
Pembroke College, Old Quad Oxford

Structural Engineering Summary For Planning

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1 Introduction

This report gives an overview of the structural works considered necessary to Old Quad at Pembroke College, Oxford, following inspections made in September and December 2023.

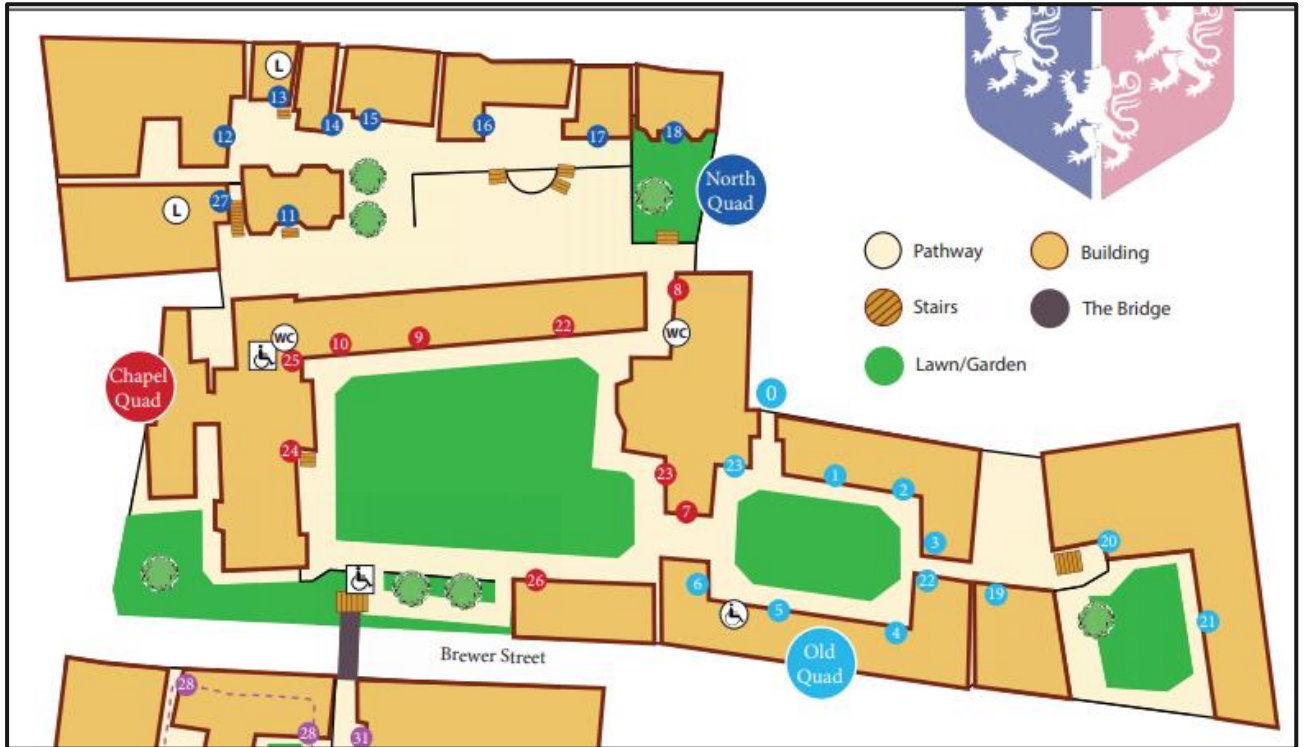


Figure 1: Map of Pembroke College

2 Summary of Inspections

August Inspection

Price & Myers visited Pembroke College on behalf of the College on 22nd August 2023. The purpose of the inspection was to advise on the structural condition of the Old Quad building.

Water damage has been reported in some areas of the Old Quad, and the SCR staircase in the Chapel Quad, which were both to be assessed on the inspection. The inspection was limited to what could be seen without the removal of any finishes and limited to staircases and a selection of rooms and the loft space above Staircase 2.

A number of minor issues were identified, these are summarised below:

Staircase 1

Cracking around the door framing to Rooms 1 and 2.
Minor cracking in the first-floor wall.

Staircase 3

Cracking and blown plaster to the wall adjacent to the MCR.
Historic cracking to the 2nd floor landing.

Staircase 4

Cracking to the side of the door to Room 3.

SCR Staircase

Damage to finishes to ceiling of 2nd floor.

Loft Structure – Staircase 2

2no Cut rafters. Warped and reduced section to 1no rafter.

Stonework

Cracking, spalling and repairs to exterior stonework.

December Inspection

A follow up inspection to re-assess the loft space above Staircase 2, Room 5.1a and Room 5.9 and the MCR. This covered:

3 Observations & Recommendations

3.1 Staircase 1

There is significant cracking to the timber frame around the door of Room 2, on the 2nd floor, of Staircase 1. A section of the timber between the roof and door looks as if it could be easily dislodged from the frame. The crack extends from the timber frame to the wall above the door, measuring up to 3.8mm

The plaster should be stripped back from the crack above the door on the 2nd floor. The original timber beading could be sanded down and re-instated or a new beading fixed in place, and the corner joint of the door frame replastered.



Photograph 1: Cracking above Room 2 on the 2nd floor of Staircase 1

There is a crack measuring up to 1mm above the door of Room 1 on the 2nd floor of Staircase 1 (Photograph 2), where the wall meets the sloping ceiling. The plaster should be cut back, and the junction inspected, additional tying between the walls may be required using remedial ties, such a helical bar. Corner beading is recommended to strengthen the re-plastered junction.



Photograph 2 Crack above door of Room 1

The ceiling on the inside of the Staircase 1 entrance arch has signs of weathering. This may be due to age, or use of an inappropriate paint. The edge of the render is damaged.

The ceiling should have the soffit opened-up locally along the damaged edge to verify the condition of the substrate before repairing the edge and re-decoration.



Photograph 3: Ceiling behind entrance arch of Staircase 1 has peeling finishes.

3.2 Staircase 3

On the 1st floor of Staircase 3 a section of wall between the MCR and window has multiple cracking. On visual inspection the cracks appear to be in the plaster which has warped out of position.

It is recommended to cut back the plaster on the section of wall between the MCR and window to confirm that the cracking in the finishes has not reached the structure behind. If it has, then structural repairs to the stonework, most likely repointing to re-instate the bond between stone, however remedial tying may also be required. The condition of the plaster may be affected by damp due to the proximity to the window. Improving the thermal performance locally could be considered.



Photograph 4: Cracking in wall on 1st floor landing of Staircase 3

On the 2nd floor landing of the staircase remedial works have been applied above door 6; multiple cracks have been filled in.

The cracking above the door to Room 3.5, on the 2nd landing of Staircase 3, appears to be visual cracking in the plasterboard around the lintel. The repair requires re-finishing rather than requiring structural repair.



Photograph 5: Remedial works on 2nd floor landing of Staircase 3

3.3 Staircase 4

There is a significant crack to the righthand side of door 3 on the 1st floor landing of Staircase 4. The deepest section of the crack is nearly 5mm wide with it expanding to 24mm at the face of the wall. Lower down the wall the crack measures approximately 3.4mm. The crack extends the full height of the wall on the 1st floor. This could indicate that the wall has moved out, however it seems most likely it is due to shrinkage of the door frame away from the wall.



Photograph 6: Crack to right of door on 1st floor Staircase 4



Photograph 7: Measurements of crack 1st floor Staircase 4

The doorframe/finishes should be removed to inspect the structure and confirm if the crack to the righthand side of door 3 on the first floor is in the structure. If confirmed, then the crack should be stitched. Helifix Cemties are to be

installed at 300mm centres with Helibond cementitious grout to stabilise the wall. If it is movement in the door frame then the door frame can be re-fixed the the wall and finishes repaired.

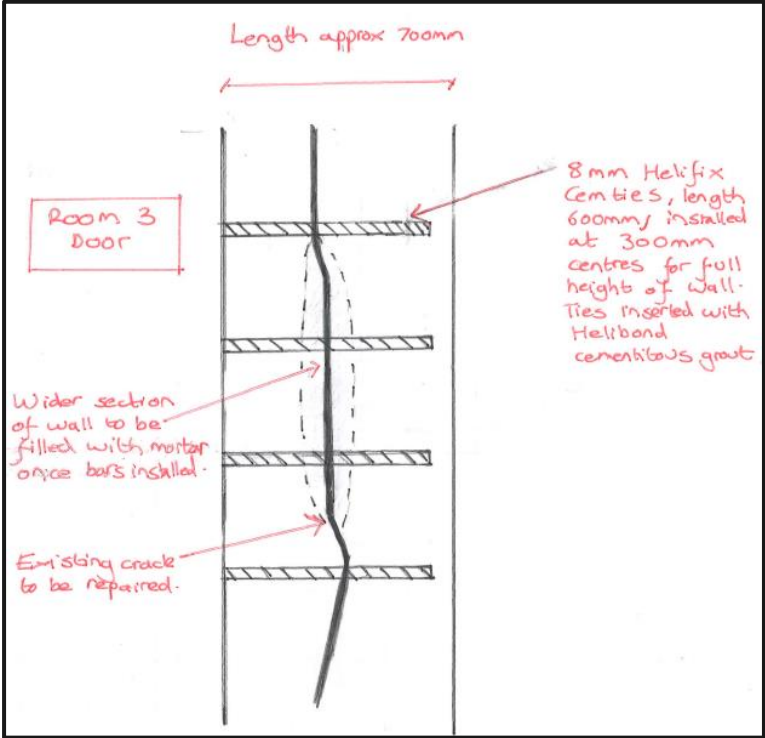


Figure 2: Crack stitching remedial detail

Though not structural, it was noted that the timber window frames on the 1st floor landing of Staircase 4 have section loss (see Photograph 8) and the joint around the window frames have opened up. This may be leading to heat loss and so the joint between the window and wall could be investigated and airtightness improved.



Photograph 8: Section loss in window frame 1st floor Staircase 4

3.4 SCR staircase

The SCR staircase has significant water damage to the ceiling of landing 2. Large sections of wallpaper and paint have peeled off. This may indicate a leak in the loft space above.

Before remedial works are implemented, the source of the water ingress should be identified, and a control put in place to prevent it from occurring again. Access to the roof structure is required to confirm ceiling structure and its condition. If the ceiling structure has been subjected to prolonged wetting, damage may have occurred to the ceiling timbers which may need treatment, repair, or replacement. Plaster repairs can follow on.



Photograph 9: Paint peeling off ceiling of 2nd floor landing of SCR staircase.

3.5 Staircase 2, 5 & 6

Staircases 2 5 & 6 were observed to be in good condition with no structural defects.

Peeling paint was noted on Staircase 6 first floor landing but no structural concerns.

3.6 Roof Structure

The loft space above Staircase 2 was accessible. Elsewhere the loft was not accessible, and it is assumed that similar issues observed above Staircase 2 may be present through other parts of the roof structure.

Above Staircase 2 the roof is formed of timber rafters, approximating to 100mm wide x 150mm deep at 400mm centres, which span to a central apex beam.

Between two of the rafters there are remains of a cut tie beam. At this point there is a halving joint in the rafter, possibly the location of a previous remedial detail where a new section of timber had been fixed to the existing. The lower section of the rafters has split and rotated. This now looks to be structurally unstable.

As access is required within this roof space, the re-introduction of the tie member is not desirable. A new 100 x 150mm C16 timber rafter can be installed alongside the existing. The rafter is to be fixed to the wall plate at the base, as per the other existing rafters, and to the central apex beam. Alternatively, the splice joint could be strengthened

and in doing so the split section of rafter repaired see Figure 3. Remove the lower section of rafter and replace with a new section of timber which can be done via a timber resin bonded splice. The new section of timber should come pre-bonded with high tensile bars. A slot is to be cut into the existing timber which is slightly longer than the protruding high tensile bars. Resin is then poured into the slot bonding the high tensile bars into the existing timber.



Photograph 10: Timber roof structure above Staircase 2



Photograph 11: Timber stump extends 90mm from rafter.



Photograph 12: Timber stump extends 150mm from rafter.



Photograph 13: Split timber rafter

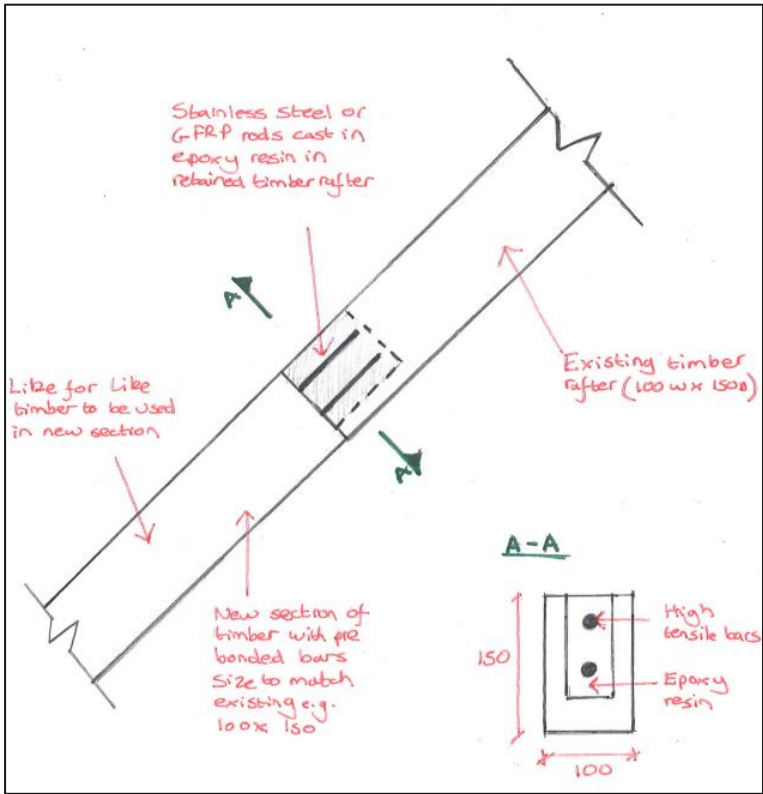


Figure 3: Timber resin splice remedial detail

One of the other rafters in this space has noticeable section loss and warping of the section. This requires further investigation and assessment for capacity. Strengthening may be required in the form of additional sections of timber placed alongside the reduced capacity section and spliced to the original with coach screws.

There are signs of fire damage to some rafters, this has led to section loss, again an assessment on the capacity of the remaining rafter is required to determine if strengthening is required. Strengthening as described in the previous paragraph.



Photograph 14: Timber rafter with section loss



Photograph 15: Fire damage to timber rafter with section loss

3.7 Rooms 5.9 and 5.1a

Cracking is present in the wall between Rooms 5.9 & 5.1a. The cracking is severe in Room 5.9 running vertically the full height of the wall approximately 0.5m from the window. The crack is apparent within 5.1a but less severe. Cracking is not apparent in the wall along Brewer Street. When observed from Brewer Street there is no obvious bowing.

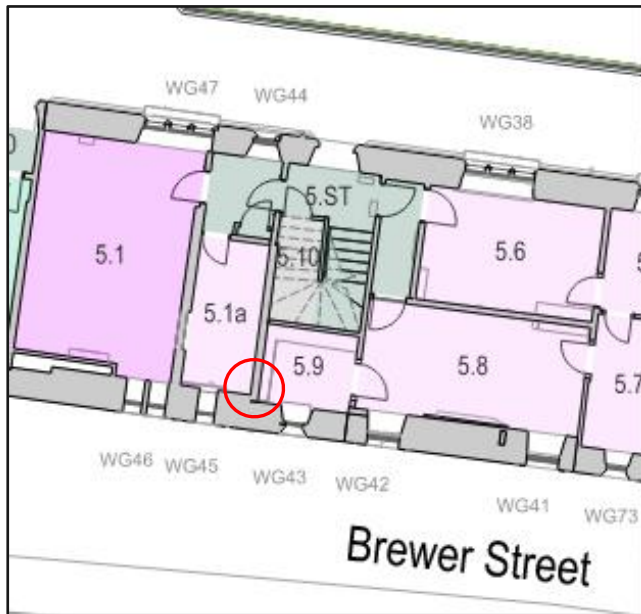


Figure 4: Location of crack

Despite this it appears that there is no bond between the cross wall and external wall. A closer inspection is required once the room can be emptied. It is likely that the plaster will need to be removed around the crack to allow closer inspection of the wall. Remedial work to re-instate, remedial tying, is likely to be recommended.



Photograph 16: Crack in cross wall Room 5.9



Photograph 17: Crack in cross wall Room 5.1a

There is further cracking in the vicinity of this crack in both rooms. Within Room 5.1a there is extensive cracking in the plastered finishes to the external wall, particularly around the head of the window opening, there is also evidence of

damp. It is not clear if the cracking extends into the structure or not. Removal of the plaster to inspect the wall behind is required to confirm.

There is also a severe crack in the head of a window opening. The cause has not been established, the plaster around the crack should be cut back for inspection of the lintel above.

Within Room 5.9 there is cracking in the ceiling, it's not thought that this is linked to the wall cracking but is most likely a failure of the plasterwork due to age or damp. This would benefit from removal and replacement.



Photograph 18: External Wall Brewer Street



Photograph 19: Further Cracking in Room 5.1a



Photograph 20: Cracking to window head in Room 5.1a



Photograph 21: Cracking to ceiling in Room 5.9

3.8 Stonework

There is localised damage to external stonework in several areas. This requires input from a stonemason as to the most appropriate method of repair. The areas of damage are summarised below.

There is localised cracked and/or missing stonework in several areas of the wall around the quad. One example of this is between Staircase 1 and Staircase 2 as shown in Photograph 22. This requires further investigation with a stonemason to establish cause. Repair to arrest further deterioration is advised.



Photograph 22: Section of stone has been lost in wall between Staircase 1 and 2

The stonework around the entrance of Staircase 1 has signs of erosion likely from weathering. There is disintegration and crumbling and flaking of stone adjacent to the entrance opening and at the base of the wall. Due to the thickness of the wall these defects will not have a significant impact of the structural integrity of the walls, but repair may be desirable for other reasons.



Photographs 23 and 24 Section loss to stonework around entrance of Staircase 1

There are holes to the entrance to Staircase 2. These may be old fixing holes, they are not of concern structurally, but repair may be desirable for other reasons.



Photograph 25: Stonework next to entrance of Staircase 2

There is cracking in the stone lintel above the window next to Staircase 3. This requires repair, such as remedial tie bars to tie across the crack, with a colour matched mortar filling the crack.



Photograph 26: Crack in lintel above window next to Staircase 3

There are sections of stone which have been eroded, often around the base of the wall. In areas, such as photograph 27, these will not affect the structure stability due to the overall thickness of the wall being significantly greater.

However, in one area (photograph 28) this erosion was possibly more significant, and this has been repaired in brick. This could be re-visited with a stone repair to match the original stone.



Photograph 27: Erosion to stonework at base of wall



Photograph 28: Remedial works to stonework now with algae/moss

Appendix A

Floor Plans



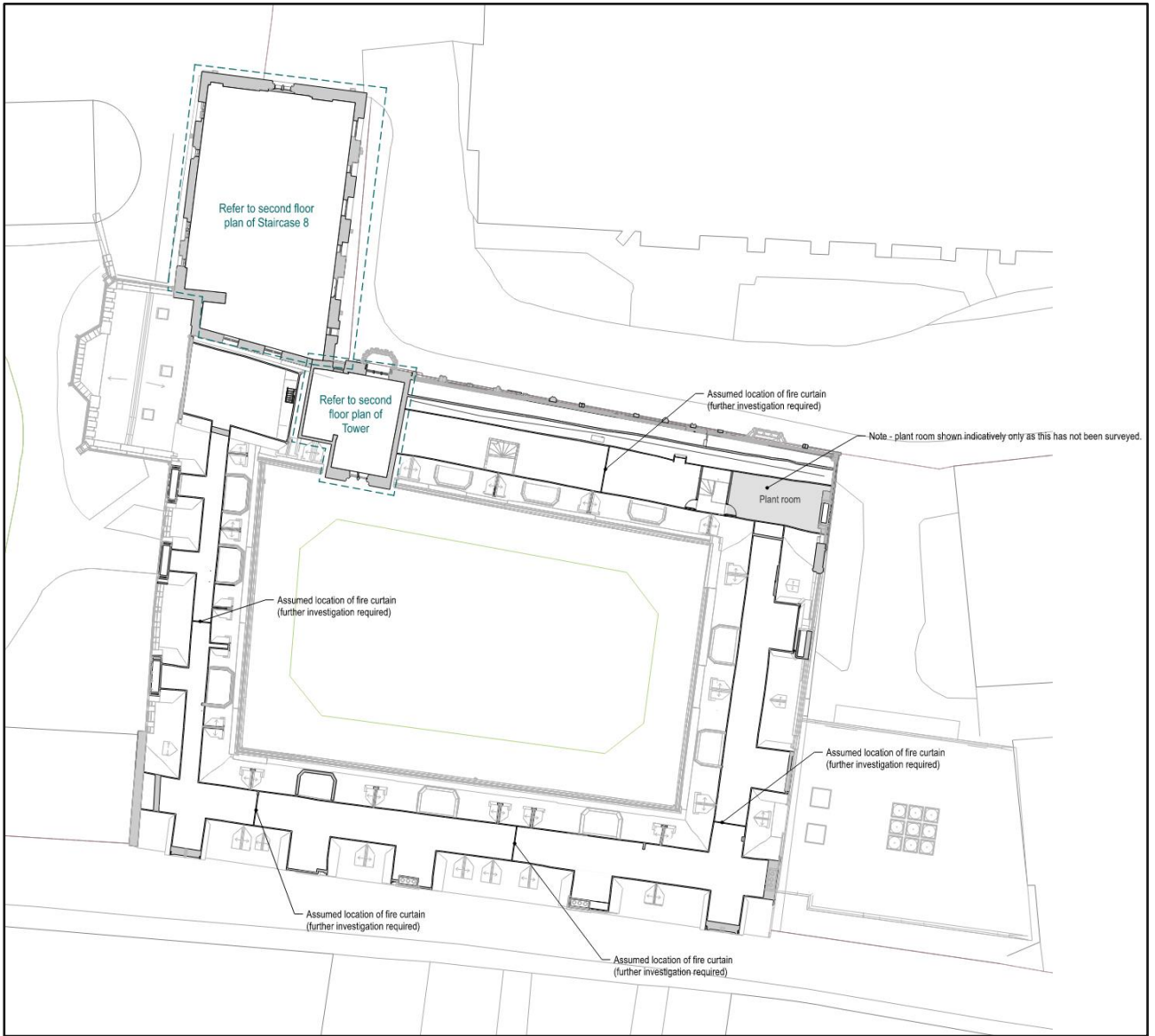
Ground Floor



1st Floor



Second Floor



Loft Space