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Our Ref: SG/sh/20340-A

REPORT

ON: 9 SOUTH TERRACE
LITTLEHAMPTON

FOR: MR & MRS P BROWN

DATE: 14TH OCTOBER 2020

PREPARED BY: S GRAY B.Eng (Hons) PGCert



1.0 INTRODUCTION

1.1 Philip Goacher Associates was instructed to carry out a visual inspection and report on structural defects to the building following water ingress damage and comment on any other structural elements that may require attention.

1.2 The inspection was carried out on Tuesday, 6th October 2020.

2.0 DESCRIPTION

2.1 The property was a mid-terrace, domestic dwelling arranged over five storeys, including a basement and attic floor.

2.2 The original property was constructed having timber floors, internal loadbearing timber and masonry walls, a timber butterfly roof, and external walls formed of a combination of brickwork and a lime/chalk matrix.

2.3 The property was Grade II Listed and understood to have been constructed late 18th century/early 19th century.

2.4 The property had a more recent first floor timber balcony, with pitched roof and steel post supports.

2.5 For the purpose of my report the front of the property was assumed to face south.

2.6 The property had suffered from water damage following failure of the original butterfly valley drainage system. At the time of my inspection, the interior finishes to the main part of the building had been stripped out and the structure was exposed. Scaffolding and screening was erected to the front of the property. The butterfly roof had been covered with a new timber flat top, although the original valley structure remained.

3.0 Internal Observations

3.1 The original roof structure was formed having 50mm x 100mm timber rafters at approximately 330mm centres. The span on-plan from the ridges to the front/rear pole plate was approximately 2.9m. The rafters appeared to be fixed to the pole plate with a mortice and tenon joint. The rafters were fixed to a ridge board at ridge level and birdsmouthed over the central loadbearing stud wall.

3.2 The position of the pole plate formed a parapet valley between the bottom of the roof slope and the front/rear parapet wall. The pole plate to the rear was found to be rotten.

3.3 New flat roof joists had been fixed to the existing rafters with steel bolts and square plate washers, forming the flat top between the butterfly ridges. The joists were OSB sheathed over.

3.4 The ceiling joists were fixed to the side of each of the rafters and were continuous over the central loadbearing stud wall.

- 3.5 Forming the master bedroom and bathroom at third floor level, and an eaves space beyond, were dwarf timber stud walls. The studs were individually fixed to the side of each rafter and onto a sole plate fixed to the top of the third floor joists.
- 3.6 There was no apparent form of restraint, bracing or tying of the original roof members, to adjacent members nor to the main building structure.
- 3.7 Multiple timber elements to the roof structure throughout were found to have deflected and bowed.
- 3.8 To the front of the property was a dormer with a flat roof. The main pitched roof was trimmed using 2No 50mm x 100mm timber trimming beam, spanning between single rafters both sides of the dormer opening. The trimmer was poorly fixed and had dropped at its centre.
- 3.9 The front elevation of the dormer had a full width timber framed window, which appeared to be loadbearing with three intermediate posts within the frame. It was understood that the timber frame window was to be replaced with an aluminium framed window.
- 3.10 Within the third floor was a rainwater channel which ran between the front and rear external walls within the floor depths. The channel discharged out of voids in the roof at front and back. It was assumed that this served the butterfly drainage, with an original downpipe being within/adjacent to the central wall.
- 3.11 The third floor joists were generally 50mm x 150mm timbers at approximately 330mm centres, however, their thickness was irregular, some found to be thinner than others. The joists spanned front to back between the front and rear external walls and lapped over a central loadbearing timber wall. Over the central wall, the lapped joists were not fixed together. There was no form of bracing or restraint to the floor timbers. The joists had warped, twisted and dropped at their centre. Multiple joists had suffered from water damage and were rotten in areas. The movement and deterioration to the joists was worse to the rear, where furring pieces and additional joists had been previously installed to level the floor and services taken through the original joists.
- 3.12 The second floor joists were of similar size to the third floor joists. Where lapped over the central masonry wall the lapped joints were not fixed together. There was no form of bracing or restraint to the floor timbers. To the front of the building, the original timber joists had clearly deflected and twisted, and more recent timber joists had been installed adjacent to the original (east half) and replacing the original (west half). The second floor joists to the front of the building spanned into timber trimmers adjacent to, but not appearing to bear onto, the front external wall. The floor joists were connected using mortice and tenon joints, but the depth of the joint was minimal. The trimmers spanned between the party walls and a central double joist. The original central double joists had a metal strap which appeared to tie into the front external wall, however, this timber was poorly deteriorated. To the rear, the second floor joists were in a poor and deteriorated condition.
- 3.13 The first floor joists spanned front to back between the front and rear external walls and the central loadbearing masonry wall. The timbers were in a better condition than found above, with minimal signs of deterioration. Two of the joists

spanning onto the front external wall had metal straps fixed to their sides, and into the front wall. To the front of the building, the floor joists were connected to a timber wall plate which sat on top of the ground floor wall. When viewed from above, the wall plate was approximately 150mm inside of the front external wall at first floor level due to the change in wall thickness (see below). The ceiling finishes to the rear had not been stripped and the floor joists were not exposed from below.

- 3.14 The hearth to the chimney breast at the rear of the third floor had dropped. The concrete hearth was supported by laths and metal straps fixed to the masonry and adjacent timber joists. The supporting structure appeared to have deflected, resulting in the chimney masonry dropping.
- 3.15 Throughout the property, the main set of timber stairs and half landings had dropped away from the party wall, and cracking was evident where the finishes remained. The stair structure had dropped towards the internal loadbearing wall. The internal wall had not been exposed at the time of my inspection, however, there were no clear signs of cracking or movement to the wall.
- 3.16 The central loadbearing spine wall was present at each floor level, providing support to the timber floor joists and the wall above. At second and third floor level, the wall was of timber construction formed of irregular timber studs at varying spacings and the structure had been exposed prior to my visit. The timbers were in a poor condition at both levels, with significant distortion and deterioration to the members. The stud wall was not fixed to the party walls. At fourth floor, two additional recent studs had been installed replacing the original.
- 3.17 The central wall at first floor level was masonry construction and exposed on one side to reveal a chalk and lime matrix construction. There was no clear sign of significant cracking, deterioration, or movement to the wall.
- 3.18 At ground floor level, the central wall was assumed to be of similar construction to first floor level, although this was not exposed. The ground floor wall had a central opening. There was no clear sign of significant cracking, deterioration, or movement to said wall.
- 3.19 The party walls, where exposed, were of a chalk and lime matrix construction. An area of the west side party wall was exposed adjacent to the central timber loadbearing wall at second and third floor level, revealing a vertical crack in the masonry. In a similar location at first floor level, there was a vertical crack at high level between the abutting central masonry wall and the party wall. Cracking was not clearly visible at ground floor level.
- 3.20 Where the party wall and front external wall was exposed in the south-west corner at second floor level, there was a tapered vertical crack where the front external wall appeared to have pulled away and outwards. Cracking was also present to the south-west corner to the plaster at high level at first floor level. There was an apparent lack of keying between the internal and external walls.
- 3.21 The front and rear external walls were constructed with a brickwork outer layer and a chalk and lime matrix internally. There were original bond timbers present within the external walls, which were either rotten and loose or had rotted away leaving rectangular voids in the wall. Brick quoin details were present around

window openings and at corners.

- 3.22 The front external wall was lined with timber studwork and finished with a browning plaster over mesh and a final skim coat. Where the masonry behind the timber studwork was exposed at second floor level, the chalk blocks were found to have eroded away.
- 3.23 Where exposed at second floor level, the internal timber studwork to the front external wall had either been installed to accommodate the pre-existing deflection of the floor joists or had deflected due to the downward pressure from the joists.
- 3.24 The top of the front external wall at second floor level had been reconstructed in brickwork onto new concrete lintels.
- 3.25 The front external wall at first and second floor level was approximately 400mm thick. At ground floor level the front external wall was approximately 550mm thick.
- 3.26 Over the ground floor bay opening, the wall above appeared to have been supported by two individual 80mm x 230mm timbers, which were poorly packed up to the underside of the masonry over, with an assortment of timbers, plastic wedges and masonry, and voids filled with an expandable foam. The timber flat roof joists to the bay were fixed into the side of the outer timber support and sat onto the loadbearing timber frame bay window.
- 3.27 The rear elevation windows had timber lintels where exposed at first and second floor level. The lintels were in a poor condition and had deflected downwards.

4.0 External Observations

- 4.1 The external elevation was painted brickwork with what appeared to be a modern exterior masonry paint.
- 4.2 The first floor balcony had timber floor joists which spanned over the flat roof to the bay into the front external wall, and which were supported externally around the perimeter by timber beams onto 60mm CHS steel posts. The joists were finished on top with modern timber decking boards. The joists had a fall downwards and away from the building, and also towards the south-west corner.
- 4.3 When viewed from below, it appeared as though the balcony joists in the south-west corner had pulled out of the wall and had since been redecorated.
- 4.4 The balcony had timber posts at first floor level, which supported timber beams and rafters to the balcony roof. The rafters were fixed to a ledger board fixed to the front external wall.
- 4.5 The CHS steel posts appeared to have a slight outward lean at their top upon visual inspection. The east most post had a vertical crack at its top which had corroded significantly and caused rust staining down the post.
- 4.6 The external ground floor concrete base outside the property had a fall downwards and away from the building.

5.0 Conclusions and Recommendations

- 5.1 The original timber butterfly roof structure was over stressed and under-sized for its structural arrangement and supported spans. There was also a clear lack of lateral restraint, bracing and tying to the base of the roof, which has resulted in deflection and movement to the roof structure. These issues will have been worsened from the water ingress event which would have caused swelling and shrinkage of the timbers, as well as causing rot.

If the remedial strengthening and replacement works are not carried out at this stage, the structural movement and deflection of the roof will continue and become worse, which will likely result in cracking and damage of finishes, and possibly failure of connections and elements. Furthermore, although wet rot does not spread, if left untreated this could lead to dry rot and significant decay and structural damage. I therefore recommend that the works are carried out at the earliest possible opportunity, and before reinstatement of finishes.

I recommend that strengthening of the overall roof structure is undertaken, which should include the following:

- 5.1.1 To strengthen the existing rafters by installing additional rafters fixed to the side of the existing. The new rafters should be installed with positive connections to the ridge board and pole plate, to ensure they are carrying the full load as intended. Any rot to the existing rafters should be cut away, which will most likely include the majority of the rafter ends.
- 5.1.2 To replace the support provided by the double trimmer over the front dormer opening. Depending on calculated loadings and actions at connections, this may be achieved by replacing the trimmer as-is and strengthening the supporting rafters both sides of the dormer opening. Alternatively, a new beam spanning between the party walls could be installed. The second option would have the benefit of reducing the loads onto the existing ceiling/floor joists and, although they will still be over stressed, this would certainly better the arrangement.
- 5.1.3 Details of the proposed new aluminium framed windows to the front dormer should be provided for review, to ensure that suitable support is maintained to the flat roof.
- 5.1.4 To replace the dwarf stud walls with new timber studs having suitable sole and top plates, with truss clip fixings to the joists/rafters.
- 5.1.5 To replace the pole plate to the rear elevation with new treated timber. This element of the works, along with the replacement of the joists (see below) will require temporary propping of the roof slope. This may be achieved through vertical props taken down to second floor level or by installing a full width timber beam between party walls with positive connections to each rafter. Additional lateral restraint may be temporarily provided by utilising tension wire cables between the rafters. The pole plate to the front did not appear to require replacing and this should be finally reviewed once dried out.
- 5.1.6 To provide additional floor/ceiling joists to the rear, installed adjacent to

and fixed to the existing joists. I recommend that the additional furring pieces and newer joists are removed and rotten ends and sections of the existing joists cut away. Positions of service pipes should be confirmed prior to the design, so that holes in joists can be designed accordingly. The joists should be sheathed top or bottom upon completion.

- 5.1.7 To introduce lateral restraint strapping between members and between members and the main building structure.
- 5.2 The rainwater channel within the third floor is redundant. I assume this will be retained as part of the original building, but covered and closed off.
- 5.3 The trimming arrangement to the second floor joists to the front appears to have been constructed in such a way as to provide support over the full height external doors/window openings. The floor joists to the front appear to have been previously strengthened/replaced and I do not believe require further work.

To the rear, the joists are in a poor and deteriorated condition, which is assumed to have been made worse due to the water ingress event. I recommend providing additional floor joists installed adjacent and fixed to the existing joists. Rotten sections of the existing timber should be cut away.

If remedial strengthening and replacement works are not carried out at this stage, the already overstressed joists will continue to deflect and twist, which will inevitably result in further deflection and damages to the finishes. Furthermore, if the deterioration of the joists due to rot and damp is left untreated and allowed to continue, the floors may become unsafe for use. I therefore recommend that the works are carried out at the earliest possible opportunity, and before reinstatement of finishes.

- 5.4 Where lapped over the central loadbearing walls, I recommend the floor joists throughout the property are bolted together and positively fixed to the wall plates. Gaps between lapped joints can be packed with timber packing or noggins as necessary.
- 5.5 The current works provide a good opportunity to remove the failed hearth to the rear second floor chimney and replace as required or infill.
- 5.6 The stairs and half landings to the property have dropped throughout, most likely as a result of undersized trimmers and inadequate support at the internal wall, which is typical of properties of this age and construction. The stairs were not exposed during my visit and may fall outside the scope of these works. However, strengthening details could be provided once exposed, if required.
- 5.7 The timber loadbearing spine wall at second and third floor level was not adequate for purpose. The construction and cut of timbers that have been used are not suitable when acting as a load bearing wall, under current standards, and their poor condition and reduced stability could have been exacerbated by the water ingress event.

I recommend that new 100mm x 100mm timber studs are installed between each original stud. At third floor level, the installation of new studs will require local cutting out of the top plate and new sole plates fixed to the structure below. The

new stud walls should be ply sheathed on both sides. At third floor level, the ply sheath should extend up and be fixed to the timber beam to which the rafters are birdsmouthed over.

- 5.8 The deterioration of materials forming the external walls, as well as its internal innings, appears to be due to water ingress and the application of inappropriate modern masonry paints to the external wall. It is likely that water ingress issues have been present for the lifetime of the structure, and this issue would have been intensified due to the water ingress event. Failure to treat this issue at the earliest available stage will allow the continuing deterioration of materials and detrimental effects.
- 5.9 I recommend that decaying and rotting timbers within the external walls are removed and the areas thoroughly prepared. All voids can be filled with brickwork (where large enough) or a lime putty. Agreement or further recommendation should be sought from the Conservation Officer.
- 5.10 Where the chalk blocks to the external wall has eroded away, I recommend advice is obtained from the Conservation Officer with regards to repairs to the chalk and lime matrix. Due to the deterioration of the chalk and arrangement of the newer brickwork around the panel, my advice would be to re-build this section to ensure future stability, however, more sympathetic repairs/strengthening may be suggested.
- 5.11 I recommend the timber framework internally lining the external walls is replaced and I recommend that plasterboard with a skim coat is used, rather than mesh and plaster as existing.
- 5.12 Over the ground floor bay opening, the support and packing to the wall above is in an inadequate state and has been poorly attended to in the past. I recommend that the two individual timbers over the opening are replaced. I believe that this would most simply be achieved using galvanised steel members. Should the remedial replacement works not be undertaken at this stage, the condition of the support arrangement, as well as the materials to the wall above, will become progressively worse.

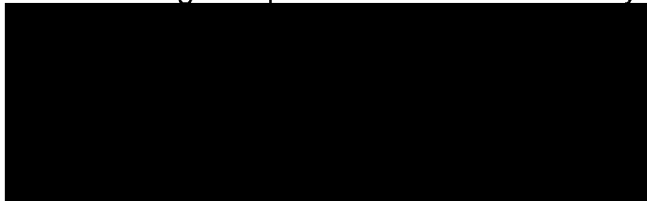
Prior to removal of the existing support, I recommend liaising with the Conservation Officer to ascertain the worth of using an injection grout into the wall above, such as Poole Heritage Grout or St Astier Hydratic Lime in order to help stabilise the wall and fill all the voids and weaknesses. The temporary support arrangement for this replacement will need to be carefully considered and it is likely that needling will be required at a higher level to avoid clashing with the balcony floor. It would be worthwhile discussing the possibilities of using vertical CemTies and plates installed from below, or a similar recommended arrangement, with Cavitytech.

- 5.13 The timber lintels to the rear windows were found to be deteriorating and rotten where inspected. The deterioration of the timbers would have been a gradual process due to the solid construction of the external walls, and one which may have been exacerbated by the water ingress event. I recommend that the lintels are replaced with prestressed concrete alternatives. If the lintels are not replaced, they will unavoidably continue to rot and decay, which may damage the window and surround.

- 5.14 I recommend that the internal remedial works are carried out at the earliest available opportunity and prior to reinstatement, so to avoid damage to new finishes and unnecessary disturbance and cost.
- 5.15 The balcony joists had a fall away from the building and appear to have pulled away from the front external wall, which may be due to the downward movement and rotation of the supporting steel posts and a lack of restraint. There was no clear sign of recent movement and it could not be confirmed whether this movement is ongoing. I recommend that strapping is introduced to every joist and fixed to the wall, in addition to the item below.
- 5.16 The crack to the top of the external steel post in the balcony structure is typical of embrittlement of the steel, most likely strain/age embrittlement, which has worsened over time, due to a combination of loaded stresses and the corrosive marine environment. The post is beyond a suitable and sympathetic repair and I recommend that this is replaced on a like-for-like basis. The new steel should be galvanised and can be powder coated to match the colour of the existing.
- 5.17 The cracking observed between the party wall and the front external wall in the south-west corner has likely been caused due to a lack of restraint and tying between the walls and to the internal floors. Recommended repairs have been provided by Cavitytech and these are reviewed and commented on below.

6.0 REVIEW OF CAVITYTECH RECOMMENDED REPAIRS - REPORT NO 68951

- 6.1 I concur with the Helibar crack stitching to the centre of the party wall and I am in agreement that this is the most sensible approach to repair this area and provide a rigid connection and stability to the wall. I also recommend that this area is exposed at third floor level and additional crack stitching undertaken as required.
- 6.2 I am in agreement with the use of bent Helibars in the front corners of the building to help key in the front external wall to the party walls. I recommend that confirmation is obtained from the Conservation Officer with regards to the type of resin injection mortar that is to be used for packing the crack once the Helibars are installed.
- 6.3 I agree with the use of Helifix bow ties to help stabilise the front external wall and secure them to the floor joists. With regards to installation of the bow ties, it should be clarified whether the rods are to be installed into the ends of the existing joists and whether they are suitable for this, or whether they will be fixed into the existing wall plates/trimmers and newly installed noggins.



SIGNED:
S GRAY

DATED: 14th October 2020