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Stonyhurst College – Old Infirmary

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Preliminary Structural Appraisal

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Executive Summary

Civic Engineers have produced a Preliminary Structural Appraisal of the Old Infirmary building at Stonyhurst College in Lancashire, to assess its current condition with a view to its renovation. The Old Infirmary is Grade II listed and is currently partly used for staff and pupil residential purposes and for teaching. This Structural Appraisal is based on available existing information provided to Civic Engineers and from a non-intrusive visual site survey on 12th December 2018.

The Old Infirmary is a three-storey traditional load-bearing stone building with timber floors, constructed in 1842-3. Based on available existing information and a site walkover, Civic Engineers identified a number of areas that were likely later alterations. These include the addition of a lift tower and alteration or addition of a staircase, replacing original stone walls with timber panelling and glazing, and converting the second floor loft space into storage rooms. In addition, the current Day Boys Study Area which links the Old Infirmary to the main College building may be a previous open-sided covered walkway that has been converted into an enclosed space. Weld House, an adjacent College building, was constructed next to the Old Infirmary in c. 2010. There may have been ground stabilization works carried out below part of the building's foundations; a quote for this work from Uretek has been provided but no evidence of actual works carried out.

During the site visit on 12th December 2018, Civic Engineers made the following observations:

- Cracking is present in walls across all floors of the building. Cracks are generally minor (<5mm); some are historic and have been plastered over. We are currently unable to determine if cracks are stable or worsening.
- Several floors have a significant slope and door frames have been distorted due to building movements. Doors have been reset to accommodate floor slopes, as there is no evidence of doors sticking in their frames.
- The pattern of cracking, floor slopes and distortions signify that differential settlement may have occurred across the building; generally the perimeter walls are a 'high point' and the internal walls are showing evidence of greater settlement. The exception to this is one of the internal corridor walls which is a location of the possible ground stabilisation works; this also appears to be a 'high point'.
- The ground conditions may vary across the site, causing differential settlement or meaning that the Uretek ground stabilisation was less effective in some areas.
- There are localised cracks around a fireplace at ground floor which has a beam and door below, suggesting that the fireplace has dropped due to inadequate support.
- There is localised cracking in the area of timber panelling, where the introduction of new beams may have changed the load path and created point loads in walls that are not sufficient to support them.
- Damp was identified in some areas; due to failed window seals and from bathrooms above that may be later additions.

Civic Engineers recommend that further surveys are carried out prior to confirmation of remediation or renovation proposals, including; further review of available archive information, intrusive ground investigation, CCTV survey and opening-up works.

1. Introduction

On behalf of Stonyhurst College in association with Levitt Bernstein architects, Civic Engineers have produced a Preliminary Structural Appraisal for the Old Infirmary at Stonyhurst College in Lancashire. Stonyhurst College is a coeducational independent school, with day pupils and boarding pupils. The Old Infirmary is a Grade II listed building and is currently partially used for teaching, and staff and pupil accommodation.

This report describes the structural condition of the building based on a site visit by Civic Engineers on 12th December 2018. The site visit included a walkover to view the external elevations and all floors (excluding rooms that were inaccessible). The site visit was a visual inspection only; no intrusive investigations were carried out and no structural elements were tested or examined in detail. From the site visit, Civic Engineers identified areas of the building that appeared to have been altered from its original state. This report describes these and suggests potential causes of some of the defects identified. Recommended further investigations are also included.



Figure 1: Photo of existing study area

1.1 Building Location

Stonyhurst College is in Lancashire to the south-west of Clitheroe. The college estate comprises a large number of buildings of different ages, the majority of which are connected. There are several Grade I listed buildings on the estate, including the Old Quadrangle and St Peter's Church. This report is focussed on the Old Infirmary, which is situated to the west of the college estate and connected to the main body of buildings. The Old Infirmary is Grade II listed.

The Old Infirmary is connected to the Old Quadrangle on the east side. To the south is a garden and to the west a road separates the building from a lake. To the north is Weld House, constructed in 2010, which is not connected to the Old Infirmary. Civic Engineers understand that an underground culvert runs past the corner of the Old Infirmary from the north towards the lake.



Figure 2: Site Location

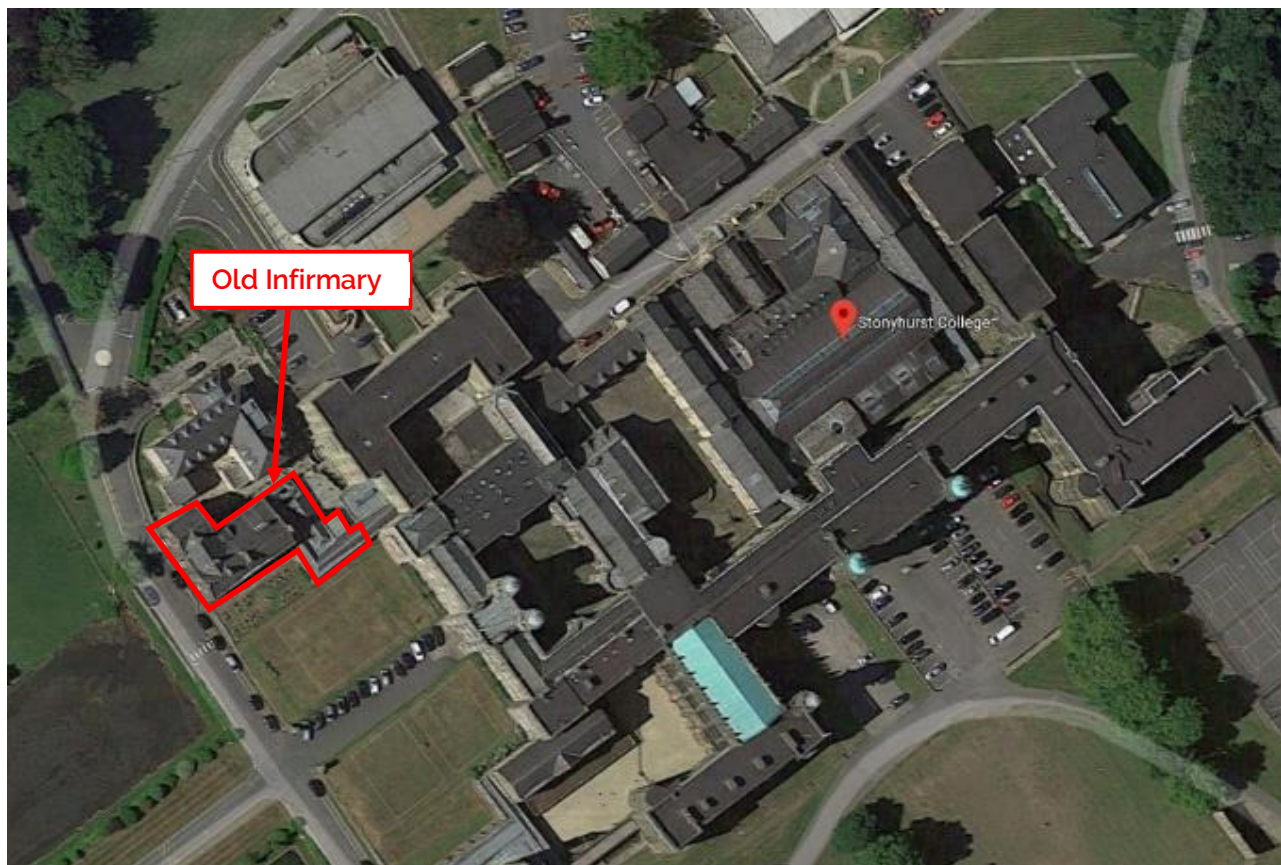


Figure 3: Site Aerial Photo

1.2 Building Description

The Old Infirmary is generally a three-storey building which is split level at the lowest level; this level is referred to as the basement. The building was constructed in 1842-3. The basement is currently used as classrooms, staff accommodation, storage and plant rooms. The ground floor (which is partially above external ground level) is currently partially used for student study areas. This floor was also previously used as Jesuit priest accommodation, but these areas are currently out of use. The first floor is currently partially used as staff accommodation; this floor also contains currently unused Jesuit priest accommodation. There is a small area of the roof void which is accessible (referred to as the second floor) and is currently used for storage. The building is traditional stone construction with timber floors and timber roof with slate covering. The ground conditions are described by specialist geotechnical consultants as poor brick fill over weak clay, and the foundations are described as strip footings. The British Geological Society maps below show that the site bedrock is sand stone and the superficial deposits are Devensian till.

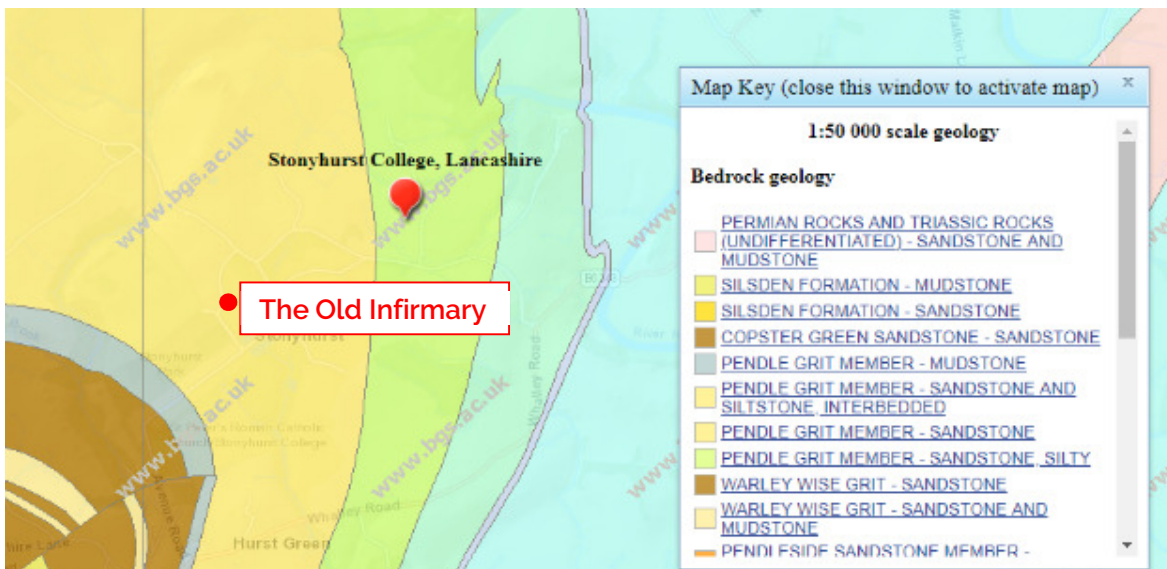


Figure 4: Superficial Site Geology (British Geological Society map)

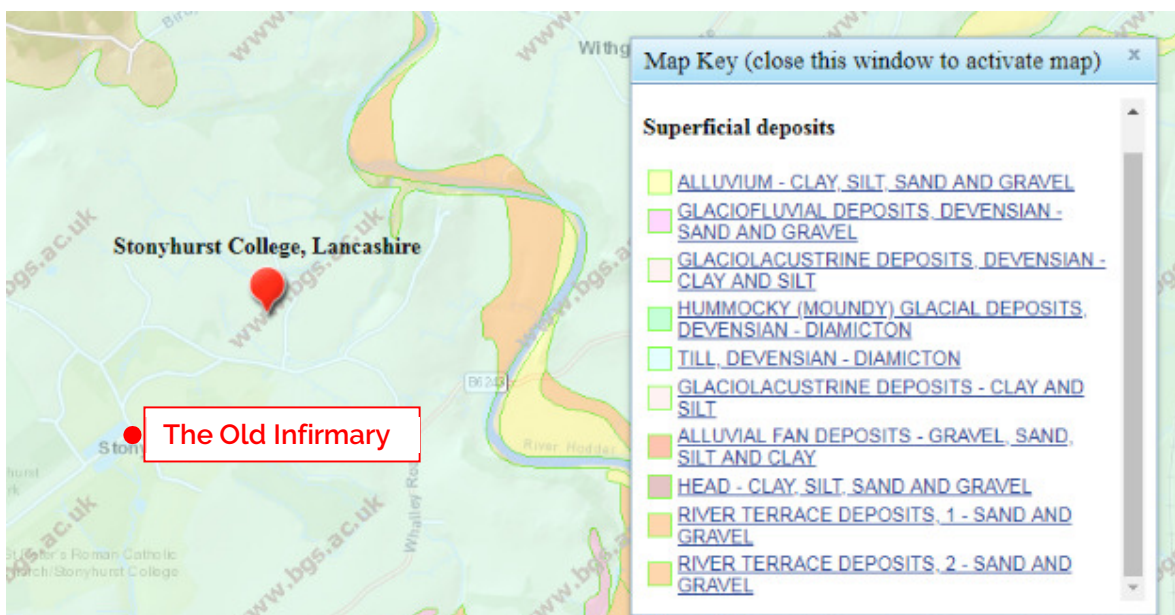


Figure 5: Bedrock Site Geology (British Geological Society map)

1.3 Listed Status

The building gained Grade II listed status on 14th January 2015. The building is described as listed for the following principal reasons:

- *“Architectural Interest: attributed to J.J.Scoles, a notable Catholic architect, the buildings are good examples of mid-C19 gothic revival work complementing the West Front composition developed by the Jesuits;”*
- *“Historical Interest: Stonyhurst was the destination for Jesuits fleeing continental persecution in 1794, and played a central role in the growth of the Roman Catholic Church in England throughout the C19 and C20, as the principal school and college for the Society of Jesus in England;”*
- *“Group Value: the Old Infirmary and passage forms part of a strong group with other elements of the complex at Stonyhurst.”*



Figure 6: South elevation of Old Infirmary and link to main building

2. Alterations to the Original Building

During the site visit on 12th December 2018, Civic Engineers noted several areas of the building and its surroundings that appeared to be alterations to the original building fabric and environment. Other likely alterations have been identified from previous notes and correspondence with other consultants.

Lift Tower

The lift tower on the north side of the building appears to be a later addition as the stonework is a different size and colour to the surrounding building.



Figure 7: Site photo of lift tower

Stair adjacent to Lift Tower

The stair on the north side of the building adjacent to the lift tower appears to have been added or reconfigured during the building's history, as the alignment of the original window is not consistent with the stair landing.

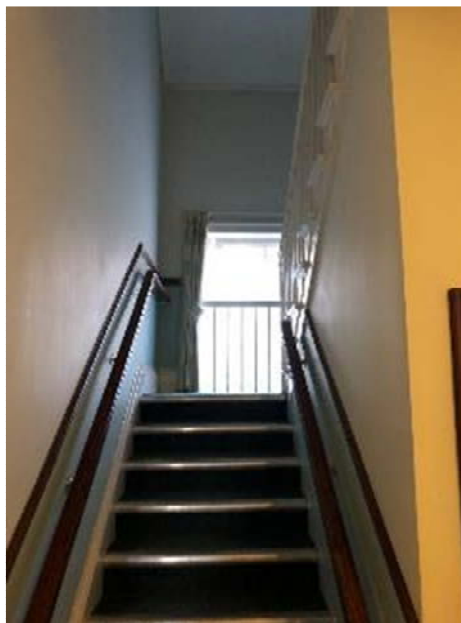


Figure 8: Site photo of stair - from outside and inside

Current Day Boys Study Area

The existing Day Boys Study Area is situated to the south-east of the Old Infirmary and provides the link to the main College buildings. The flagstone floor and the arched windows suggest that this area may previously have been an open-sided covered walkway which has been converted into an internal space. The area to the north of this space may be a later extension as the arched windows (refer to Figure 9, left photo) suggest that this was previously an external wall.



Figure 9: Site photos of current Day Boys Study Area

Weld House

Weld House was built to the north of the Old Infirmary in 2010. The two buildings are not physically linked however Weld House is only approximately 2m from the Old Infirmary at its closest point. Weld House is a maximum three storey traditional stone building. From discussions on site with the Estates Manager, Civic Engineers understand that it is supported by piled foundations; no existing drawings have been made available to date.



Figure 10: Site photo of Weld House

Second Floor Storage Space

A small area of the roof space is accessible (referred to as the second floor). This is likely to be a later conversion and includes the possible addition of a 1m³ water tank. The rooms are currently used for storage, although appeared to be unused at the time of Civic Engineers' site visit. From inspection into the roof space, it appears that an original chimney on the north side of the roof pitch has been removed and a lightwell has been installed.

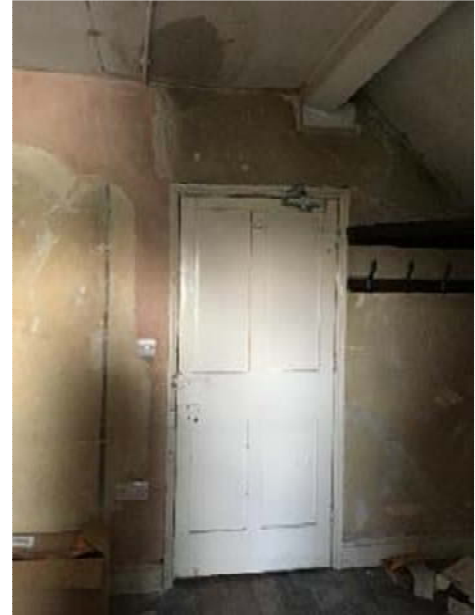


Figure 11: Site photo of Second Floor storage room

Ground Floor Lobby Walls

At ground floor there are currently timber panelled and glazed walls separating the lobby and stairs from the main corridor. It is likely that these walls were previously load-bearing external stone walls, as they are behind the lift tower which is likely to be a later addition (see above). Therefore, new beams will have been installed above the timber panelling to transfer the load previously supported by the original stone walls. The maximum span of beam is approximately 4.1m long.

Ground Stabilisation

Civic Engineers understand that as part of refurbishment works in c. 2004, ground stabilisation works were carried out to part of the Old Infirmary. This understanding is based on a quote from Uretek to carry out the works. The quote states that settlement had occurred to the building and suggest that it has been "caused by long term consolidation of poor brick fill, with possible damage from an old culvert". The quote proposes to use the Uretek ground stabilisation system; an injected polymer which improves the strength of soil when injected. This system is "suited to granular soils and cohesive soils with a low plasticity...unable to treat ground where subsidence has been caused by clay shrinkage". The proposal was to inject the Uretek polymer at 1m intervals along the two main internal corridor walls, at 3m below foundation level.

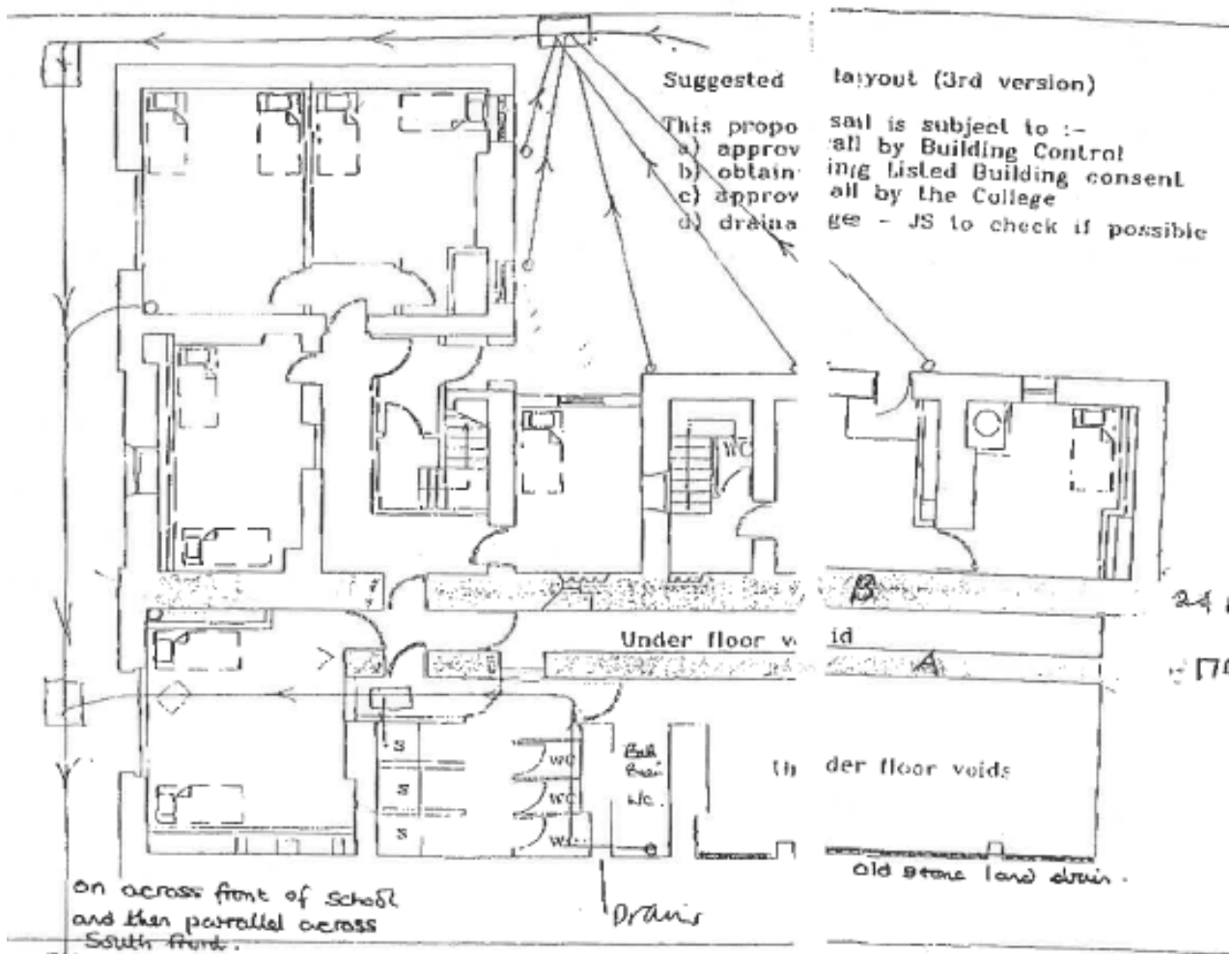


Figure 12: Extract from Uretek ground stabilisation quote (2004)

3. Site Observations

The following provides an overview of the observations made by Civic Engineers during a site visit to the Old Infirmary on 12th December 2018. Refer to Appendix 1 for Site Observations Sketches. The relevant photos for each item are included in Appendix 2.

3.1 Basement

The Key Plan in Figure 13 shows the locations of observations made by Civic Engineers of the basement. Refer to Table 1 for descriptions of each observation and photo references.

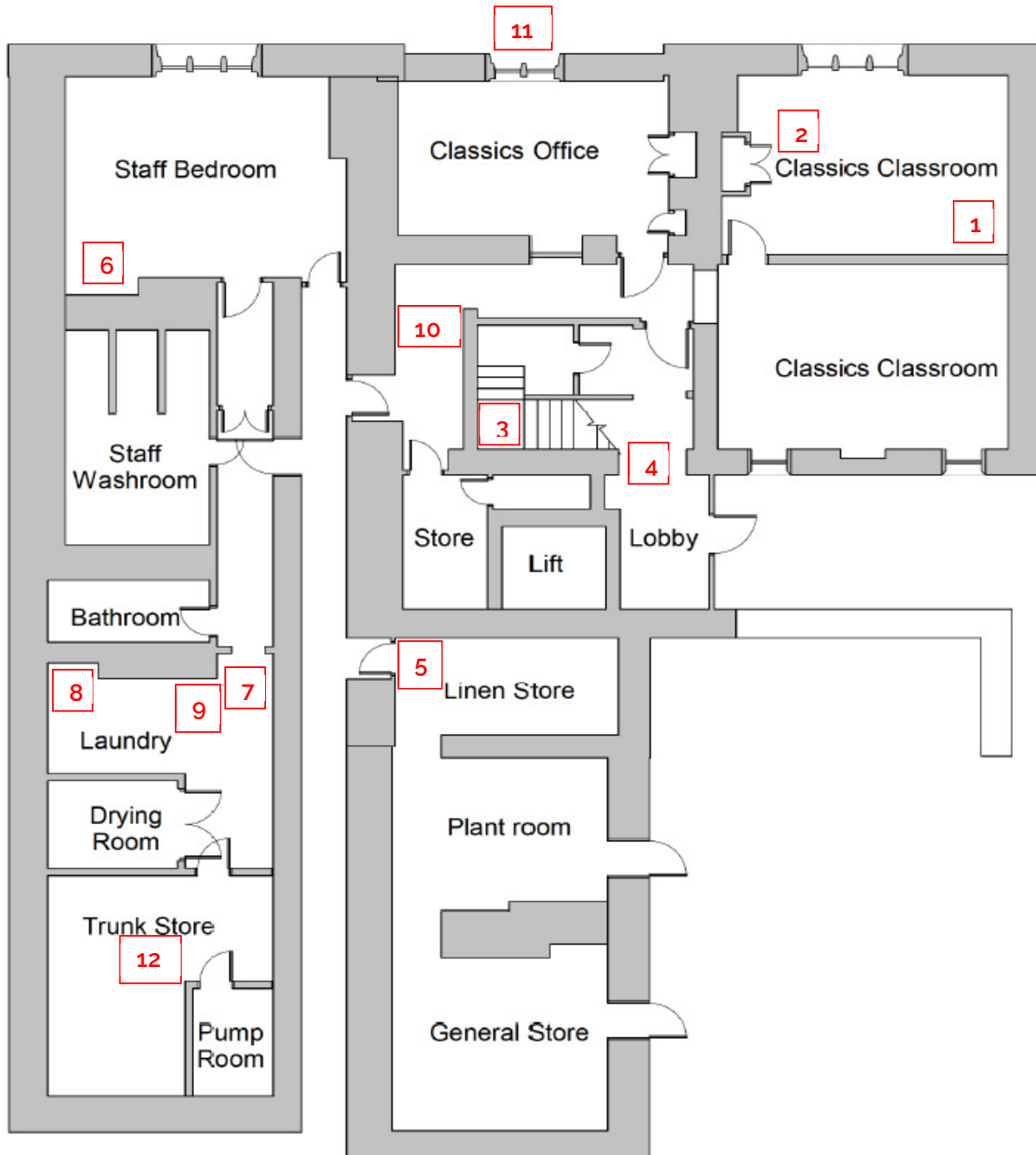


Figure 13: Basement – Site Observations Key Plan

The site observations described in Table 1 relate to the basement of the Old Infirmary. Refer to Figure 13 for the location of each item.

Item	Description	Photo References
1	Minor diagonal crack between external wall and ceiling.	5826
2	Distance between ceiling and top of cupboard door frame is greater on the right-hand side of the cupboard door, suggesting that the basement floor and ground floor are not level with respect to each other.	5821
3	Damp noted on staircase walls.	5865
4	Noted that current internal opening between staircase and lobby was likely part of the original external wall as a stone archway is visible.	5819
5	Long minor diagonal crack (=1mm width) on wall from doorframe to ceiling.	5861
6	Diagonal crack from top corner of wall towards centre of wall. Crack is wider at the top. Crack starts below a bulkhead assumed to be covering a timber beam.	5839
7	Basement floor slopes up from the bathroom towards the drying room.	N/A
8	Minor diagonal crack on wall between external retaining wall and ceiling.	5853
9	Minor cracks just above floor level next to doorframe.	5850
10	Long horizontal crack along wall between door and adjacent wall, approximately mid-height on wall. Vertical crack on wall from plug socket.	5828, 5831
11	Diagonal stepped crack in external stone wall, below and to the right of the basement window. Crack widens from 10-20mm over 300mm. Diagonal stepped crack between basement and ground floor windows in centre of windows.	5785, 5790, 5792
12	Crack in basement floor.	1051

Table 1: Basement Site Observations

3.2 Ground Floor

The Key Plan in Figure 14 shows the locations of observations made by Civic Engineers at ground floor. Refer to Table 2 for descriptions of each observation and photo references.

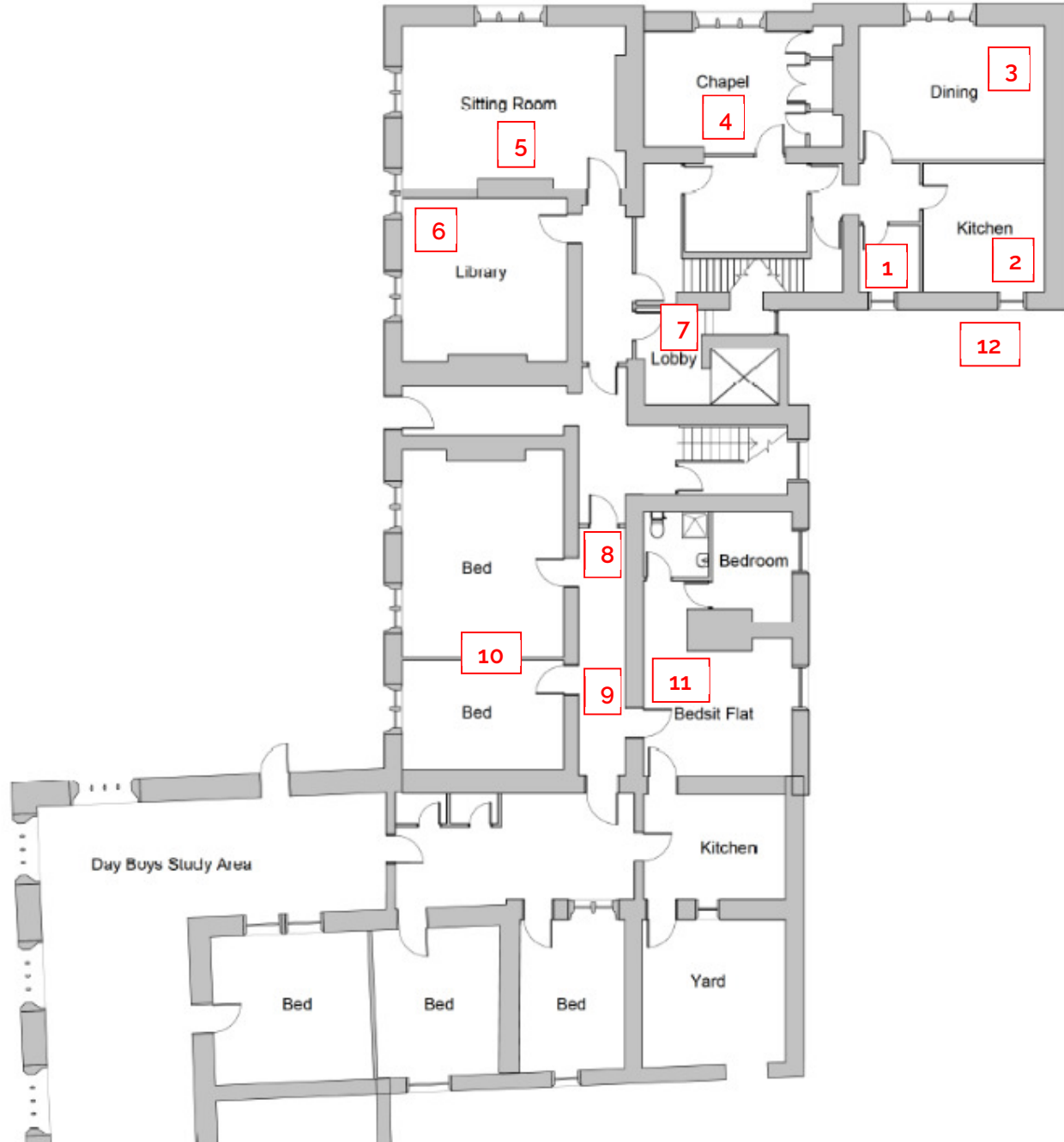


Figure 14: Ground Floor - Site Observations Key Plan

The site observations described in Table 2 relate to the ground floor of the Old Infirmary. Refer to Figure 14 for the location of each item.

Item	Description	Photo References
1	Horizontal crack from window onto side bathroom wall. Evidence of damp below window suggests window seal has failed.	1059, 5872, 5877
2	Minor vertical crack from ceiling on right-hand side of window. Varying widths of plinths below kitchen units suggest that floor slopes upwards away from door and window.	5880, 5878, 5879
3	Noted that the floor in the dining room slopes downwards towards the door from the other three corners of the room.	N/A
4	Noted that the floor in the Chapel slopes downwards by approximately 30mm across the room, with the lowest point at the cupboards. 60mm difference noted across the lobby outside the Chapel, in the same direction. Damp noted on ceiling.	5887, 5889
5	Diagonal cracking either side of fireplace suggests that fireplace has settled.	5890, 5893
6	Diagonal cracks on wall from plug socket.	5894
7	Diagonal crack from corner of opening in stone wall, above timber frame. Extends from top corner of door frame to ceiling, appears widest at the door frame. Minor vertical crack above the door between the lobby and the corridor.	5898, 5899
8	Noted that the ceiling above slopes 80mm downwards above the door.	5960
9	Noted that the top of the doorframe slopes 40mm downwards (to the right of the doorframe when viewed from the corridor). Historic cracks have been plastered over on left of doorframe (when viewed from corridor). This is apparent on both sides of the wall.	5961, 5962, 5964
10	Noted that the floors in both bedrooms slope downwards from the external wall to the corridor wall.	N/A
11	Archway noted adjacent to back-to-back fireplaces; may have been added at a later date	5955

Item	Description	Photo References
12	<p>Minor crack above right-hand side window; possibly due to thermal expansion.</p> <p>Noted that the centre of this elevation appears consist of different (smaller) stone to the majority of the building.</p> <p>Noted that wall has been repointed.</p> <p>Noted that lintels have been replaced.</p> <p>Noted that previous plant growth on walls has been removed.</p> <p>Noted that windows have been fixed in with cementitious mortar.</p>	5812, 5815

Table 2: Ground Floor Site Observations

3.3 First Floor

The Key Plan in Figure 15 shows the locations of observations made by Civic Engineers at first floor. Refer to Table 3 for descriptions of each observation and photo references.

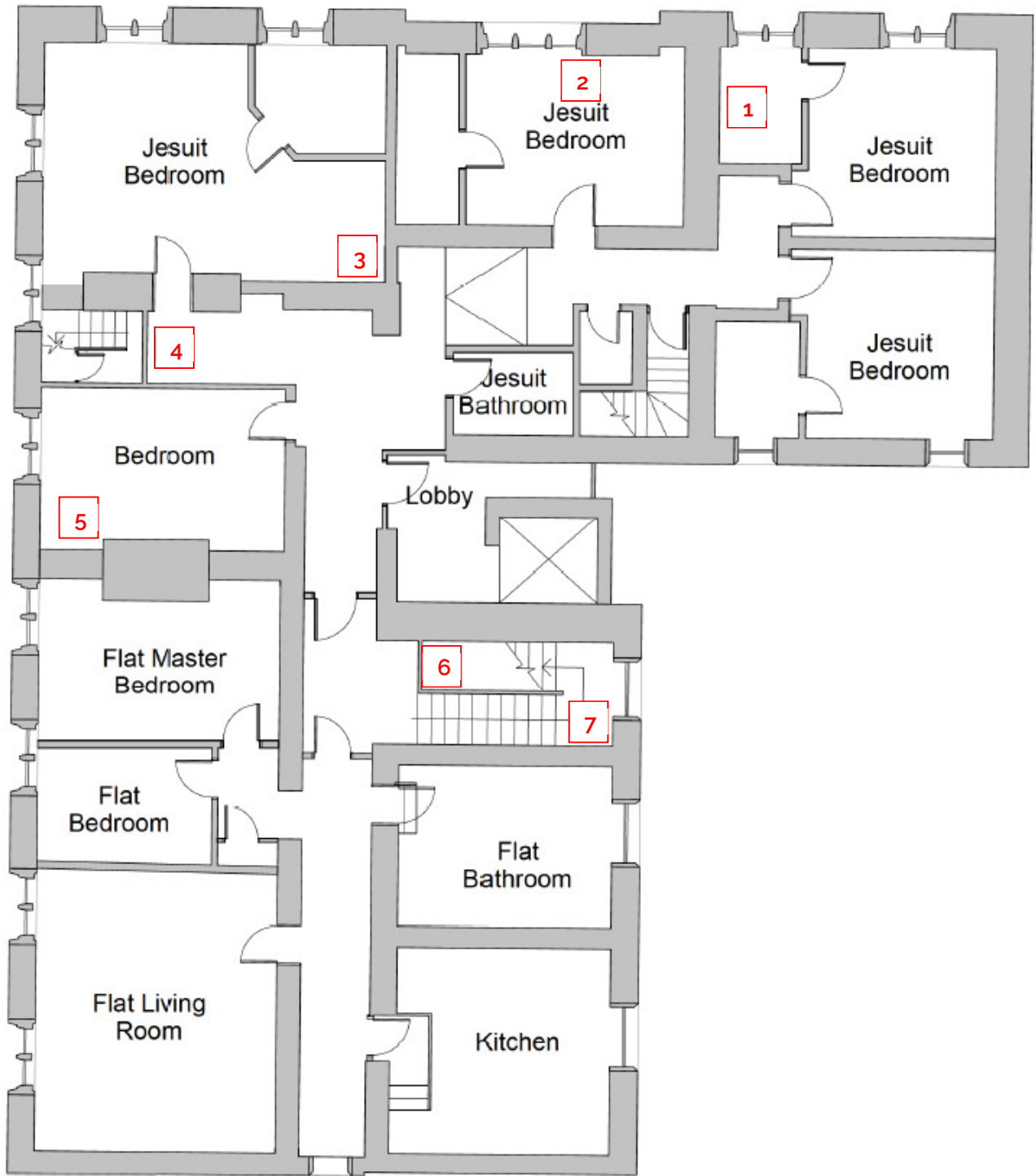


Figure 15: First Floor - Site Observations Key Plan

The site observations described in Table 3 relate to the first floor of the Old Infirmary. Refer to Figure 15 for the location of each item.

Item	Description	Photo References
1	Diagonal crack in bathroom wall from top corner of wall falling towards window.	5907
2	Damp noted below window on the right-hand side. Noted that the floor of the bedroom slopes downwards away from the bathroom.	5905
3	Minor crack in ceiling across corner between two walls.	5910
4	Cracks and damp noted to wall under staircase to second floor (right-hand side wall when viewed from door to staircase). Wall to left-hand side is damp and bows out into the staircase area.	5914, 5917
5	Diagonal cracks near bottom of wall, next to fireplace. Damp noted on ceiling.	5935, 5938
6	Crack in wall between archway and pitched roof over staircase.	5943
7	Diagonal crack in external wall to staircase, between ceiling and adjacent wall.	5946

Table 3: First Floor Site Observations

3.4 Second Floor

The Key Plan in Figure 16 shows the locations of observations made by Civic Engineers at second floor. Refer to Table 4 for descriptions of each observation and photo references.

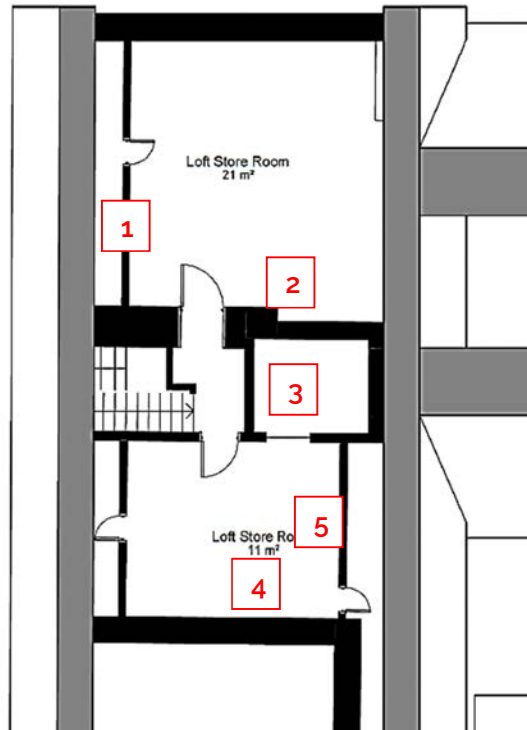


Figure 16: Second Floor - Site Observations Key Plan

The site observations described in Table 4 relate to the second floor of the Old Infirmary. Refer to Figure 16 for the location of each item.

Item	Description	Photo References
1	Long diagonal cracking noted across chimney breast to left of door, and on wall to right of door. Direction of cracks 'arch' towards door, suggesting that the door has dropped. Cracking noted above door around roof beam.	5923, 5924, 5927, 5926
2	Long diagonal crack (plastered over) from bottom corner of wall up to top of wall.	5919
3	Hot water tank noted (assumed 1m ³). Note that label on plan shows 'Lift'; not present on site.	N/A
4	Long crack in wall (has previously been plastered over) from cupboard door.	5933
5	Noted that original chimney has been removed and a lightwell has been installed.	N/A

Table 4: Second Floor Site Observations

4. Discussion of Observations

At a site visit on 12th December 2018, Civic Engineers made a series of observations at the Old Infirmary as detailed in Section 3. In general, no urgent structural issues were observed. The building has suffered movement in some locations which can be identified through cracking, falls in the floors and distortion of door frames. Damp ingress is evident in some locations; around windows and on ceilings. Cracks encountered are generally minor (up to 5mm in width). Some appear to be historic and have been plastered over, with no apparent evidence to suggest these cracks are still mobile or worsening. This is to be verified through further investigation (refer to Section 5).

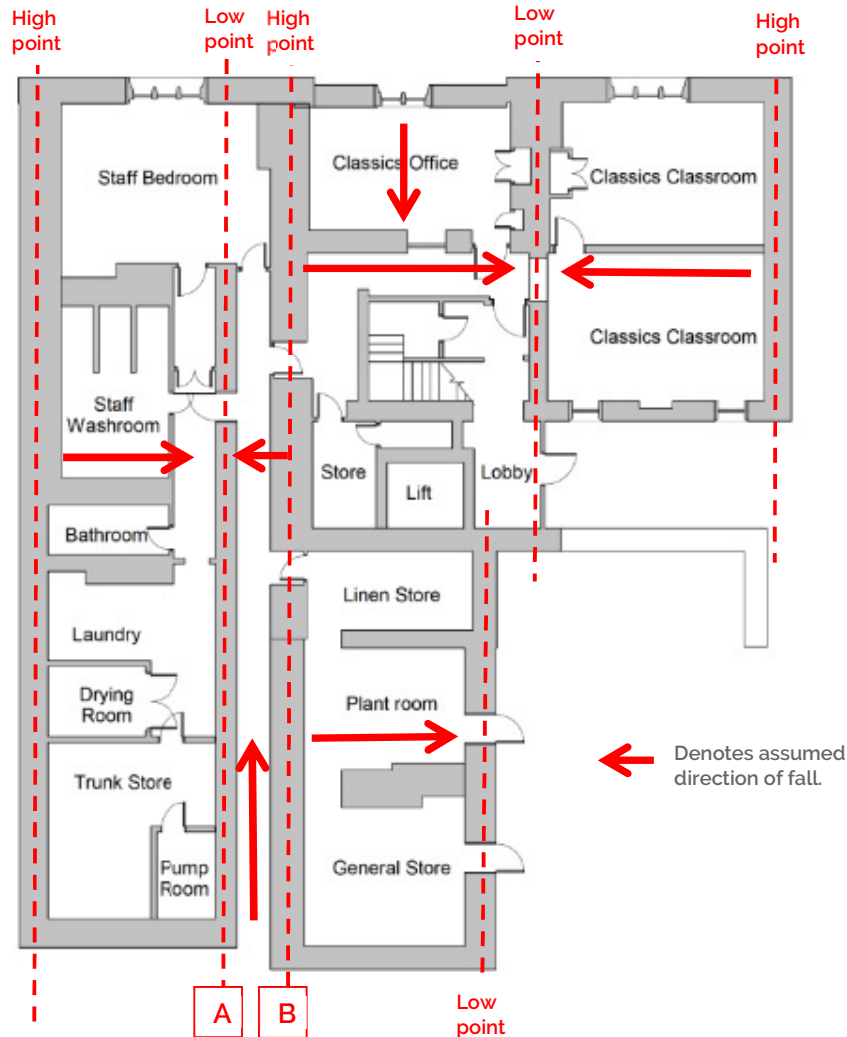


Figure 17: Summary of assumed building movement

Figure 17 shows a summary of the evident location and direction of overall movement across the building, based on the patterns of cracking, floor slopes and distortion identified. The figure shows that generally the external walls are a high point and the internal walls appear to have dropped in relation; excluding the north-facing external wall to the plant room at basement level which is a low point. The only internal high point is the northern wall to the main corridor, labelled as 'B' on Figure 17.

The quote by Urettek discussed in Section 2 states that the ground stabilisation system that was proposed is "suited to granular soils and cohesive soils with a low plasticity...unable to treat ground where subsidence has been caused by clay shrinkage.". The quote also describes the ground conditions as

poor brick fill over weak clay. As this system is not suited to clay, it is likely that the stabilisation was carried out to the overlying brick fill. As a full ground investigation is not available, there is a possibility that the ground conditions vary across the site, causing differential settlement.



Figure 19: Beam below fireplace

In addition to the overall building movements, there are two areas of the building where localised cracking has occurred. These are potentially due to alterations to the original building. The bedroom in the south corner of the building (Staff Bedroom at basement as shown in Figure 17) has a fireplace at ground floor. At basement level, there is a doorway below the fireplace which appears to be a later addition so there is likely a lintel across this doorway. There is also a boxed-out beam below the fireplace, below the ground floor. Cracking at ground floor shows that the fireplace has dropped in relation to the adjacent walls, possibly due to deflection or undersizing of the lintel or beam. A crack at the end of the beam shows that there may have been a change in the load path by introducing a point load into the wall.

At ground floor, the original stone walls around the lobby appear to have been replaced by timber panelling and glazing. Therefore, new beams or lintels will have been installed over the timber panels, changing the load path from a linear load to a substantial point load at the end of the new beams. The longest beam is approximately 4.1m in length. There is evidence of cracking at basement level below this location, suggesting that the original wall and foundations are not sufficient to support the point loads. There is also a crack at ground floor at the end of one of the assumed lintels, suggesting that a change in load path has caused movement in the wall (refer to Figure 20).

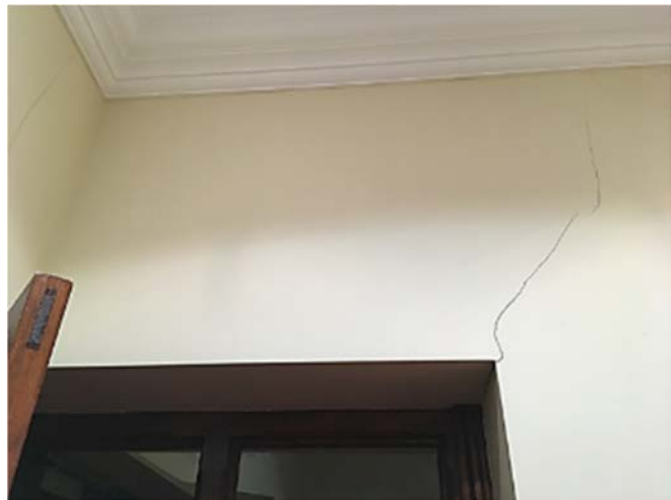


Figure 20: Photo of crack at end of assumed lintel

The evidence of damp around several of the windows shows that window seals have failed and are no longer watertight. At ground floor level, damp is noted on the ceilings of the existing Sitting Room and Chapel in the south corner of the building. The source of this is likely to be failed plumbing work in the en-suite bathrooms in the two Jesuit Bedrooms above at first floor level which may be a later addition. The original first floor construction may not have been designed or waterproofed sufficiently for the addition of the bathrooms. Similarly, damp noted on the wall of the main staircase at ground floor is directly below the Jesuit Bathroom at first floor. Damp was identified on the ceiling of the Bedroom at first floor level, directly below the hot water tank above at second floor.

5. Recommendations

Civic Engineers recommend that, prior to the detailed design of any remedial or renovation works to the Old Infirmary building, further investigations are carried out in order to inform proposals. The recommended investigations are as follows;

- Review of any further available archive drawings or information in order to understand the structure and any alterations that have been made.
- Intrusive ground investigation in order to confirm the ground conditions across the site and the existing foundations. As there is a possibility that ground conditions vary across the site, investigation locations should be spread to give information across the site.
- CCTV survey to identify the condition of the existing drainage, locate the existing culvert and confirm suitability of the existing network for the proposed scheme.
- Opening-up works to further investigate cracking; this is likely to include the removal of plaster to walls and ceilings. Crack monitoring may also be required to determine if cracks are stable or worsening.

The proposed scopes of the investigations described above are included in Appendix 3 of this report.



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