end of the building, by Bay House, and a second staircase immediately to the north of the central bay by the west elevation. This second staircase appears to be a later addition.

4.1.10 The use of the building has remained broadly the same throughout although the lecture rooms have more recently been converted to kitchens and 'social rooms' on each floor level. The original layouts were also arranged such that each dormitory was formed of two rooms. These rooms were joined together through large openings in the adjoining cross wall. These openings have since been infilled during refurbishment works in 1972.

4.1.11 The original lecture rooms contained curved walls at the eastern end of the spaces. These were removed during the early 1970's work to create the layouts that exist today. These alterations appear to have required alterations to re-support the floors locally.

4.2 Description of Existing Structure – A Summary

4.2.1 The existing structure is summarized on drawings 9100-DRG-03MW-LG900, 01900 and RF900.

4.2.2 The building has a cellular load bearing masonry structure. This supports the floors and roof structures that are predominantly formed of timber construction although some areas of concrete filler joist floor construction exist at upper ground floor level. These are described in more detailed below. The building relies on the cellular layout for overall stability.

4.3 Wall Construction

4.3.1 The load bearing external walls appear to be of solid brick masonry construction. They are laid in a Flemish bond. The windows are formed using brick arches externally and have backing lintels behind. At third floor level, H&R have identified these as softwood lintels, but on the other floors, concrete lintels have generally been noted. One softwood lintel has been confirmed at ground floor level which suggests others may exist across the building.

4.3.2 The internal load bearing walls run each side of the central corridor with some load bearing masonry walls running back to the elevations. These are also of solid brick masonry construction in the original building. Some of the crosswalls originally had dominant openings within them joining two spaces together but were infilled during refurbishment works in 1972 to form smaller individual rooms. This infill appears to be done using non loadbearing timber studwork.

4.3.3 There are a number of chimney breasts within the masonry walls. These are arranged such that each pair of rooms that originally formed a dormitory had a fireplace. These will contain flues that rise to the chimneystacks at high level.

4.4 Existing Floor Construction

4.4.1 Timber joisted floors appear to exist throughout most of the first, second and third floor levels. These span between the elevations and corridor walls and between the corridor walls themselves.

4.4.2 At upper ground floor level, the same pattern generally exists except for the corridors and some of the rooms on the eastern side in the central area. In these areas clinker concrete filler joist floor construction exist. The small rooms facing the Quadrangle in the central portion of the building also appear solid and could be of filler joist construction too.

4.4.3 Bressummer beams and other floor beams probably exist in the larger lecture rooms that exist behind the central bay window on the west elevation. These could be steel or timber although this has not been confirmed.

4.5 Existing Roof Structure

4.5.1 The roof is formed using a timber carpentered roof which takes support off the internal load bearing walls. Common rafters and hips are supported off timber wall plates in the elevations. The construction of the bell clock tower has not been viewed to date.

4.6 Existing Foundations

4.6.1 Trial pit investigations by Soiltechnics have exposed the foundations at three locations along the elevations. This includes two locations against the east elevation and one location along the west elevation. ESG have also excavated three trial pits internally at lower ground floor level.

4.6.2 A trial pit at lower basement level externally on the east elevation has revealed the front elevation is founded on a concrete strip foundation which bears on to natural very silty clay of the Claygate Member at 0.9m below ground level. The description of the soils indicates no tree roots were noted

4.6.3 A second trial pit on the cobbled walkway showed the east elevation is founded on a concrete strip foundation which bears on to natural slightly gravelly very sandy clay of the Claygate Member at 1.5m below ground level. The description of the soils indicates no tree roots were noted.

4.7 Original Staircase on East Elevation

4.7.1 H&R have identified the embellishment to the sides of the entrance staircase appears to be a terracotta ‘faience’. This sits above a brick wall with an arched opening.

4.7.2 The stairs themselves appear to be natural stone and span between the outer wall and the east elevation.

4.8 External Fire Escape Staircase

4.8.1 The external fire escape staircase appears to be of steel construction. It has not been assessed in detail as this structure is proposed for removal as part of the proposed redevelopment of the site.

5.0 Imposed Floor Loads

5.1 Based on the understanding of how the existing building has evolved over time, most of the existing floors appear to date from 1889 to 1891.

5.2 It is possible that the structure was designed in accordance with industry guidance that was available at the time. The key documents that existed around the 1890's are noted in the table below together with the classification of loads each document provided. Even if this guidance was not strictly used, it gives an indication of what industry thinking was during this period.

5.3 Encyclopaedia of Architecture 1881:

	Pounds Per Square Foot (lbs per sq ft)	**kN/m²**
Public Halls in which people only accumulate	128	6.1
Ordinary Dwelling houses	100	4.7

5.4 Dormon Long and Co Handbook 1895:

	Pounds Per Square Foot (lbs per sq ft)	**kN/m²**
Public Halls or Schools	110	5.2
Dwellings or Office Buildings	80	3.8

5.5 Appleby's Handbook of Machinery 1903:

	Pounds Per Square Foot (lbs per sq ft)	**kN/m²**
Stairs and passages	80 to 90	3.8 to 4.3
Offices, libraries etc.	70 to 80	3.3 to 3.8
Dwelling room floors	56 to 70	2.6 to 3.3
Attic floors	34 to 56	1.6 to 2.6

5.6 As a comparison, the current recommended imposed loads for residential use are as follows:

	kN/m²
Residential floors	1.5
Residential corridors and staircases	3.0

5.7 In addition to these loads, a provisional allowance of $1.0kN/m^2$ should be provided on the floors for lightweight partitions.

5.8 This review suggests the existing floors should be adequate for the proposed imposed loads provided the floors were designed correctly.

5.9 An initial assessment of the floors indicates they have a theoretical imposed load capacity of at least $2.5kN/m^2$.

6.0 Observations on the Condition of the Existing Structure

6.1 This section of the report summarizes issues that have been observed on site or have been identified in H&R's reports which relate to the condition of the existing structure.

6.2 The building generally appears to be in an average condition for its age and type. Issues that have been identified are linked with the effects of water ingress in to the structure. These observations are set out below.

6.3 External Observations – East, West and North Elevations

6.3.1 There are signs of repairs to a number of gutters. This suggests there have been historic issues with water ingress.

6.3.2 The guttering along the north elevation appears to have failed recently as there is widespread algae on the surface of the cornice directly below the gutter by the fire escape staircase.

6.3.3 There are signs that climbing plants have previously grown up some parts of the elevations. Some blockages have also been noted in the gutters where vegetation has piled up.

6.3.4 H&R highlight the rainwater pipes are vulnerable to blockage.

6.4 Internal Observations

6.4.1 The timber condition survey by H&R has generally found the timber floors to be in a reasonable condition and no significant or existing decay is occurring. There is a potential for some rafters to be decayed where they sit on the external walls and some allowances for repairs should be made.

6.4.2 H&R have also assessed the roof structure from limited observations at second and third floor levels. They noted no obvious signs of significant decay or infestation. There is a potential for some rafters to be decayed where they sit on the external walls and some allowances for repairs should be made.

6.4.3 The timber floors generally feel reasonably stiff when walked upon.

6.4.4 H&R have noted a softwood lintel has been noted at ground floor level on the west elevation, immediately to the north of the central bay. This has decayed and needs to be replaced.

6.4.5 At basement level, there are a series of cracks in the soffit of the concrete filler joist floor below the ground floor corridor. This could be associated with corrosion of embedded filler joists. Opening up works are required to confirm the condition of the embedded steelwork.

7.0 Proposed Strategy for Structural Engineering Works

7.1 1.1 Given the existing structure is in an average condition for its age and type, it should respond well to the proposed refurbishment. Essentially the building was designed as a college building providing living accommodation. The proposed refurbishment will convert the building to residential flats. This use is compatible with the existing structure.

7.2 The proposed refurbishment will involve a number of internal alterations to remove sections of existing load bearing walls and to form new walls. The basement floors are to be lowered and so a provisional allowance has been made for underpinning existing foundations. At the northern end of the building externally, the existing fire escape staircase is to be removed. Some structural repairs will also be required.

7.3 Building Regulations and Extending the Useful Life of the Existing Structure

7.3.1 In accordance with the Building regulations, the Maynard Wing will undergo a material change of use. However, the Building Regulations do not identify specific structural engineering requirements that the existing structure needs to adhere to under Part A of the Building Regulations.

7.3.2 The key structural engineering aspects however are to design all alterations to be sensible in engineering terms and to see that the floors have sufficient strength and stiffness for the proposed use as residential flats. Provided any new partitions are designed to be lightweight timber or metal stud partitions and new sound insulation and fire protection are lightweight, the provisional structural engineering assessment shows it is unlikely the existing retained floors will need to be strengthened for the intended use, provided the condition of the structural elements is reasonable and has not been undermined by previous ill-judged alterations. A further more detailed assessment of the existing floors is being carried out to confirm this.

7.3.3 New structural elements will be designed in accordance with current Eurocodes and British Standards.

7.4 Conservation Engineering Approach

7.4.1 Given the Maynard Wing is listed Grade II it has additional importance linked with its historic and architectural interest.

7.4.2 The engineering strategy for the structural design will therefore aim to limit the impact of the structural works on the historic fabric. Existing structure will be retained where possible and new structural elements – whether related to alterations or repairs - will be designed to be compatible with the historic fabric. They will also be reversible and interpretable for what they are, as part of a proposed 21st century refurbishment. This approach is good in conservation terms but also provides a sensible and economic engineering approach for the works.

7.5 Building Warranty Provider

7.5.1 It is understood the proposed Warranty Provider is Premier. An early meeting should be arranged with Premier to understand what measures they will expect to see implemented structurally as part of the proposed refurbishment.

7.5.2 Examples of work they may require are noted below:

i. The structure is required to have a life of at least 60 years.

ii. The existing foundations may need to be inspected more fully than has been carried out to date in order to demonstrate the building has satisfactory foundations, even though there are little or no signs of differential settlement. If foundations are found to be locally shallower, they may insist on the foundations being underpinned.

iii. Where concrete foundations exist, Premier may insist on concrete testing being carried out to demonstrate the concrete is in a reasonable condition and will be able to perform adequately for a further 60 years.

iv. All timbers built in to external walls would need to be checked for decay or infestation. Any affected timbers would need to be replaced. Unaffected timbers will require re-support off joist hangers or removed and re-installed with additional protection from a damp proof membrane.

7.5.3 Of these examples, example iv is the most likely one to be required. It may be a requirement for all embedded timbers and not just those in vulnerable areas.

7.6 Structural Issues Associated with Water Ingress

7.6.1 The main issue which has affected the condition of the existing structure is the effects of water ingress. This is usually associated with gutters and rain water pipes not having a robust design or having been maintained effectively. This allows areas of the elevations to become saturated after periods of heavy rain. The Maynard Wing is especially vulnerable to this given it is close to large trees in the Quadrangle.

7.6.2 Buildings of this age and type require good cross ventilation within the structure to help maintain its condition. Regular maintenance to keep gutters and rainwater pipes free of blockages and vegetation is also important. The building has also been empty for some time and unheated spaces will also have encouraged damp to migrate.

7.6.3 As such, the most vulnerable areas of the structure are at eaves level by the existing gutters and along the lines where rainwater pipes exist. These areas coincide with where the condition of the structure tends to be poorest and usually where most historic repairs have been carried out. Whilst there are some patches of damp along the elevations and the gutters and downpipes have been problematic in the past, the timbers viewed to date do not appear to be significantly affected by decay from the limited opening up works carried out.

7.6.4 Given this pattern, it is important that where timber repairs are now proposed, they are detailed such that timbers will not be susceptible to decay in future. This is particularly so in the areas highlighted as being vulnerable. This will require embedded timber joists to be either cut back and re-supported off joist hangers or for the ends to be wrapped with a damp proof membrane and ventilated where retained as embedded in the external walls. Timber lintels in vulnerable areas will need to be replaced with concrete lintels and bonding timbers will need to be cut out and replaced with brickwork.

7.6.5 Although non-structural, well maintained pointing to the mortar courses in the brick elevations is important to limit the potential for water ingress. Where hard cementitious pointing has been used it can encourage water to become trapped within the brickwork when there is driving rain. It is also brittle and susceptible to cracking. This combined with freeze thaw action can cause the surface of the bricks to spall and for pointing to fall out exposing softer mortar behind which then also weathers. It is recommended that all the pointing and other non structural features such as flashing and haunches on chimney stacks are checked and repaired as necessary. Hard cementitious pointing should be replaced with a softer more compatible mortar as specified by the architect.

7.7 Existing Concrete Filler Joist Floors

7.7.1 1.2 The building contains clinker concrete filler joist floors at upper ground floor level, and possibly elsewhere. These contain steel or wrought iron 'I' sections set between 450mm and 900mm apart and the space between is filled with a concrete infill. Usually this is mass concrete which arches between the iron / steel sections. The mass concrete is a clinker concrete. It is obvious from its darker appearance compared with normal concrete and on account of the black-coloured aggregate that is used from which the concrete takes its name. This aggregate is often pieces of old coke or slag used in heavy industry.

7.7.2 As with the existing timber floors, it makes sense from a structural engineering and conservation perspective to retain these floors provided they are in a reasonable condition.

7.7.3 The acoustic and fire performance of such floors needs to be addressed however. Clinker concrete is often not very dense and so the floors tend to have insufficient mass to meet modern acoustic requirements. The concrete cover to the iron or steel joists is often very small so the joist may not have adequate inherent fire protection. Measures similar to those required for timber floors may therefore be required to address the acoustics and fire compartmentation.

7.7.4 The use of clinker concrete raises two further potential issues. Occasionally clinker concrete can be quite friable and weak. This can raise question marks over its longer term durability – such as its ability to cope with foot traffic along corridors over a 50 or 60 year period. Clinker by its nature can also contain high levels of Sulphur. When it comes in to contact with water, a weak sulphuric acid can develop which can be highly corrosive to the embedded iron or steel sections. A protective waterproof render can be used to address this issue in vulnerable areas such as shower rooms and kitchens where water ingress is more likely to occur.

7.7.5 These issues need to be examined in more detail by carrying out some concrete testing on the clinker concrete and testing a core sample to check its density and strength.

7.8 Proposed Structural Repairs

7.8.1 Based on the observations and opening up works carried out to date, the following structural repairs are expected to be necessary as part of the proposed refurbishment. This list is provisional and will be confirmed once the floors are lifted completely by the builder during the construction phase.

7.8.2 The outline scope of structural repairs to the walls, floors and roof is as follows:

i. Splice repairs to decayed ends of rafters where decayed. Timber wall plates in affected areas will probably need to be replaced too. Further repairs to the roof joists and ridge plates across the flat sections of the roof and to the timber frame forming the bell clock tower may also be necessary.

ii. Splice repairs to decayed ends of floor joists where decayed. New joist ends to be supported via joist hangers are to be isolated from the external wall via a damp proof membrane.

iii. Removal of decayed timber wall plate and bonding timbers and replacement with brickwork. Embedded timber to be removed also from areas that are not decayed but are in areas highlighted as being vulnerable.

iv. Heavily notched joists will need to be strengthening and stiffened by fixing additional joists to the sides of affected joists.

v. Potential repairs to the filler joist floors will be confirmed once they have been investigated and tested.

vi. Although not strictly structural, repairs may be required to the terracotta faience embellishment to the staircase on the east elevation.

7.8.3 Whilst not strictly repairs, the following enhancement works are required to the timber floors.

i. Solid timber blocking pieces need to be added between joists, where this has not been provided. This is to enhance the stiffness of the floors by improving the 'load share' between adjacent joists.

ii. Existing floor joists are to be doubled up along the lines of new partitions to improve the stiffness of the floors on these lines.

iii. It is understood stone and other brittle finishes may be proposed on the timber floors. This approach is not recommended as timber floors and brittle finishes are not compatible with one another and there is a high risk that brittle finishes will crack. A timber joisted floor is - by its nature - lightweight and susceptible to more noticeable deflections than a heavier concrete floor. The volume of timber is also not stable as it will shrink or expand slightly as moisture levels change within the atmosphere. Whilst such issues can be controlled to some degree, they cannot be removed altogether and as such the risk of cracking will remain.

7.8.4 Other structural repairs may become necessary as the building is opened up. Examples include addressing ill-conceived structural alterations that have been carried out in the past and structural features such as openings which are currently concealed behind finishes. The programme for the construction works needs to leave sufficient time to allow the structure to be thoroughly assessed once it is fully opened up so the final scope of structural repairs can be confirmed without causing delay to the works.

7.9 <u>Proposed Structural Alterations</u>

7.9.1 As highlighted above, the proposed refurbishment will involve a number of internal alterations to remove sections of existing load bearing walls and to form new walls. The basement floors are to be lowered and so a provisional allowance has been made for underpinning existing foundations. At the northern end of the building externally, the existing fire escape staircase is to be removed.

7.9.2 The existing internal walls are to be altered. Some existing door openings will be infilled and new door openings formed. In some areas, sections of the existing wall will be removed to form more open plan space. New door openings will be formed using lintels whilst larger openings will be formed using steel beams supported off new concrete padstones cast on to the existing walls.

7.9.3 The new internal walls are to be formed using brickwork. The new walls will need to be properly tied and bonded to the existing walls so that the cellular structure works as one. New walls will be supported off new strip foundations bearing on to the natural ground. These foundations will be dowelled to existing foundations to limit the potential for differential settlement.

7.9.4 The lower ground floor level is to be lowered between 500mm and 1400mm. This is to provide sufficient head room at this level for residential accommodation. Given that the depth of the existing foundations varies slightly where they have been confirmed through trial pit investigations, it is expected the excavations involved with reducing the floor level would undermine some of the existing foundations. Some existing foundations will therefore be underpinned to maintain the stability of the structure. Further trial pit investigations are necessary to establish the foundation depths more clearly so that the extent of underpinning can be confirmed.

7.9.5 The new lower floor slab will be formed using a ground bearing reinforced concrete slab.

7.9.6 Given the nature of these alterations there will naturally be some adjustment to existing load paths. Some disturbance to the existing structure over where new openings are to be formed may also adjust slightly as new supporting beams deflect under the loads. This may generate some slight movements in plaster finishes and brickwork. Allowance should therefore be made for making good slight cracks that occur as part of the works.

8.0 Proposed Further Investigations

8.1 The following additional opening up works and other investigations are necessary to assist with the development of the working drawings:

i. Further trial pits are required at lower ground floor level to confirm the extent of underpinning where the floors are to be lowered.

ii. The existing solid floors need to be examined in more detail. These are clinker concrete filler joist floors and so concrete testing is necessary to assess how robust and durable the concrete is. The condition of the filler joists should also be checked, especially where the cracks are visible on the soffit of the ground floor corridor.

iii. The floor beams within the central bay need to be exposed on each floor level to confirm the construction and structural condition. The existing joisted floor also needs to be assessed in these areas.

iv. Further opening up works is required to check the backing lintels as the pattern of concrete lintels and softwood lintels recorded by H&R does not appear wholly consistent. This may reveal there are further softwood lintels to those already identified.

v. In relation to the external staircase on the east elevation, the faience to the embellishment needs to be checked using a non-destructive radar to assess whether the faience contains embedded cramps and ties, and if so, what the condition of the ironwork is.

vi. Further access is required to assess the condition of the timber construction within the roof.

8.2 The programme for the construction works needs to leave sufficient time to allow the structure to be thoroughly assessed once it is fully opened up so the final scope of structural repairs can be confirmed without causing delay to the works.

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