TIMBER ASSESSMENT RE-SURVEY

THE WELL HOUSE TAVERN
ROYAL CLARENCE HOTEL
CATHEDRAL YARD
EXETER

January 2022

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1.0 BRIEF:

1.1 Instructions were received via Natasha Brent, Development Manager, Akkeron Group to visit site to assess the current condition of retained timbers in the Well House Tavern and Royal Clarence Hotel site, and identify any changes since the first survey carried out in 2017.

1.2 The 2017 survey was confined to the Well House Tavern. This report includes an assessment of surviving timber elements in the Royal Clarence Hotel site also assesses

2.0 NOTES:

2.1 The site investigation was carried out on 27 January 2022.

2.2 The weather was overcast with occasional rain during the site visit.

2.3 Generally elements are identified in accordance with the recommendations of *Recording Timber-Framed Buildings: an illustrated glossary* published by the Council for British Archaeology.

2.4 For identification purposes it is assumed that the front elevation of the Well House Tavern faces due south, with No 16 forming the west part of the building and No 17 the east section.

2.5 Phil Thorpe, Structural Engineer, was on site during the assessment, and the findings were discussed with him on site. This report expands on and summarises those discussions.

2.6 % l.e.s. - *loss of effective cross-section* is a figure that combines quantitative data (e.g. size of cavities, variations in density etc) with qualitative judgements (e.g. quality of timber, growth rate, structural role etc).

3.0 SPECIALIST EQUIPMENT USED

3.1 **Sibert DDD microdrill**

The microdrill works by recording the rate of penetration of a 1mm diameter probe as it penetrates into the timber being tested, up to a depth of 200mm. The better the condition and quality of the wood tested, the slower the rate of penetration. The results can be recorded to a paper chart, from which the quality and condition of the timber can be assessed, and the presence and extent of any degradation can be measured and located within the cross-section. The hole left by the probe after testing is 1mm diameter, and is indistinguishable from a furniture beetle flight hole.

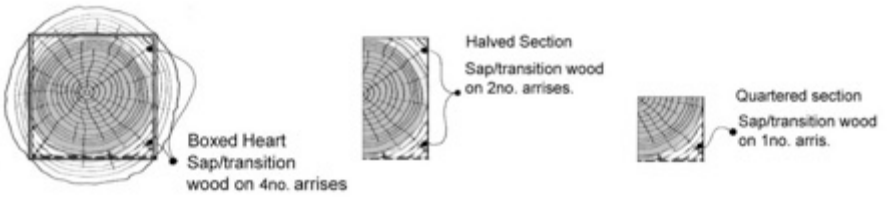
3.2 **Protimeter MS moisture meter**

The Protimeter measures the electrical resistance of the timber between two prongs a fixed distance apart, and correlates this to the moisture content of the timber. In practice, there are many factors, such as salts and surface finishes etc, that will alter the resistance of a material, and therefore the accuracy of the moisture content readings obtained. Moisture meter readings taken at or near the surface of the timber will also vary from day to day, depending on changes in weather and seasonal variations.

4.0 Timber – Terminology and Species

4.1 Reference is made in this report to sapwood, transition wood and heartwood. It is important to have some understanding of the processes of timber conversion and frame construction used historically.

4.2 Felled trees (i.e. in the round) were generally hewn square and used in that state (i.e. boxed heart) for large section timbers, or further converted by sawing as shown below. It was common for a proportion of the sapwood to be retained after conversion.



Timber Conversion - Retention of Sapwood

4.3 Where a timber has been sawn, one of the sawn faces is always used as the upper face (i.e. the reference plane for setting out joints etc).

4.4 The majority of the 'original' or earlier structural timbers are oak, but some other hardwoods such as chestnut and elm may well also have been used.

4.5 The heartwood of oak is durable, but can be attacked by various fungi if exposed to excessive moisture over prolonged periods. The heartwood can also be attacked by Deathwatch beetle, but generally only if there has been preceding or concurrent fungal attack. The juvenile wood - the first 10-15 years of growth at the centre of the heartwood - is generally less durable.

4.6 Some fungi such as *Fistulina hepatica* can attack oak trees prior to their felling and conversion. The damage may not be sufficient to prevent use of the timber, but may modify the heartwood sufficiently for Deathwatch beetles to colonise.

4.7 The sapwood of oak (as with most timbers) is not durable and can readily be attacked by fungi and various insects, including Deathwatch beetle (*Xestobium rufovillosum)* and furniture beetle *(Anobium punctatum)*.

4.8 Degradation of sapwood will often occur within fifty years of construction, and will often die out naturally as food supply and/or conditions change. All fungi are very sensitive to moisture levels and will die if the moisture content of the timber is below approximately 24%. Timber in a well ventilated unheated building is typically 16-18%mc, and below 16%mc in a heated building. Wood-boring beetles are sensitive to moisture levels and will not normally thrive at the moisture levels typically found in a well maintained historic building, but can survive at moisture contents below 16%.

4.9 In most circumstances, sapwood degradation is not structurally significant, unless the proportion in the cross-section is too great, or sapwood has been retained in critical areas such as joints. Generally, carpenters and framers were careful to ensure this did not occur.

4.10 The majority of the visible timbers in the Royal Clarence Hotel site (and later elements and additions in the Well House Tavern) are softwood, probably European redwood (*Pinus Sylvestris),* imported from the Baltic States, but other softwoods imported from North America may also be incorporated.

4.11 The durability of European redwood is very dependent on the quality of the timber. If sourced from slow-grown natural forest, it is very much more durable than timber of the same species sourced from fast-grown managed plantations. The heartwood is considerably more durable than the sapwood, and is generally moderately resistant to beetle attack.

4.12 Slow-grown timber generally contains a much smaller proportion of sapwood than fast-grown.

4.13 The sapwood of European redwood (and all softwoods) is much less durable and can readily be attacked by various insects, most commonly furniture beetle, and by various fungi if the moisture content is above approximately 25% for prolonged periods. Degradation of sapwood will often occur within fifty years of construction, and will often die out naturally, but beetles can attack heartwood, particularly if the trees are fast grown.

5.0 REPORT

Figure 1. Identification Plan

Well House Tavern

5.1 The roof structures over both No.16 & No.17 have been largely replaced. The new construction seems to function satisfactorily and appears to be watertight, except at Location A – See 5.2.

Location A

5.2 Rainwater is penetrating the party wall between No.16 and the adjacent property to the west, resulting in an active fungal outbreak in timbers in the party wall and adjacent flooring below. This is presumably caused by a blockage and/or failure in the rainwater discharge from the new roof.

5.3 The fungus is a brown rot, probably *Coniophora puteana,* commonly known as Cellar rot. However, there are a number of brown rots that exhibit similar characteristics, and specific identification is not essential. All fungi will die when the moisture level in the timber drops below 23-24%mc.

Figure 2. Fungal outbreak on west wall of No.16

5.4 On the day of site survey, typical timber moisture content at and near the surface of exposed timbers was 17 -19%mc. Immediately under the roof/gutter leak, timber moisture content was typically greater than 27%mc

5.5 No other active or recent degradation caused by fungal or insect activity could be identified in the retained historic timbers.

5.6 By visual inspection, there has been no significant additional deformation or dislocation of surviving elements since the 2017 survey.

Location B

5.7 The structure of the front (south) elevation remains concealed externally by a cementitious render applied to expanded metal lath, and finished with a non-breathable cementitious paint.

5.8 Internally, the structure is largely concealed by modern finishes, with impermeable paints.

5.9 The external render is cracked in many places, and there is evidence of widespread timber decay in window frames etc. Lead flashings are poorly detailed and/or missing/damaged in many places

5.10 The combination of large glazed areas, cracked external render and non-breathing paints etc is almost certain to have allowed significant water penetration, and consequent degradation of the timbers within the wall thickness.

5.11 The structural configuration and condition will need to be carefully and thoroughly assessed. Even in poor condition, it is quite possible/likely that the external and internal finishes are playing a significant structural role. No significant opening up should be carried out until adequate temporary supports are in place.

Royal Clarence Hotel

Location C

5.12

Figure 3. Timber lintels and struts built into saturated exposed masonry walls

The surviving walls are fully exposed to the elements and have not been capped or protected in any way. Timber lintels and vertical props are built into what is effectively saturated brickwork, and will almost inevitably suffer structurally significant fungal degradation at some stage. The lintels are likely to degrade from the ends and from the back, leaving the visible face relatively undamaged until the timber is severely weakened.

The vertical props appear to be softwood, and will readily absorb moisture through the end grain in direct contact with the saturated masonry. Pre-treated timber may have been specified, but it is highly unlikely that the end-grain cut on site would subsequently have been adequately site-treated. Fully pre-treated timber can be vulnerable to fungal attack within five years on site when in contact with saturated masonry.

Location D

Figure 4. Fungal degradation in first floor timbers

5.13 There is widespread brown rot attack in the first floor joists and floor boards. The timbers could not be safely accessed for close inspection, but by visual inspection from ground level, the fungus is probably Cellar rot (*Coniophora puteana*). Specific identification is not necessary. The fungus is well established, and likely to have resulted in 30-50% l.e.s. in the joists and >50% l.e.s. in the boards.

Location E

Figure 5. Severe degradation at Location E

5.14 The softwood beam is severely degraded at the south (right hand as viewed) end, and to approximately 2m from the end.

Location F

Figure 6. Widespread fungal degradation at Location F

5.15 There is widespread and active fungal degradation in the boards and joists.

Location G

5.16 There is widespread and active fungal degradation in the primary beams, common joists and floorboards. Degradation is likely to be structurally significant.

Location H

5.17 There are numerous lintels, bonding timbers and other timber elements throughout the wall, all of which are vulnerable to fungal degradation,

which will occur away from the visible face. Any compression in these elements, particularly in a wall with so many other structural discontinuities, and possibly also thermal stress damage following the fire, would create significant instability.

5.18 There are well established Buddleia bushes growing at high levels in the masonry. As they grow, the expansion of the roots into bedding courses in the masonry will often jack up substantial sections of masonry, including chimney stacks.

Figure 7. Well established Buddleia bushes growing in the masonry.

5.19 The street (east) side of this wall is covered with cementitious render and impermeable masonry paint, which will prevent any evaporation.

5.20 As the masonry consequently becomes progressively and chronically saturated, there is a risk that the lime-based mortar used in the original construction will begin to lose strength and coherence, adding to the risk of instability.

5.21 The chimney stacks are not braced and may be at significant risk in high winds. If a stack were to fall, and take out some of the structural scaffold support on the way down, there is a risk of progressive and catastrophic failure.

Location I

Figure 8. Potentially unstable chimney stack at the north end of site

5.22 Although there is no visible timber present at this location, the chimney stack which, prior to the fire, was braced by the roofs and floors of the Royal Clarence Hotel, appears to have moved out from the party wall. Some or all of this movement may have occurred prior to the fire, but thermal stresses caused by the heating and cooling of the fire is likely to have created further weakness. This increases the potential instability now that it is effectively free-standing. There may be no physical connection between this stack and the adjacent property, and there is likely to be a gap between the adjacent roof pitch and the stack through which water will penetrate. Any bonding timbers and/or bressumers built into the stack/wall will be vulnerable to degradation, and the prolonged saturation of the masonry will tend to reduce its structural coherence.

6. Conclusions and Recommendations

Well House Tavern

6.1 Generally, the surviving timber elements have not further degraded since the 2017 survey, and with the exception of Location A, there is no widespread fungal or beetle activity.

6.2 The rainwater penetration into the party wall between No.16 and the adjacent property at Location A should be remedied as soon as possible.

6.3 While the area remains saturated, any chemical treatment will be ineffective. As soon as the water penetration is stopped, the wall will dry and the fungus will die, and any chemical treatment will be unnecessary.

6.4 When the structure has dried out, the timbers within the party wall will need to be microdrilled to assess residual strength. It should not be assumed that timbers need to be replaced, just because there has been some fungal activity.

6.5 The structure of the front elevation is currently concealed by finishes externally and internally. The finishes, which are of little or no historic significance, will need to be removed to allow assessment, but this can only be done after necessary temporary support works are in place.

6.6 At this stage, it should be assumed that the structural elements are softwood, and likely to have suffered structurally significant degradation due to water penetrating trough the impermeable finishes.

6.7 If the existing structure can be retained, it is likely to require the insertion of a plywood external ‘skin’ and a secondary internal softwood frame.

Royal Clarence Hotel

6.8 The surviving walls at Location C are effectively free-standing, with no floors or roof structures to provide bracing. Significant decay in any of the timbers built into the walls could create instability. The exposed walls should be capped as soon as possible, and detailing improved to reduce the risk of degradation. A more durable permanent solution will be required.

6.9 Whilst the building fabric remains effectively saturated, chemical treatments will not be effective. Water-based chemicals will quickly dilute to ineffective concentration, and spirit-based chemicals will not penetrate the saturated fabric.

6.10 As and when the building fabric becomes protected from the elements and begins to dry, there may be a case for targeted chemical treatment to provide some protection whilst the fabric continues to dry down to

the point where the fungus dies naturally. This typically happens when the timber moisture content drops below 23-24%mc. Chemical treatments do not provide permanent protection against fungal attack

6.11 The remaining timbers at locations D – H could not be safely accessed for detailed testing. By careful visual inspection from ground level, the majority of the timbers have suffered some structurally significant fungal degradation.

6.12 The timbers are all softwood, dating mainly from the mid/late C19th and/or early C20th. They are 'stock' sawn timbers, and do not in themselves have great historic significance.

6.13 Detailed close inspection and testing may allow perhaps 50% of the timbers to be retained with extensive repair and strengthening, but the merit of doing so is questionable.

6.14 Although not specifically a timber issue, the stability of elements of the east wall and particularly the chimney stack at the north end is of very great concern.

6.15 When masonry becomes saturated, bonding timbers and lintels etc built into the walls will absorb moisture from the surrounding saturated masonry and will consequently swell, jacking up the surrounding masonry, creating discontinuities and other weaknesses. If the timbers then degrade and compress, hinge points will form in the masonry.

6.16 Even where no degradation occurs, when the building is repaired and subsequently dries back down to a typical ambient 16%mc, the timbers will shrink back to the original size, and often become loose within the wall, as the masonry rarely returns to its corresponding original form.

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